OCCASIONAL PAPERS: 13

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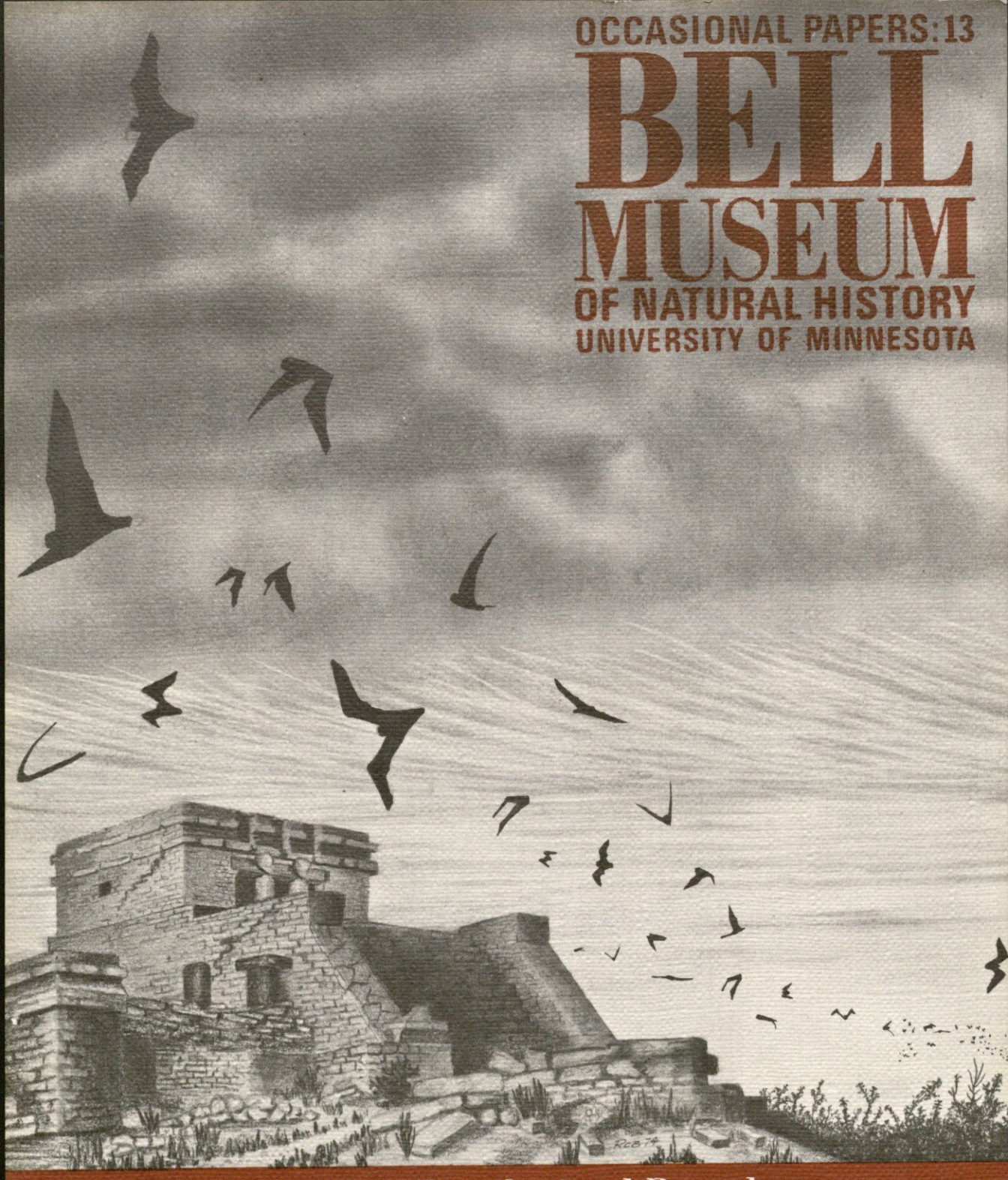

Mammalian Distributional Records in Yucatán and Quintana Roo, with Comments on Reproduction, Structure, and Status of Peninsular Populations

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Mammalian Distributional Records in Yucatán and Quintana Roo, with Comments on Reproduction, Structure, and Status of Peninsular Populations

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ABSTRACT

Specimens of one marsupial, 25 species of bats, one edentate, 12 species of rodents, and five carnivores are reported from localities in Yucatán and Quintana Roo. *Noctilio leporinus* and *Eumops bonariensis* are added to the faunal list of Yucatán, and the first specimens of *Chiroderma villosum* and *Lasiurus intermedius* from Quintana Roo are reported. Other species poorly known from the peninsula and represented in our collections include *Eptesicus furinalis, Lasiurus ega, Eumops glaucinus, Promops centralis, Tamandua tetradactyla, Heteromys gaumeri, Coendou mexicanus,* and *Conepatus semistriatus.*

Indices of similarity and diversity were calculated and discussed for samples of bats from nine collecting sites and for rodents from four sites. Trends in reproductive patterns of peninsular mammals and our interpretations of some aspects of man's interactions with mammals of the area are discussed.

INTRODUCTION

Early interest in the mammalian fauna of Yucatán resulted in one of the first major faunal works on Méxican mammals, entitled "Monografia de los mamíferos de Yucatán," by G. F. Gaumer in 1917. Subsequent shorter reports, such as those by Hatt (1938 and 1953), Hatt and Villa-R. (1950), Jones and Lawlor (1965), Pearse and Kellogg (1938), and other workers cited beyond, have further enhanced our understanding and appreciation of this peninsular fauna. Recently, a series of papers providing an annotated checklist of mammals of the Méxican portion of the peninsula has appeared (Jones *et al.*, 1973, 1974*a*, 1974*b*, and Genoways and Jones, 1974).

In the spring of 1973, we had opportunity to study mammals on the peninsula and to make collections at several localities in the state of Yucatán and in the Federal Territory of Quintana Roo. Many of the specimens obtained provide data that fill major gaps in our knowledge of the mammals of this area, whereas others reveal the still primitive state of our knowledge of this fauna. The geology, physiography, climatology, and vegetative patterns of the peninsula were described succinctly by Jones *et al.* (1973). In the discussion following the accounts of species, we reflect on the reproductive characteristics and future outlook of those portions of the mammalian fauna studied and consider briefly the organization and structure of some of the populations sampled.

Most of our material was captured alive in conjunction with other studies. For example, Robert Jenness and Birney preserved livers from most specimens as part of a study of the evolutionary history of the ability of mammals to synthesize ascorbic acid. Williams prepared chromosomes from many individuals on behalf of Robert J. Baker, and Birney preserved spermatozoa from breeding males as part of a series of ongoing studies with Hugh H. Genoways. Specimens collected by Bowles were obtained primarily in conjunction with a teaching program offered by Central College, Pella, Iowa.

Specimens are housed at Central College, Pella (CC), The Museum of Texas Tech University, Lubbock (TTU), and the Bell Museum of Natural History at the University of Minnesota, Minneapolis (MMNH). The sequence for listing specimen localities is alphabetical by state or territory, then north to south and west to east for localities at the same latitude. Measurements of embryos are crown-rump length before removal of extra-embryonic membranes.

ACKNOWLEDGMENTS

It is our pleasure to express warm appreciation to Señor Ticul Alvarez, Dirección General de la Fauna Silvestre, for issuing us collecting permits, Dr. and Mrs. Robert Jenness for collecting assistance and advice, J. Knox Jones, Jr. for reviewing the manuscript, and Hugh H. Genoways for providing financial and logistic support for Williams, assisting in identification of specimens, and for reviewing the manuscript. For assistance in the field and for sharing space and facilities at the

Colegio Peninsular in Mérida we thank the staff and students of Central College, especially Kevin Curry and Tad Mills. Judy Eger kindly verified our tentative identifications of specimens assigned to *Eumops bonariensis*. Additionally, we sincerely thank the many Méxicans who assisted our efforts in every way from quick and efficient auto repair to granting permission to collect mammals on their property. Marcia Birney prepared the illustrations.

Birney was supported in part by a Sigma Xi Grant in Aid of Research and in part by funds made available by the Graduate School and the College of Biological Sciences, the University of Minnesota. Expenses for Timm were solely from the latter source. Bowles was aided financially by funds from the Central College Research Council. Williams was supported by funds made available through the Institute of Museum Research, Texas Tech University. This venture would not have been possible without the support, cooperation, and assistance provided by the Foreign Area Study Program at Central College.

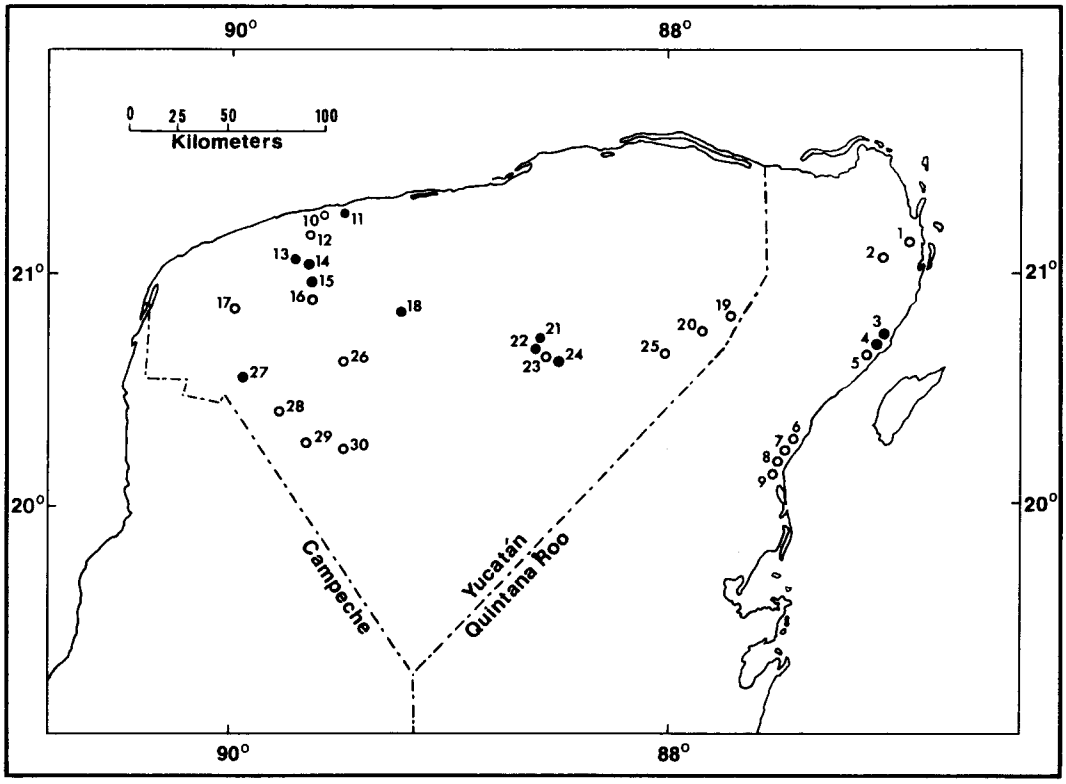

FIGURE 1. Map of northern portion of Yucatán Peninsula showing localities from which specimens reported herein were obtained. Solid symbols denote primary collecting sites described in text whereas open symbols represent less intensively studied sites. Some symbols are slightly misplaced to prevent overlap with adjacent symbols or lines representing geographic boundaries. Localities are as follows. QUINTANA ROO: (1) 6 km. SW Puerto Juárez; (2) 20 km. SW Puerto Juárez; (3) 8 km. N, 5.5 km. E Playa del Carmen; (4) 14 km. NE Playa del Carmen; (5) 6.5 km. NE Playa del Carmen; (6) 8 km. NE Tulum; (7) 6 km. NE Tulum; (8) 1.5 km. S, 1.5 km. E Tulum; (9) 5 km. S, 1 km. E Tulum. YUCATAN: (10) 10 km. E Progreso; (11) 19 km. E Progreso; (12) 8 km. S Progreso; (13) 2.5 km. NW Dzitya; (14) 4 km. E Dzitya; (15) Mérida; (16) 8 km. S Mérida; (17) 6 km. S, 5 km. W Kinchil; (18) Cueva de Hoctún, 1 km. S Hoctún; (19) 2 km. SW X-Can; (20) 20 km. SW X-Can; (21) 3-3.5 km. N Piste; (22) Piste; (23) Chichen-Itzá; (24) 2 km. E Chichen-Itzá; (25) 8 km. ESE Ticuch; (26) 1.5 km. S Telchaquillo; (27) Cueva de Oxkintok, 3 km. S, 1 km. W Calcehtoc; (28) 14 km. SW Muna; (29) 8 km. S Santa Elena; (30) Cueva de Loltun, 8 km. SW Oxkutzcab.

DESCRIPTIONS OF PRIMARY COLLECTING LOCALITIES

During this investigation, mammals were obtained at 30 localities (Fig. 1). Collecting efforts were extensive at some, whereas others may represent only the source of a single road-killed specimen. Certain comparisons of the faunas from 12 primary collecting sites are made in the discussion section of this report. These sites are described briefly to avoid redundancy in accounts of individual species and in the discussion that follows. Abbreviated names given in parentheses are used to refer to these sites in the discussion and in some associated figures.

8 km. N, 5.5 km. E Playa del Carmen, Quintana Roo (Quasi Rainforest)

Collections were made both by netting and live-trapping. Traps were set in the relatively dense, deciduous quasi rainforest along a narrow, rocky trail leading toward the coast (to Cabañas Capitán Lafitte) from Highway 307. Nets were stretched across the flyway created by the trail.

14 km. NE Playa del Carmen, Quintana Roo (Plantation)

Traps were set on both sides of Highway 307, some in quasi rainforest and others in and around the edges of a small banana plantation. Corn and other cultivated plants were growing under and near the banana trees. Nets were set in the banana field and over an adjacent cenote. Two Mayan houses were located near the cenote, which lead into a small cave with a pool of standing water. Rodents from this locality and the previous one are considered as a single sample in the discussion beyond, and referred to as the "Quintana Roo" sample.

19 km. E Progreso, Yucatán (Progreso)

At this locality, two Mayan houses about 100 meters south of the beach were near the center of a cultivated grove of coconut palms and a few fruit trees. The grove was approximately 20 acres in size and was surrounded on three sides by low scrubby vegetation. Nets were stretched in the grove near the houses. Traps were set in the houses and in the surrounding scrub, but no rodents were captured.

2.5 km. NW Dzitya, Yucatán (Dzitya)

This was the location of a water-filled cenote. Water level in the cenote was about 3 meters below ground level of the area, but less than 1 meter below the top of the lowest part of the limestone wall. Dimensions of the water-covered surface were about 10 by 20 meters. A subterranean passageway that led from the primary opening to a vertical secondary entrance about 15 meters away was used by bats as a flyway and perhaps as a roost. Habitat surrounding the cenote included grazed, xerophilic thornforest and cultivated fields of henequén (*Agave*).

4 km. E Dzitya, Yucatán (Dzitya)

Live-traps were set at this site, which was along the road between Dzitya and Highway 273. Much of the habitat consisted of ungrazed thornforest, with one small grassy opening. Most traps were set in the thornforest or in the grassy area, but one trapline was in an adjacent henequén field.

Colegio Peninsular, Mérida, Yucatán (Colegio)

Also known as "Rogers Hall," this is the site of a school near the northern edge of Mérida. Collecting was by mist nets set over the swimming pool at the school.

Country Club Campestre, Mérida, Yucatán (Campestre)

Mist nets were stretched over and adjacent to a man-made, rectangular pond of water surrounded by ornamental plants at this country club near the northern edge of Mérida. Surface dimensions of the pond were approximately 20 by 75 meters.

Cueva de Hoctún, 1 km. S Hoctún, Yucatán (Hoctún)

This is a warm, humid cavern accessible through a small cenote in a henequén field. The portion of the cavern we visited was shallow with a moist dirt floor. The

only standing water was about 75 meters from the entrance. Openings in the porous ceiling contained clusters of roosting bats. This cavern had a man-made walkway and probably was a site of previous human habitation. At least one deeper cavern led down and away from one side of the main cavern, but it was not investigated. Bats were captured in hand nets and mist nets both within the cavern and at the entrance.

3 km. N Piste, Yucatán (Piste)

Only live-traps were set at this locality. They were set in and near two weedy cornfields, where some year-old cornstalks remained. Soil was several inches deep at places, but there was no paucity of the omnipresent limestone rocks and outcrops. Relatively tall, dense thornforest surrounded the cornfields.

Piste, Yucatán (Piste)

Mist nets were stretched over the swimming pool of a local motel (Poxil). No traps were set. In consideration of similarity and diversity, bats from here were included with those from *3.5 km. N Piste*, a place where nets were stretched across a narrow road in dense thornforest.

2 km. E Chichen-Itzá, Yucatán (Chichen)

Live-traps and gopher traps were set on both sides of Highway 180. Some traps were set in the roadside ditch, but most were placed in a weedy cornfield with persisting cornstalks from the previous wet season and piles of brush from the clearing of thornforest. Others were set in a broad, rocky draw having relatively deep soil and tall deciduous vegetation.

Cueva de Oxkintok, 3 km. S, 1 km. W Calcehtoc, Yucatán (Oxkintok)

This extensive cave is accessible by a ladder in one of two large (diameter about 25 meters), interconnected sinkholes, each of which dropped straight down for 10 to 25 meters. Lush vegetation, including banana trees, grew in the protected sinkholes where light entered from the openings. The presence of bedrock metates near the entrance and broken pottery deep within the cave attested to previous human habitation. Inside, the cave was hot and humid. Nets were set at the cave entrance and under the associated banana trees. Habitat of the surrounding area was xerophilic thornforest. A few live-traps were set at this locality, but sampling of rodents was not complete enough for comparisons of the rodent fauna.

ACCOUNTS OF SPECIES

Didelphis virginiana yucatanensis J. A. Allen, 1901

Gardner (1973) recognized two species of *Didelphis* on the Yucatán Peninsula. Previously, only a single species was recognized and thus specimens of both have been reported under a single name. Jones *et al.* (1974*b*:3) followed Gardner and suggested that *D. virginiana* may be more common than its congener, *D. marsupialis*, on the peninsula. We captured a young adult female *D. virginiana* (MMNH) at the Colegio Peninsular on 4 May. She was carrying five young (mean total length, 108 mm.; mean weight, 11.1 gm.) in the pouch (none saved). At least two other opossums, presumably of this species, were seen at the Colegio. Two road-killed individuals were retrieved on 6 May from Highway 180, one at 20 km. southwest of X-Can, Yucatán (TTU) and the other at 6 km. southwest of Puerto Juárez, Quintana Roo (MMNH).

Noctilio leporinus mastivus (Vahl, 1797)

A big fishing bat (MMNH) was captured 19 km. east of Progreso, Yucatán, about two hours after sunset on 26 April in a mist net set in a coconut grove. *Artibeus jamaicensis*, the only other species of bat netted there, was abundant in the grove. The *Noctilio*, a young adult male with incompletely fused phalangeal epiphyses and unworn teeth, had testes that measured 8 mm. in length.

Jones *et al.* (1973:7) reported this fishing bat from a single locality on the Yucatán Peninsula, near Puerto Real on Isla del Carmen, Campeche. No additional specimens from the peninsula were available to Davis (1973), who studied geographic variation in this species. Our specimen is the first from the state of Yucatán and documents a second locality of record for the peninsula.

Selected external and cranial measurements of this specimen are: length of forearm, 85.4 mm.; greatest length of skull, 27.1 mm.; zygomatic breadth, 19.7 mm.; mastoidal breadth, 19.1 mm.; interorbital constriction, 7.4 mm.; length of maxillary toothrow, 10.6 mm.

Pteronotus parnellii mesoamericanus Smith, 1972

Although observed at several collecting sites, the only sizable colony of Parnell's mustached bat encountered consisted of an estimated 200 individuals seen by Bowles in a small room in a cave at the ruins of Mayapan. Hatt (1953:70) and Jones *et al.* (1973:8) reported this bat from three other localities in Yucatán.

Three of four adult females captured in late April and early May were pregnant, each with a single embryo. These measured 20, 20, and 22 mm. Testes of three adult males were 3, 3, and 4 mm. in length.

Specimens examined (9).—QUINTANA ROO: 14 km. NE Playa del Carmen, 1 (MMNH); YUCATAN: 2.5 km. NW Dzitya, 3 (2 MMNH, 1 TTU); Cueva de Hoctún, 1 km. S Hoctún, 1 (TTU); Ruinas de Mayapan, 1.5 km. S Telchaquillo, 2 (1 MMNH, 1 TTU); Cueva de Oxkintok, 3 km. S, 1 km. W Calcehtoc, 2 (1 CC, 1 TTU).

Pteronotus davyi fulvus (Thomas, 1892)

We found Davy's naked-backed bat to be common in northwestern Yucatán. A maternity colony consisting of at least a thousand individuals, including adults of both sexes, was observed in Cueva de Hoctún. A second sizable colony was seen in a cave near Kinchil. Jones *et al.* (1973:8) reported this bat from only two localities in Yucatán.

Embryos of the following sizes were carried by female naked-backed bats: 6, 10, 13, and 13 mm. (11 April); 3 and 12 mm. (19 April); 15 mm. (24 April); 16, 19, and 20 mm. (2 May). One reproductively inactive female was examined on 2 May. Mean (and extreme) length of testes of 14 males obtained between 11 April and 2 May was 2.6 (2-4) mm.

Specimens examined (28).—YUCATAN: 2.5 km. NW Dzitya, 1 (MMNH); 6 km. S, 5 km. W Kinchil, 5 (2 MMNH, 3 TTU); Cueva de Hoctún, 1 km. S Hoctún, 14 (3 CC, 5 MMNH, 6 TTU); Piste, 2 (MMNH); Cueva de Oxkintok, 3 km. S, 1 km. W Calcehtoc, 6 (4 MMNH, 2 TTU).

Mormoops megalophylla megalophylla Peters, 1864

Peters' leaf-chinned bat was one of the commonest bats in Cueva de Oxkintok. A net set at a main entrance captured so many leaf-chinned bats just after sundown that two people could not remove and release them as rapidly as they became entangled. The net was reset about three hours later with the same results. This species apparently was present only in low numbers in Cueva de Hoctún on 2 May and was not represented in a sample taken there on 11 April.

Each of 13 females collected at Cueva de Oxkintok on 25 April carried a single embryo. The mean embryo length was 21 mm. with extremes of 17 and 23 mm. Two of three females obtained on 2 May had single embryos that measured 22 and 23 mm., whereas the third was not pregnant. Mean (and extreme) testes lengths of five males captured between 25 April and 2 May was 3 (2-4) mm.

Specimens examined (28).—YUCATAN: Cueva de Hoctún, 1 km. S Hoctún, 5 (4

MMNH, 1 TTU); Piste, 1 (MMNH); Cueva de Oxkintok, 3 km. S, 1 km. W Calcehtoc, 22 (2 CC, 10 MMNH, 10 TTU).

Micronycteris megalotis mexicana Miller, 1898

Our specimen of the Brazilian small-eared bat was a reproductively inactive female (MMNH) netted on 2 May over a swimming pool in Piste, Yucatán. Measurements of this specimen are: length of forearm, 34.9 mm.; greatest length of skull, 18.2 mm.; zygomatic breadth, 9.2 mm.; breadth of braincase, 7.7 mm.; mastoidal breadth, 8.5 mm.; length of maxillary toothrow, 7.2 mm.

Mimon cozumelae Goldman, 1914

Two specimens of the Cozumel spear-nosed bat were taken. One was netted at the cenote 2.5 km. northwest of Dzitya, Yucatán (CC), and the other along a trail in second growth thornforest 3.5 km. north of Piste, Yucatán (MMNH). Both were adult males which had testes that measured 3 and 4 mm., respectively, on 2 and 12 May.

Glossophaga soricina leachii (Gray, 1844)

Pallas' long-tongued bat, the only glossophagine known from this portion of México, was considered one of the most abundant and widespread bats on the Yucatán Peninsula by Jones *et al.* (1973:13). We found it at several collecting sites, attesting to its ubiquity on the peninsula, but nowhere did we encounter it in large numbers. Our specimens were captured over a cenote, around fruit trees at a convent, in a thornforest, and from a small room in a ruin. A female (released) with a semivolant young (TTU) was taken from Cueva de Hoctún. Four other females obtained late in April evinced no sign of reproductive activity. Testes lengths of four adult males were 5, 5, 6, and 7 mm.

Specimens examined (11).—QUINTANA ROO: 8 km. N, 5.5 km. E Playa del Carmen, 5 (3 MMNH, 2 TTU). YUCATAN: 2.5 km. NW Dzitya, 1 (CC); Mérida, 4 (2 MMNH, 2 TTU); Ruinas de Kabak, 8 km. S Santa Elena, 1 (MMNH).

Carollia perspicillata azteca Saussure, 1860

Two adult male (1 MMNH, 1 TTU) short-tailed bats were captured by us at the banana plantation 14 km. northeast of Playa del Carmen, Quintana Roo, on the night of 28 April. Both appeared to be in breeding condition, having testes that measured 8 mm. in length. Measurements of our specimens match closely those given by Jones *et al.* (1973:15) for 10 adults of this species from the peninsula.

Sturnira lilium parvidens Goldman, 1917

With the exception of a single specimen of yellow-shouldered bat reported from "northern Yucatán" in the late 1800's, the species previously was known on the peninsula only from the tall forests of Campeche and Quintana Roo (Jones *et al.*, 1973:16). One of our specimens was netted over a swimming pool in Piste and a third escaped while being removed from a net set in a trail in the thornforest 3.5 km. north of Piste. This species was one of the more common bats taken from nets set in the banana plantation and over the adjacent cenote northeast of Playa del Carmen. Two adult females captured on 29 April carried single embryos that measured 10 and 12 mm. Volant young also were removed from nets on that date as were four adult males, whose testes were 5, 6, 6, and 7 mm. in length.

Specimens examined (12).—QUINTANA ROO: 14 km. NE Playa del Carmen, 11 (6 MMNH, 4 TTU). YUCATAN: 2.5 km. NW Dzitya, 1 (TTU); Piste, 1 (TTU).

Chiroderma villosum jesupi J. A. Allen, 1900

Our single specimen (MMNH) of the hairy white-line bat was captured in a mist net set across a narrow road in quasi rainforest at 8 km. north and 5.5 km. east of Playa del Carmen, Quintana Roo. It constitutes the first locality of record for the species in Quintana Roo and the second on the peninsula. Jones *et al.* (1973:17) reported a specimen of *C. villosum* from southern Campeche.

The dorsal stripe of our specimen is faint, but easily visible in the lumbar region. Testes measured 6 mm. in length and the phalangeal epiphyses are closed. The following selected external and cranial measurements correspond closely to those given by Goodwin (1969:81) for an adult female from Oaxaca: total length, 76 mm.; length of forearm, 44.7 mm.; greatest length of skull, 23.8 mm.; zygomatic breadth, 15.7 mm.; length of maxillary toothrow, 8.5 mm.

Artibeus jamaicensis yucatanicus J. A. Allen, 1904

The Jamaican fruit-eating bat was the commonest bat we encountered. Except for a single *Noctilio*, all of at least 50 bats captured in two nets in a grove of coconut palms east of Progreso were of this species. Several were released from nets stretched over a swimming pool at Piste and approximately one hundred were captured over a cenote in which they were roosting northeast of Playa del Carmen. Although Jones *et al.* (1973:18) frequently captured *A. lituratus* in the same nets with *A. jamaicensis*, we did not encounter the larger *A. lituratus*.

Dates of capture and length of embryos for pregnant females (each carried a single embryo) were as follows: 17 March, 18, 38, and 42 mm.; 23 March, 33 mm.; 24 April, 8 mm.; 26 April, 18 mm.; and 29 April, 9 mm. Females with fresh uterine scars were obtained on 18 and 23 March, 20, 23, and 29 April, and on 2 and 7 May. Reproductively inactive females were captured on 23 March and 2, 23, and 29 April. Mean (and extreme) testes length of four males taken in March, seven taken in April, and six taken in May were, respectively, 9.0 (7-10), 8.6 (7-11), and 8.2 (7-9) mm.

Specimens examined (50).—QUINTANA ROO: 8 km. N, 5.5 km. E Playa del Carmen, 6 (1 MMNH, 5 TTU); 14 km. NE Playa del Carmen, 3 (MMNH); 5 km. S, 1 km. E Tulum, 3 (2 MMNH, 1 TTU). YUCATAN: 19 km. E Progreso, 2 (1 MMNH, 1 TTU); Mérida, 13 (2 CC, 7 MMNH, 4 TTU); 8 km. S Mérida, 5 (1 CC, 2 MMNH, 2 TTU); 6 km. S, 5 km. W Kinchil, 11 (1 CC, 4 MMNH, 6 TTU); Piste, 5 (MMNH); Cueva de Oxkintok, 3 km. S, 1 km. W Calcehtoc, 2 (MMNH).

Artibeus phaeotis phaeotis (Miller, 1902)

Four specimens of the dwarf fruit-eating bat were captured in mist nets on the evening of 28 April. Two adult males (TTU) were captured over the cenote by the banana plantation 14 km. northeast of Playa del Carmen, Quintana Roo. An adult female and the juvenile male (both MMNH) she was carrying became entangled in a net set in quasi rainforest 8 km. north and 5.5 km. east of Playa del Carmen.

Desmodus rotundus murinus Wagner, 1840

Most of our specimens were captured over the cenote northwest of Dzitya. No vampires had been captured on the night of 24 April until a *Lasiurus ega* became entangled in our net and was encouraged to vocalize. Within five minutes, two *Desmodus* struck the net only a few feet from the southern yellow bat. Nine vampire bats were captured that evening, most of them at times when other bats were vocalizing.

Lengths of single embryos carried by two pregnant females on 24 April were 11 and 12 mm. Testes lengths of four males captured that date were 4, 6, 7, and 8 mm.

Specimens examined (12).—YUCATAN: 2.5 km. NW Dzitya, 10 (1 CC, 4 MMNH, 5 TTU); Mérida, 1 (CC); Cueva de Oxkintok, 3 km. S, 1 km. W Calcehtoc, 1 (MMNH).

Diphylla ecaudata centralis Thomas, 1903

Two hairy-legged vampire bats (1 male, TTU, and 1 female, MMNH) were removed from a net that also caught a *Desmodus* at Cueva de Oxkintok, 3 km. south and 1 km. west of Calcehtoc, Yucatán. In Cueva de Hoctún, 1 km. south of Hoctún, Yucatán, three juveniles, two males and a female (MMNH), were captured on 11 April. On 2 May a lactating

adult female and her non-volant female progeny (both MMNH) were captured in the same cave.

The pronounced maternal behavior of *Diphylla* is worthy of note. The lactating female was placed in a wire cage and the juvenile allowed to cling to the outside of this cage for a few hours so that a sample of milk could be acquired from the adult. She was extremely alert and mobile, invariably hanging next to the juvenile and moving quickly to any place in the cage next to the young if it was moved. After being milked, the female was returned to the cage, which then contained the juvenile. She went immediately to it and almost forcefully took it under her wing. Carter (1971:239) has noted an apparent close relationship, during both roosting and foraging, between adult females and weaned young of this species.

Natalus stramineus saturatus Dalquest and Hall, 1949

All of the funnel-eared bats taken by us were removed from caves. For example, two were captured in a small dip-net deep within Cueva de Oxkintok, where many bats of this species were seen during the afternoon of 25 April. However, none was taken in mist nets at an entrance to the cave later that night. Four of our five adult females were not pregnant; the embryo of the other, taken 19 April, measured 12 mm. Testes length of three males was 2 mm.

Specimens examined (10)—YUCATAN: 6 km. S, 5 km. W Kinchil, 1 (TTU); Cueva de Hoctún, 1 km. S Hoctún, 3 (1 CC, 2 MMNH); Cueva de Oxkintok, 3 km. S, 1 km. W Calcehtoc, 2 (1 MMNH, 1 TTU); Cueva de Loltun, 8 km. SW Oxkutzcab, 4 (1 CC, 1 MMNH, 2 TTU).

Myotis keaysi pilosatibialis LaVal, 1973

A single specimen (adult male, MMNH) of Keays' myotis, considered as one of the most abundant cave bats on the peninsula by Jones *et al.* (1973:22), was captured by us. It became entangled in a mist net set over the cenote 2.5 km. northwest of Dzitya, Yucatán.

Eptesicus furinalis gaumeri (J. A. Allen, 1897)

Jones *et al.* (1973:22) noted that the tropical brown bat was known from the Yucatán Peninsula by only six preserved specimens from scattered localities and by a few remains (3 skulls and a mandible) recovered from a cave deposit at Actun Spukil (see Hatt, 1953:61). We captured nine adults of this species. A male (MMNH) was netted over a swimming pool at Piste, Yucatán, on the night of 2 May and one male and seven females (1 CC, 4 MMNH, 3 TTU) were removed from one of three nets over the cenote at 2.5 km. northwest of Dzitya, Yucatán, between 1900 and 2200 hours on 9 May.

The larger of our two males had testes that measured 8 by 4 mm. on 2 May, whereas those of the smaller were 5 mm. in length on 9 May. Five of the females were pregnant at the time of capture, each carrying two embryos. Mean (and extremes) embryo length was 16 (13-18) mm. The other two females evinced no sign of reproductive activity.

Although systematics of Middle American bats of the genus *Eptesicus* recently was reviewed (Davis, 1965, 1966), so few specimens of *E. furinalis gaumeri* from Yucatán (type locality, Izamal—see J. A. Allen, 1897) are available that we provide comparative measurements from our specimens: those of two males are followed by means (and extremes) of seven females. Total length, 88, 97, 91.2 (89-95) mm. (six only); length of forearm, 37.0, 36.9, 39.3 (38.3-41.1) mm.; greatest length of skull, 14.3, 15.3, 15.1 (14.7-15.8) mm.; zygomatic breadth, 10.1, 10.5, 10.6 (10.4-10.9) mm.; breadth of cranium, 7.2, 7.5, 7.4 (7.2-7.6) mm.; length of maxillary toothrow, 5.4, 5.4, 5.6 (5.5-5.6) mm.; length of palate, 5.8, 5.8, 5.9 (5.7-6.0) mm.

Lasiurus ega xanthinus (Thomas, 1897)

The southern yellow bat previously was known from the Yucatán Peninsula by a skull from Ebizt Cave, Oxkutzcab (Pearse and Kellogg, 1938:303) and four preserved specimens (Jones *et al.*, 1973:23). Villa-R. (1967:415) observed an estimated 15 in-

dividuals at a Mayan house, but preserved only one specimen from the group. Jones *et al.* considered the species as rare on the peninsula.

Seven additional specimens of *Lasiurus ega* were collected by us from three localities. An adult female (TTU), reproductively inactive, was found dead on the beach 10 km. east of Progreso, Yucatán, on 28 March. Four *L. ega* (3 MMNH, 1 TTU) were captured on 24 April in a mist net stretched over the cenote 2.5 km. northwest of Dzitya, Yucatán. One of these was captured only a few minutes after sunset and the others within three hours after sunset. A fifth specimen (CC) was captured at this locality on 9 May. Our remaining specimen (TTU) was captured about 2130 hours over a swimming pool at Piste, Yucatán, on 1 May.

The female from Piste carried a single embryo 32 mm. in length whereas the one captured near Dzitya on 9 May was carrying two that were 10 mm. in length. Baker *et al.* (1971:849) found a mode of three embryos per pregnant female of this species in southern Texas.

The intraspecific taxonomic history of *L. ega* was reviewed by Baker *et al.* (1971), leaving in question the relative status of *L. e. xanthinus* and *L. e. panamensis* north of Panamá. They assigned their material to the latter subspecies. We report comparative measurements below and continue to recognize specimens from Yucatán as *L. e. xanthinus*. Our measurements are means (and extremes) of four females and two males: total length, 119 (111-125) mm.; length of forearm, 45.7 (41.6-48.1) mm.; greatest length of skull, 15.0 (14.2-15.9) mm.; zygomatic breadth, 10.6 (10.2-10.9) mm.; length of maxillary toothrow, 5.4 (5.1-5.6) mm.; mastoidal breadth, 8.6 (8.3-8.9) mm.; interorbital breadth, 4.4 (4.2-4.5) mm.

Lasiurus intermedius intermedius H. Allen, 1862

Jones *et al.* (1973:23) reported six specimens of the big yellow bat from two localities in Yucatán, the only stations of occurrence known on the peninsula. They noted an additional record that originally was reported by Gaumer (1917:274). We acquired three additional specimens of this bat, including the first recorded from Quintana Roo and two from new localities of record in Yucatán.

On the night of 29 April, an adult female (MMNH) *L. intermedius* was captured in a mist net set in quasi rainforest 8 km. north and 5.5 km. east of Playa del Carmen, Quintana Roo. It was carrying a single embryo that measured 18 mm. A second adult female (CC) was netted at the Country Club Campestre near the northern edge of Mérida, Yucatán, on 8 May. It too was pregnant, carrying three embryos that averaged 16 mm. in length. Our third big yellow bat (TTU) was netted on 9 May over the cenote 2.5 km. northwest of Dzitya, Yucatán. She was neither pregnant nor lactating.

Our specimens are large by comparison with measurements given by Hall and Jones (1961:89) for *L. i. intermedius* from elsewhere in México, but smaller than those given for *L. i. insularis* from Cuba. Sequence of specimens in the following listing of measurements is that in which they are discussed above: total length, 160, 152, 142 mm.; length of forearm, 55.8, 57.6, 56.0 mm.; greatest length of skull, 19.3, 19.4, 19.7 mm.; zygomatic breadth, 14.1, 14.2, 14.5 mm.; length of maxillary toothrow, 6.8, 7.2, 7.2 mm.; interorbital breadth, 4.9, 4.7, 5.1 mm.

Rhogeessa tumida H. Allen, 1866

Two adult female *Rhogeessa* (1CC, 1MMNH) were captured in a mist net set over the cenote 2.5 km. northwest of Dzitya, Yucatán, on the night of 9 May. Each carried two embryos that measured 8 mm.

Bats of the genus *Rhogeessa* were revised by Goodwin (1958) and more recently by LaVal (1973). Jones *et al.* (1973:24) expressed reservations regarding the taxonomy of little yelow bats from Yucatán but assigned specimens to *R. parvula aeneus* after Goodwin (1958), the only available revision at that time. We have followed LaVal (1973) in referring our specimens to *R. tumida*, and place the following selected measurements on record: total length, 74, 73 mm.; length of fore-

TABLE 1. Selected measurements of six species of molossid bats from Yucatán. Numbers in parentheses following means denote number of individuals when different than shown on left.

Number	Sex		Total Length	Length of Forearm	Greatest Length Skull	Length Maxillary Toothrow	Zygomatic Breadth	Interorbital Breadth	Mastoidal Breadth	Palatal Breadth at Molars
					Molossus ater nigricans					
3	♀	**Mean**	130.3	51.1	21.5	7.9	13.8(2)	4.3	13.3	9.8
		Range	(125-134)	(50.4-51.8)	(21.1-21.9)	(7.8-7.9)	(13.4-14.2)	(4.3-4.4)	(13.1-13.6)	(9.6-10.1)
1	♂		130	52.4	21.5	8.2	14.1	4.7	13.1	10.2
					Molossus sinaloae sinaloae					
3	♀	**Mean**	120.5(2)	45.6	18.8	7.1	11.7	4.0	11.2	8.5
		Range	(118-123)	(44.3-46.4)	(18.5-19.3)	(7.0-7.2)	(11.4-12.0)	(3.9-4.2)	(11.1-11.3)	(8.4-8.5)
7	♂	**Mean**	125.3(6)	46.0(6)	19.4	7.3	12.2	4.0	11.8(6)	8.8
		Range	(116-134)	(44.8-46.6)	(18.2-19.8)	(7.1-7.4)	(11.9-12.3)	(3.8-4.1)	(11.6-12.0)	(8.5-9.3)
					Eumops auripendulus oaxacensis (from Jones *et al.*, 1973:27)					
1	♀		131	54.5	23.8	8.4	----	4.3	12.0	----
					Eumops bonariensis nanus					
2	♀	**Range**	(89-90)	(39.3-40.4)	(16.2-16.8)	(6.3-6.3)	(10.2-10.4)	(3.9-4.1)	(9.5-9.5)	(7.1-7.1)
2	♂	**Range**	(92-95)	(37.7-40.2)	(16.0-16.8)	(6.0-6.6)	(10.3-10.7)	(3.8-4.2)	(9.5-9.9)	(6.9-7.6)
					Eumops glaucinus					
15	♀	**Mean**	134.7	58.8	22.5	9.1	14.1	4.9	12.8	9.7
		Range	(130-140)	(56.6-61.5)	(22.1-22.8)	(8.8-9.4)	(13.8-14.6)	(4.7-5.1)	(12.5-13.1)	(9.3-10.2)
4	♂	**Mean**	137.7	57.8	23.1	9.2	14.5	4.9	13.1	9.7
		Range	(134-144)	(56.9-59.2)	(22.7-23.5)	(9.0-9.4)	(14.2-14.9)	(4.8-5.0)	(13.0-13.4)	(9.6-9.9)
					Promops centralis centralis					
6	♂	**Mean**	136.2	52.3	20.7	8.2	13.0	4.3	12.3	9.7
		Range	(128-143)	(49.8-54.3)	(20.1-21.3)	(8.0-8.5)	(12.7-13.3)	(4.2-4.4)	(12.1-12.6)	(9.5-10.1)

arm, 28.3, 28.1 mm.; greatest length of skull, 12.1, 11.8 mm.; breadth of brain case, 5.2, 5.2 mm.; zygomatic breadth, 7.7, 7.7 mm.; mastoidal breadth, 6.4, 6.4 mm.; length of maxillary toothrow, 4.5, 4.5 mm.

Molossus ater nigricans Miller, 1902

Although commonly netted in Mérida, only four specimens of the black mastiff bat were preserved by us (2CC, 1 MMNH, 1 TTU). These were captured in mist nets at the Colegio Peninsular. Two females captured on 14 and 28 March each carried a single embryo that measured, respectively, 3 and 12 mm. An adult male had testes 7 mm. in length on 14 March. Measurements are given in Table 1.

Molossus sinaloae sinaloae J. A. Allen, 1906

We found Allen's mastiff bat common in and near Mérida. In addition to specimens preserved, many were released from nets set at the Colegio Peninsular and the Country Club Campestre, as were several captured northwest of Dzitya. Specimens from southwest of Kinchil were captured by hand from a roost on timbers over the doorway of a machine shed.

The three females in our sample were pregnant. One taken on 14 March carried two embryos that were 2 mm. in length. Single embryos that measured 3 and 13 mm., respectively, were carried by females taken on 11 and 23 April (also see Bowles, 1973). Testes of four males taken in March and April averaged 6.2 (4-8) mm. in length. See Table 1 for selected measurements.

Specimens examined (10).—YUCATAN: 2.5 km. NW Dzitya, 1 (MMNH); Mérida, 7 (3 CC, 1 MMNH, 3 TTU); 6 km. S, 5 km. W Kinchil, 2 (1 MMNH, 1 TTU).

Eumops bonariensis nanus (Miller, 1900)

Peters' mastiff bat first was reported from México by Lay (1963:376), on the basis of an adult male from northeast of Tepa, Tabasco. Subsequently, Alvarez and Aviña (1964:248) obtained a female northeast of Tlacotalpan, Veracruz. No other specimens of the species have been reported from México and, thus, it previously was unknown from the Yucatán Peninsula. Four specimens of *Eumops bonariensis* are among our specimens from Yucatán.

An adult male having testes 5 mm. in length and a female with one embryo that measured 8 mm. were captured on 28 March at the Colegio Peninsular in Mérida (1 MMNH, 1 TTU). A second adult female carrying an embryo measuring 16 mm. was preserved after it was netted over the pond at the Country Club Campestre (TTU). A single adult male (MMNH) whose testes measured 4 mm. in length was captured over the cenote 2.5 km. northwest of Dzitya, Yucatán, on 12 May.

In addition to the four specimens saved, three females and 10 males of a small molossid bat, thought at the time to be *Tadarida laticaudata*, were released at the Colegio. Likewise, 11 females and six males were captured and released at the Country Club Campestre. No specimens of *T. laticaudata* were preserved by us and the identity of the realeased bats probably shall remain unknown. We now suspect that some or all may have been *E. bonariensis*. On the other hand, Jones *et al.* (1973:24) reported nine *T. laticaudata* from Mérida, five of which were obtained in 1971 by Bowles. This indicates that *T. laticaudata* is common in this portion of the peninsula, at least in certain years. The absence of specimens of *E. bonariensis* from previous samples is of interest, because all four randomly selected individuals of 34 small free-tailed bats captured in 1973 proved to be of this species, which previously was thought to be rare in México and absent from the Yucatán Peninsula.

Selected measurements of our four specimens are included in Table 1.

Eumops glaucinus (Wagner, 1843)

Wagner's mastiff bat generally has been considered as rare and as having poorly defined distributional limits (see Davis and Russell, 1954:70). Villa-R. (1967:451) examined specimens from as far north as Colima, but reported only five localities of record for the species in México. Jones *et al.* (1973:26) added a specimen labeled as from "N. Yucatán" to this list.

We preserved 19 specimens of *E. glaucinus* from two localities. Two adult females (1 MMNH, 1 TTU) were captured by hand from the main support of a machine shed at 6 km. south and 5 km. west of Kinchil, Yucatán, in the afternoon of 19 April. Approximately 12 other individuals escaped. Four days later, a single adult male (MMNH) was removed from the same support. Six adult females (1 CC, 2 MMNH, 3 TTU) were removed from mist nets at the Country Club Campestre on 8 May. On the evening of 17 May, 22 *E. glaucinus* and 10 other molossids were netted at the same site. Twelve of the *Eumops* and most of the other bats were released; three of the *Eumops* preserved were adult males and seven were adult females (1 CC, 4 MMNH, 5 TTU).

Testes of the male from Kinchil were 7 mm. in length, whereas those of all three from Mérida measured 8 mm. One of the seven females taken on 17 May evinced no sign of reproductive activity, but all others were pregnant. One of these carried two embryos that measured 6 (rt.) and 3 mm. (lt.) whereas each of the other five carried a single embryo. Those of the two females from near Kinchil were 15 and 17 mm.; mean (and extremes) length of the six embryos measured on 8 May was 18.7 (6-30) mm. and that of the remaining five from 17 May was 24.0 (20-28) mm. Selected measurements of our series of *E. glaucinus* are given in Table 1.

Promops centralis centralis Thomas, 1915

Only a single specimen of *Promops centralis* had been preserved from Yucatán since Thomas (1915:62) named the species on the basis of three specimens from "N. Yucatán." We preserved six specimens, all adult males, of Thomas' mastiff bat from two sites near the northern edge of Mérida, Yucatán. One specimen (testes 5 mm. in length) was netted over the swimming pool at the Colegio Peninsular on 28 March (CC), four (testes 6, 7, 7, and 7 mm.) were taken there on 22 April (2 MMNH, 2 TTU), and one (testes 3 mm.) was netted at the Country Club Campestre on 8 May (MMNH). The species may not be as rare on the Yucatán Peninsula as generally has been thought. Selected measurements of *P. centralis* are given in Table 1.

Tamandua tetradactyla mexicana (Saussure, 1860)

An adult male tamandua (CC) was found dead on Highway 180, 8 km. east southeast of Ticuch, Yucatán, on 7 May. Testes were 30 mm. in length. Selected external and cranial measurements are: total length, 1125 mm.; length of tail, 520 mm.; length of hind foot, 102 mm.; length of ear, 42 mm.; occipitonasal length, 126.5 mm.; breadth of braincase 41.8 mm.; least interorbital breadth, 24.6 mm. This animal seemingly is rare on the peninsula (see Jones *et al.*, 1974*b*:9).

Sciurus yucatanensis yucatanensis J. A. Allen, 1877

An adult female Yucatán gray squirrel (MMNH) was purchased at the market in Mérida, Yucatán, on 24 April. We were told that it had been trapped recently in the city. She gave birth to three young (two females and one male; MMNH) early the following morning. From 1 May until at least 4 May, an adult male in breeding condition was for sale at the market. We examined a juvenile gray squirrel kept as a pet by a Mayan boy in Puerto Morelos, Quintana Roo, on 28 April. The boy told us it had been captured nearby.

Orthogeomys hispidus yucatanensis (Nelson and Goldman, 1929)

Although only two specimens of the hispid pocket gopher were trapped by us, we frequently observed its characteristic mounds. Gopher mounds usually were seen wherever the underlying limestone was covered by at least a few inches of soil. Freshly formed mounds were abundant in road ditches, low areas, and in a cornfield 2 km. east of Chichen-Itzá, Yucatán, where one young adult female (MMNH) was captured in a steel trap on 2 May. Several other steel traps and two Macabee traps were disturbed by gophers during the night. A subadult male (TTU) was captured in shallow, rocky soil where the edge of a road ditch met the thornforest

6.5 km. northeast of Playa del Carmen, Quintana Roo. Testes of this animal measured 8 mm. The female was neither pregnant nor lactating.

Heteromys gaumeri J. A. Allen and Chapman, 1897

We found Gaumer's spiny pocket mouse to be common at two localities near Piste and Chichen-Itzá on 2 May. For example, in 67 Sherman live-traps baited with a mixture of rolled oats, cracked corn, and small seeds, we took 17 *Heteromys*, 19 *Sigmodon hispidus*, nine *Mus musculus*, six *Peromyscus yucatanicus*, and four *Ototylomys phyllotis*. Traps were set in and along the edges of two previously described cornfields north of Piste. A specimen from southwest of Muna was taken in heavily grazed thornforest and those from near Dzitya were trapped in nearly impenetrable thornforest. Our specimens included both subadults and adults, but no juveniles were captured. Weights and reproductive characteristics are given in Table 2.

Specimens examined (26).—YUCATAN: 4 km. E Dzitya, 3 (1 MMNH, 2 CC); 3 km. N Piste, 13 (7 MMNH, 6 TTU); 2 km. E Chichen-Itzá, 9 (7 MMNH, 2 TTU); 14 km. SW Muna, 1 (TTU). Additionally, four specimens from the Piste locality and one from that with reference to Chichen-Itzá were taken alive to the University of Minnesota.

Oryzomys palustris couesi (Alston, 1877)

Although apparently widespread and locally abundant on the peninsula (Jones *et al.*, 1974*a*:9), only three specimens of the marsh rice rat were obtained. Two males (MMNH), one juvenile and one subadult, were taken at the grassy edge of a cattail marsh 8 km. south of Progreso, Yucatán, on 4 May. An adult female (CC), which carried five embryos (two right and three left) that measured 12 mm. in length, was trapped on 7 May from a pile of cut grass and weeds under some coconut palms adjacent to the beach 5 km. south and 1 km. east of Tulum, Quintana Roo.

Ototylomys phyllotis phyllotis Merriam, 1901

We found the big-eared climbing rat to be one of the most ubiquitous mammals on the peninsula. Well-sampled habitats that did not yield *Ototylomys* were cultivated henequén fields, cattail marsh, and dense, short vegetation, including native palms, associated with the gulf-coast beach. Habitats from which the species was taken include grazed and ungrazed xerophilic thornforest, quasi rainforest, banana plantation, weedy cornfields (see account of *Heteromys gaumeri*), and the dense vegetation growing in a warm and humid sinkhole leading to a large cave. The genus *Ototylomys* recently was reviewed systematically by Lawlor (1969).

Our sample of *Ototylomys* included juveniles, subadults, and adults. Reproductive characteristics of the two older age groups are given in Table 2. Three of four adult females maintained alive had litters as follows: male and two females on 19 May; male and female on 21 May; and one of each sex plus one unsexed animal that did not survive, born on 29 May.

Specimens examined (17).—QUINTANA ROO: 8 km. N, 5.5 km. E Playa del Carmen, 3 (2 MMNH, 1 TTU); 14 km. NE Playa del Carmen, 1 (MMNH); 1.5 km. S, 1.5 km. E Tulum, 1 (MMNH). YUCATAN: 4 km. E Dzitya, 7 (5 MMNH, 2 TTU); 3 km. N Piste, 4 (1 MMNH, 3 TTU); 2 km. E Chichen-Itzá, 1 (TTU). Eleven additional specimens from some of these localities and from 14 km. southwest of Muna, Yucatán (1), and 3 km. south and 1 km. west of Calcehtoc, Yucatán (1), were taken alive to the University of Minnesota.

Peromyscus leucopus castaneus Osgood, 1904

The white-footed mouse was the principal mammalian species utilizing the habitat created by the cultivation of henequén north of Mérida. The species also was common in the second-growth deciduous thornforest of that area, where it was trapped with *Heteromys*, *Ototylomys*, and *Sigmodon*. One *P. leucopus* was taken in the same trapline with a *P. yucatanicus* in

TABLE 2. Reproductive characteristics of subadult and adult members of six species of rodents in Yucatán and Quintana Roo during the period 23 April to 10 May, 1973. Code abbreviations are as follows: Cl (corpora lutea); Em (embryos); La (lactating); Sc (scars of single age); Sc, 2A (scars of at least two ages); Sp (undeterminable number of scars present). Total length, if available, is shown with an asterisk for animals of unknown weight.

Males		Females	
Weight	Testes Length X Width	Weight	Reproductive Characteristics
		Heteromys gaumeri	
41.5	6 X 3	(36.6-65.4)	No Em: No Sc
47.5	7 X 5	(N = 11)	
50.0	8 X 5	43.2	5 Sc; 2 L, 3 R
51.3	7 X 3	51.8	2 Em X 16; L
57.4	7 X 4	56.4	3 Em X 12; 1 L, 2 R
62.0	21 X 13	59.4	1 Sc; L
62.4	16 X 11	63.5	No Em; Sc?
72.9	20 X 13	65.3	4 Em X 23; 2 L, 2 R
85.4	20 X 13		
		Ototylomys phyllotis	
46.7	14 X 8	53.2	2 Em X 10; 1 L, 1 R
46.9	13 X 7	54.1	2 Em X 20; 1 L, 1 R
55.8	18 X 8	62.7	2 Em X 18; 1 L, 1 R
		65.1	1 Em X 19; L
		65.8	2 Sc; 1 L, 1 R: La
		87.2	3 Em X 20; 2 L, 1 R
		305*	3 Em X 7; 1 L, 2 R
		310*	4 Em X 38; 2 L, 2 R
		Peromyscus leucopus	
18.0	11 X ?	14.4	2 Sc; L
18.5	9 X 6	16.8	2 Em X 2; L: Sp
19.3	11 X 6	17.2	3 Sc; 1 L, 2 R: La
19.4	13 X 7	19.1	5 Sc, 2A
20.0	13 X 7	19.7	4 Sc; 1 L, 3 R
20.7	14 X 7	19.7	5 Sc, 2A
20.8	12 X 7	20.2	6 Sc, 2A
21.2	12 X 7	20.5	5 Sc; 2 L, 3 R
21.4	14 X 8	22.6	3 Em; 2 L, 1 R: Sp
21.6	13 X 8	23.1	3 Sc; 1 L, 2 R
23.0	13 X 7	24.4	3 Em X 12; L: Sp
23.5	15 X 8	24.7	3 Em X 18; 2 L, 1 R
24.0	15 X 7		
		Peromyscus yucatanicus	
	13 X 7	22.1	3 Sc; 1 L, 2 R
20.0	13 X 8	23.2	3 Sc; 1 L, 2 R
23.9	15 X 8	23.3	3 Em; 1 L, 2 R
26.3	12 X 8	23.6	3 Sc; 2 L, 1 R: 5 Sc (old): I
27.1	13 X 8	24.4	4 Em X 5; 1 L, 3 R
27.5	16 X ?	26.5	3 Em X 5; L
32.1	14 X 7	28.5	8 Sc, 2A
222*	9 X 6	29.6	8 Sc, 2A
223*			

Table 2 (Continued)

Males			Females	
Weight		Testes Length X Width	Weight	Reproductive Characteristics
		Sigmodon hispidus		
Range	N	Means	41.4	2 Cl; 1 L, 1 R
			41.7	3 Em X 15; 1 L, 2 R
(42.1-48.0)	6	14.7 X 8.5	49.9	Sc, 2A: La
(50.0-57.0)	7	19.0 X 9.9	52.6	3 Em X 18; 2 L, 1 R
(60.0-68.6)	5	16.6 X 9.8	53.1	3 Em X 3; 1 L, 2 R
(75.1-95.8)	5	19.4 X 10.0	60.4	4 Em X 22; 2 L, 2 R
104.6	1	11 x 7	66.6	3 Em X 8; 2 L, 1 R
			78.6	5 Sc; 3 L, 2 R: Sp (old): La
			88.7	4 Em X 26; 2 L, 2 R
			99.9	7 Em X 23; 2 L, 5 R
			206*	7 Sc; 3 L, 4 R: Sp (old)
		Mus musculus		
9.9		7 X 4	11.4	4 Sc; 3 L, 1 R: La
10.0		7 X 4	11.9	Sc, 2A
12.2		8 X 4	12.4	5 Sc; 3 L, 2 R: La
12.5		6 X 4	17.0	6 Sc; 3 L, 3 R: La
15.4		8 X 4	17.2	5 Sc; 2 L, 3 R: La
16.4		6 X 4	17.7	5 Sc; 2 L, 3 R: La
16.4		6 X 4	-----	4 Cl; 2 L, 2 R
-----		6 X 4	-----	5 Sc; 3 L, 2 R: La
-----		8 X 5	-----	11 Sc, 2A
-----		10 X 5	-----	5 Em X 5; 2 L, 3 R

heavily grazed thornforest southwest of Muna, the only locality where the two species were trapped together by us. Reproductive characteristics of our adults and subadults are shown in Table 2. Two juveniles trapped on 23 April are not included in the table.

Specimens examined (29).—YUCATAN: 2.5 km. NW Dzitya, 2 (1 MMNH, 1 TTU); 4 km. E Dzitya, 26 (2 CC, 15 MMNH, 9 TTU), 14 km. SW Muna, 1 (TTU).

Peromyscus yucatanicus J. A. Allen and Chapman, 1897

Lawlor (1965) reviewed the systematics of the Yucatán deer mouse and described the pattern of intraspecific geographic variation. We found the species widely distributed in a variety of habitats including quasi rainforest, a banana plantation, grazed thornforest, and weedy cornfields. Our *P. yucatanicus* were all adult, albeit a few were completing the post-subadult molt. As can be seen in Table 2, all of our females were either pregnant or contained uterine scars.

Specimens examined (20).—QUINTANA ROO: 14 km. NE Playa del Carmen, 5 (1 MMNH, 4 TTU); 6 km. NE Tulum, 1 (CC); 1.5 km. S, 1.5 km. E Tulum, 3 (MMNH). YUCATAN: 3 km. N Piste, 6 (4 MMNH, 2 TTU); 2 km. E Chichen-Itzá, 2 (MMNH); 3 km. S, 1 km. W Calcehtoc, 2 (1 MMNH, 1 TTU), 14 km. SW Muna, 1 (MMNH). Six specimens were taken alive to the University of Minnesota—two from 8 km. north and 5.5 km. east of Playa del Carmen, Quintana Roo, and the others from localities listed above.

Sigmodon hispidus microdon Bailey, 1902

The hispid cotton rat was considered one of the commonest mammals on the peninsula by Jones *et al.* (1974*a*:17), and our findings corroborate that opinion. This

rat was common in weedy cornfields (see account of *Heteromys gaumeri*) and in a banana plantation and surrounding quasi rainforest in Quintana Roo. It was taken with *Oryzomys palustris* at the grassy edge of a cattail marsh and with *Ototylomys* and *Peromyscus leucopus* on the edge of a grassy clearing in xerophilic thornforest. The specimen listed below with reference to X-Can is a nearly complete skeleton removed from the stomach of a road-killed barn owl (*Tyto alba*). Our sample included juveniles, subadults, and adults. Reproductive characteristics of animals in the oldest two age categories are given in Table 2.

Specimens examined (44).—QUINTANA ROO: 8 km. N, 5.5 km. E Playa del Carmen, 2 (MMNH); 14 km. NE Playa del Carmen, 4 (1 MMNH, 3 TTU). YUCATAN: 8 km. S Progreso, 2 (MMNH); 4 km. E Dzitya, 1 (MMNH); 3 km. N Piste, 16 (7 MMNH, 9 TTU); 2 km. E Chichen-Itzá, 18 (12 MMNH, 6 TTU); 6 km. SW X-Can, 1 (CC). Four additional specimens from 3 km. north of Piste were taken alive to the University of Minnesota.

Mus musculus Linnaeus, 1758

The introduced house mouse is widely distributed on the peninsula and apparently becomes locally abundant in disturbed areas. Our specimens are from a weedy cornfield (see account of *Heteromys gaumeri*), buildings, disturbed thornforest adjacent to a sisal factory on the north edge of Mérida, and along a road in dense thornforest. All subadult and adult house mice trapped were reproductively active, as shown in Table 2.

Specimens examined (16).—YUCATAN: 4 km. E Dzitya, 3 (MMNH); Mérida, 4 (1 CC, 2 MMNH, 1 TTU), 3 km. N Piste, 8 (2 MMNH, 6 TTU); 14 km. SW Muna, 1 (MMNH).

Rattus rattus (Linnaeus, 1758)

Four non-breeding juveniles (2 MMNH, 2 TTU) were trapped on storage shelves inside a Mayan house at 14 km. northeast of Playa del Carmen, Quintana Roo, on 29 April. A subadult male (MMNH) with testes 21 mm. in length was trapped from a rocky area in a nearby banana field.

Agouti paca nelsoni Goldman, 1913

A young male paca was purchased in the market in Mérida by Williams on 1 May and taken alive to Texas Tech University. The seller, whom we deduced through poor communication also to be the trapper, wrote for us that the animal was captured near Tzucacab, Yucatán. He indicated that pacas are easily acquired in that area.

Coendou mexicanus yucataniae Thomas, 1902

An adult male Méxican porcupine (MMNH) was purchased in the market in Mérida, Yucatán, on 3 May. The vendor, who did not claim to be the trapper and with whom communication was difficult, reported that the animal had been captured in the vicinity of Chetumal, Quintana Roo. The animal was in breeding condition with testes 22 mm. in length and sperm in highly convoluted epididymides. A young porcupine that had been captured in the ruins of the Temple of Warriors at Chichen-Itzá, Yucatán, was observed by Bowles on 12 May.

Urocyon cinereoargenteus fraterculus Elliot, 1896

A young male gray fox (TTU) that had been shot recently near the north edge of Mérida, Yucatán, was purchased on the night of 25 April. Testes of this specimen were 13 mm. in length. Earlier that evening a gray fox was observed as it ran across the road and bounded over a stone fence 4 km. east of Dzitya, Yucatán. The vulture-cleaned skins of two gray foxes of unknown sex were obtained from Highway 180—one from 2 km. southwest of X-Can, Yucatán, (CC) and the other from 3.5 km. southwest of X-Can (MMNH). We consider the species to be common in the area where we worked.

Nasua nasua yucatanica J. A. Allen, 1904

A young female coati (MMNH) was purchased from the vendor of the Méxican porcupine (see account of that species) at the same place and time. He did not know the locality of origin of this speci-

men. Erupting permanent teeth in each maxillary are the canine, P4, and M2. An adult coati was observed on 29 April as it crossed the road ahead of us, then stood on a log in the adjacent ditch, along Highway 307 a few kilometers southsouthwest of Puerto Morelos, Quintana Roo. Another coati was observed by Bowles on 6 May along the road to Xel-Há, 8 km. north of Tulum, Quintana Roo.

Mustela frenata perda (Merriam, 1902)

A long-tailed weasel was observed on Highway 180, 14 km. southwest of X-Can, Yucatán, by Bowles and Kevin Curry on 28 April. Habitat along the road was second growth quasi rainforest.

Conepatus semistriatus yucatanicus Goldman, 1943

A striped hog-nosed skunk (MMNH) of unknown sex was found dead on Highway 180, 20 km. southwest of Puerto Juárez, Quintana Roo, on 28 April. The skin of this specimen nearly had been cleaned by vultures. It apparently consititutes the third specimen and second locality of record for this species in Quintana Roo. Goldman (1943:89) examined two specimens from La Vega (the type locality) when he named *C. s. yucatanicus*. Two of us (Birney and Williams) inspected the flattened remains of another road-killed hog-nosed skunk near the southeastern edge of Mérida, Yucatán, on 30 April.

Felis yagouaroundi fossata Mearns, 1901

At a place 6.5 km. northeast of Playa del Carmen, Quintana Roo, the site of an automobile breakdown where we were active most of the day on 29 April, Williams observed a jaguarundi cross the highway at a distance of less than 100 meters.

DISCUSSION

Results of our investigations on the Yucatán Peninsula have given us some insight regarding three basic aspects of the biology of the mammals of this area. Do mammals of the peninsula have similar reproductive strategies that have evolved in response to the peninsular environment, or has each species adapted uniquely? What, if any, are the structural patterns of similarity and diversity within this peninsular fauna? What effects do man and his agricultural practices have on the mammalian fauna and what might be its future? These questions will be considered separately below.

Reproduction

The dependency of bat species on an adequate food supply for reproduction has been considered recently by Mares and Wilson (1971) and by Fleming *et al.* (1972). The latter authors proposed a scheme of four reproductive patterns exhibited by Central American bats. In each case the reproductive pattern is highly reflective of dependability and seasonality of food resources. Fleming (1973) reported a more pronounced general trend toward breeding seasonality of bats than of rodents in Panamá. He noted that breeding in both groups is greatest near the end of the rainy season and suggested that cessation of heavy rains, may be a cue to breeding. Because we do not have year-round reproductive data for many species from the Yucatán Peninsula, it is not possible to determine if the reproductive habits are modified in the arid northern portion of the region where we concentrated efforts. However, by pooling our reproductive observations with those made by Bowles (1973) and Jones *et al.* (1974*a*), a few images of the reproductive strategies of certain species emerge.

Species of both rodents and bats can be separated into two groups: those that demonstrate a high degree of synchrony and seasonality of breeding and those in which breeding seems to be spread out over a lengthy period of time. Bats of the "synchronous" group for which enough

data exists to make a tentative assignment are *Pteronotus parnellii, P. davyi, Mormoops megalophyla, Eptesicus furinalis, Lasiurus ega, L. intermedius, Rhogeessa tumida, Molossus ater, M. sinaloae,* and *Eumops glaucinus.* Those of the "asynchronous" group seem to be *Glossophaga soricina, Sturnira lilium, Artibeus jamaicensis, Desmodus rotundus,* and *Diphylla ecaudata.* It is immediately obvious that the first group contains the insectivores of the families Mormoopidae, Vespertilionidae, and Molossidae, whereas those in the latter are all of the family Phyllostomatidae. Apparently the Yucatán Peninsula, and perhaps tropical habitats in general, have more constant fruit (see Tamsitt and Valdivieso, 1963, 1964) and blood resources than insect resources (see Wilson, 1971).

We consider it noteworthy that there is little or no tendency toward multiple births in phyllostomatids and mormoopids and only an occasional instance of two embryos in molossids, yet several species of vespertilionids produce two or three young per litter. If multiple-birth litters is an adaptation to a monestrous breeding habit that evolved in response to a seasonal insect resource, it is curious that the mormoopids have only a single young per litter and perhaps only a single litter per year. The reproductive habits of the more insectivorous phyllostomatids will prove to be important in solving this problem, but our data for these species are scanty.

Rodents for which we have reproductive data are those listed in Table 2. All appear to be "asynchronous" in that females in essentially all stages of reproduction can be found in the same population during the wet season, but some species apparently are capable of year-round breeding whereas others tend to have more distinct breeding seasons. *Heteromys gaumeri* appears to begin breeding late in the dry season, continue throughout the wet season, and cease breeding in perhaps January. Several females in our sample were pregnant but the majority were not; some males had large, scrotal testes, but others did not. Many of the nonbreeding individuals of both sexes were judged on the basis of weight to be late-born young of the previous wet season. Jones *et al.* (1974*a*) reported a female that was pregnant late in December. Fleming (1970, 1971) observed marked seasonality in the distantly related *Liomys adspersus,* but was unable to determine if the congeneric *H. desmarestianus* bred throughout the year in Panamá.

Lawlor (1969:435) suggested that *Ototylomys phyllotis* breeds throughout the year. The presence of juveniles, subadults, and adults, including females in several stages of reproductive activity, corroborates that conclusion. He also noted a reduction in number of *in utero* young per female from Tabasco to Nicaragua. Our average (and range) of 2.5 (1-4) young per female is higher than that of 2.25 (1-3) calculated by Lawlor for the Yucatán Peninsula. Additionally, we note in our data a marked tendency for larger females to carry more embryos than smaller conspecifics.

Breeding habits of *Peromyscus leucopus* in Yucatán are similar to those of *Heteromys,* except that breeding activity in *P. leucopus* apparently begins somewhat earlier. This is indicated by a pregnant female trapped in March (Jones *et al.,* 1974*a*) and two April-taken juveniles in our sample, which otherwise consisted mostly of adults and a few subadults. Mean (and extreme) embryo counts of gravid females (N = 6) examined by us and by Jones *et al.* (1974*a*) is 3.0 (2-5). Comparable figures for the northern extremes of Ontario (Coventry, 1937:489) and Wisconsin (Long, 1973:17), respectively, are 5.0 (3-7) and 4.8 (3-7). Long (*op. cit.*) utilized data on this species to expand the theory proposed by Spencer and Steinhoff (1968) to explain the adaptation of geographic variation in litter size and the means by which natural selection operates to affect litter size. However, Long did not include southern populations of the species in his study.

The other two species of rodents for which we have reproductive data, *Sigmodon hispidus* and *Mus musculus,* both appear to breed throughout the year on the Yucatán Peninsula, at least when local conditions are favorable. Fleming (1970:484) found that cotton rats produce litters throughout the year in Panamá. Our sample of house mice contained juveniles, subadults, and adults. Every subadult and adult female was or recently had been

reproductively active, but Jones *et al.* (1974*a*) examined two adult female house mice that were reproductively inactive in June and July. Based on scar counts, number of corpora lutea, and number of embryos, the mean litter size for house mice in Yucatán appears to approximate five, but some of our scar counts conceivably included more litters than we judged. Elucidation of post-Columbian patterns in geographic correlates to litter size in this species will be of interest.

In summary, breeding synchrony tends to be more strictly defined in seasonally breeding bats than in their rodents counterparts. Seasonality of breeding is also more easily defined for many bat species, especially mormoopids, vespertilionids, and molossids, than for the apparently seasonal rodents such as *Heteromys gaumeri* and *Peromyscus leucopus*. Both groups contain species that appear to be capable of breeding throughout the year, but a greater proportion of rodents than bats demonstrate this propensity. Reproductive patterns of bats appear to be closely related to food resources, with the fruit-, pollen and nectar-, and blood-feeding phyllostomatids having greater flexibility than insectivorous species. No unique trends or reproductive strategies of either bats or rodents are apparent for the Yucatán Peninsula, but the extent of our study does not preclude their existence, at least in the arid portions.

Structural patterns

In consideration of faunal organization and structure, we have elected to use the results of our own collections rather than to include all species known from each area on the basis of previous collections. This decision allows us to make comparisons based on groups of organisms occurring together at one time, but it tacitly assumed that we sampled the total fauna proportional to its existence. We realize this is an invalid assumption, which sufficiently vitiates the discussion to render it a consideration of trends. However, we consider some of these trends to be both meaningful and informative. Throughout the following paragraphs, samples under consideration are referred to by their shorthand names as given in parentheses in the previous descriptions of collecting localities.

Results of considerations of similarity, as calculated by a simple formula ($S = \frac{2C}{A+B}$), wherein similarity (S) equals twice the number of species in common between two localities (C) divided by the sum of the number of species at the two localities (A + B) (Sorensen, 1948:7), are shown graphically in Figure 2. This similarity index does not reflect either actual or relative density of individual species, as does the R_e index described by Horn (1966) and used by Harris (1971) to compare grassland mammalian faunas. Instead, it considers only the presence or absence of a given taxon at the given sites and thus is similar to a resemblance equation (see Preston, 1962) such as those used to compare mammalian faunas by Burt (1958) and Hagmeier and Stults (1964).

Bat faunules from nine localities and rodent faunules from four localities were compared. Similarity of rodent faunules are relatively much higher than those for bats, the mean similarity for rodents being 66% and that for bats being only 27%.

Certain of the two-by-two similarity indices merit special note and explanation. Rodent indices are relatively high as noted above, but that between Dzitya and the quasi rainforest is noticeably lower than the others. Dzitya is the driest habitat sampled and least like the more moist coast of Quintana Roo. The two geographically intermediate and closely associated sites, Piste and Chichen-Itzá, are also ecologically and environmentally intermediate. It appears to be these environmental differences that are being reflected by the pattern of similarity indices for rodents.

Two bat indices are notably high. These are (1) Colegio and Campestre and (2) Hoctún and Oxkintok. The first two localities are close together near the northern edge of Mérida. Surrounding habitat is similar, though more open around Campestre, and both were netting sites involving open water accessible to the rapid-flying molossids that comprised the bulk of both samples. Hoctún and Oxkintok both are cave sites. Although they are not close geographically and they differed in struc-

Plantation					Quintana Roo	.40	.60	.80
.54	Quasi Rainforest					Dzitya	.80	.60
.25	.29	Progreso					Piste	.80
.30	.10	.00	Dzitya					Chichen
.15	.33	.22	.38	Campestre				
.18	.20	.29	.32	.83	Colegio			
.33	.18	.06	.30	.00	.00	Hoctún		
.40	.29	.18	.52	.12	.14	.40	Piste	
.31	.17	.22	.29	.14	.16	.77	.38	Oxkintok

FIGURE 2. Comparative similarity values for bat faunules (lower left) and rodent faunules (upper right) in Yucatán and Quintana Roo. Similarity was calculated as $S=\frac{2C}{A+B}$, where A and B are number of species in samples A and B, respectively, and C is number of species common to both.

ture and associated vegetation, they obviously provided roosting facilities for many of the same caverniculous species. The two rainforest sites near Playa del Carmen, labeled "Plantation" and "Quasi Rainforest" yielded more similar faunules than any remaining pair of localities. We do not find this surprising, but, in fact, were surprised that they were not more similar. Perhaps the presence of the small cenote and the different foods provided by the agricultural activities at the plantation contributed to the faunal differences, or perhaps more intensive collecting at the two sites would result in the collection of more species in common to both.

An index of species diversity for each site was calculated by the well-known Shannon-Wiener formula ($H = -\Sigma p_i \log_{10} p_i$; where p_i is the proportion of species i in the sample). These are shown in Table 3 together with the number of species and our best estimate of the number of individuals in each sample. In those instances where an exact count does not exist for a common species (such as *Mormoops megalophylla* in Cueva de Oxkintok) we have made a conservative estimate. Using the

TABLE 3. Species diversity (see text for method of calculation) and numbers of species and individuals of bats and rodents captured at primary study sites in Yucatán and Quintana Roo.

	Rodents				Bats								
	Quintana Roo	Dzitya	Piste	Chichen	Quasi Rainforest	Plantation	Progreso	Dzitya	Colegio	Campestre	Hoctún	Piste	Oxkintok
Number of Species	5	5	5	5	5	6	2	14	5	7	6	9	7
Number of Individuals	23	41	54	34	29*	117*	51*	43	242	83	216*	54*	292*
Diversity (H)	.64	.48	.64	.49	.42	.25	.04	.98	.42	.62	.16	.51	.42

*Number of individuals for one or more species estimated as discussed in text.

Shannon-Wiener formula, this results in slightly elevated estimates of H.

Mean diversity of rodent samples (0.56 with extremes of 0.48 and 0.64) was slightly greater than that of bat samples (0.43 with extremes of 0.04 and 0.98) and much less variable between localities. This general pattern exists despite there being fewer rodent species than bat species on the peninsula and despite the relatively fewer rodent than bat species captured per site (mean of 5.0 for rodents at the four sites and 6.8 for bats at the nine sites). At most bat sites, Dzitya being the single exception, one or two bat species tended to dominate, which drastically reduced diversity of bat faunas even though several species usually were represented by one or a few specimens. No rodent locality was dominated by a single species.

No single species dominated at Dzitya, the most diverse bat side. Fourteen species were obtained at this locality with the most abundant, *Desmodus rotundus*, being represented by only ten individuals. The sample having the lowest index of diversity, Progreso, consisted of only two species. *Noctilio* was represented by a single specimen whereas *Artibeus jamaicensis* was represented by a conservatively estimated 50 individuals. The "cultivated" nature of this "island" of coconut palms resulted in what essentially was a monoculture of habitat, which apparently contributed to its low bat diversity. Six species of bats were collected from Hoctún, but *Pteronotus davyi* so dominated the bat fauna (estimated 200 individuals) that diversity there was low. Similarly, *Artibeus jamaicensis* was by far the most abundant bat at the Plantation site in Quintana Roo. More intensive censusing with more nearly equal effort at each site would be necessary before clear-cut patterns of bat species diversity in the various peninsular habitats could become evident.

Effect of Man's Activities on Small Mammals

The impact of man's activities on other mammals probably exceeds that of any other species. Nevertheless, this aspect of mammalian ecology often is ignored as being "unnatural," or it is considered only by alarmists. Some notes and comments regarding this interaction in the henequén zone of northwestern Yucatán may be of interest.

The marked wet and dry seasons of the area result in strong "seasonality" of mammalian activities, including agricultural practices of man. This together with the rocky, shallow nature of the soil drastically limits the variety of crops and agricultural practices that successfully can be pursued. Fortunately, the use of chemicals, such as fertilizers, herbicides, and pesticides, seems to be limited. In the long-term course of events, we predict that continued reliance on nonchemical means of crop production (see below) will prove most economical and successful for man and presents a

rather optimistic future for the small mammals and probably for much of the other wildlife of the area.

In the drier northern portions of the peninsula, the normal agricultural practice includes slash-and-burn of the second growth thornforest. Notwithstanding the unfavorable connotations frequently associated with this practice (Gourou, 1956), it has been in use there for at least 4000 years. In areas having sufficient moisture and soil (e.g., near Chichen-Itzá), clearing is followed by one or a few years of corn cropping during the wet season with the land lying essentially unused by man during the dry season. This provides excellent habitat for *Heteromys, Sigmodon,* and *Peromyscus yucatanicus* (see trapping results at 3 km. north of Piste in the account of *H. gaumeri*). Predators of these species undoubtedly benefit at this time. Following corn cropping, the land may be planted in henequén or it may be allowed to lie fallow for several years, during which time the successional trend is toward a return to scrub thornforest. Little corn is raised in the drier portion of northern Yucatán, where the present major habitats are thornforest and henequén fields.

Individual *Agave* plants live for approximately 20 years, with lower leaves being harvested three times annually after about the seventh year (Chardon, 1961:50). These fields also provide habitat for small mammals even though weeds are chopped one to three times per year, depending on the size of the henequén plants (Chardon, *loc. cit.*). The one henequén field in which we trapped (near Dzitya) harbored a high population of *Peromyscus leucopus.* After the uppermost branches of the *Agave* have been harvested the plant flowers and dies. The normal practice then is either to plant a second crop of henequén or to allow the field to be fallow for some period of time, which results in a successional trend toward thornforest. It may or may not be heavily grazed during this period.

Populations of most small mammals, especially *Peromyscus* (both species), *Ototylomys, Heteromys,* and based on sight records, *Sylvilagus* and *Didelphis,* are provided with suitable habitat by second-growth thornforest. Larger mammals, including most carnivores and the white-tailed deer, appear to have a high degree of impunity from human disturbance in the thornforest, but we have little data to substantiate this hypothesis. We found thornforest difficult for a walking man to negotiate and saw little evidence that people spend much effort beyond the forest edges, especially where the forest is not grazed. Many natives of rural areas hunt extensively for gray foxes and cottontail rabbits, and with appreciable success, but it appears that they are harvesting only those animals that leave the forest habitat or venture near its edges. Basic breeding populations probably are seldom if ever threatened. Even at times of population lows, we doubt that most terrestrial mammals, at least smaller species able to utilize thornforest, are seriously stressed by the hunting activities of man. The proportion of thornforest to active cropland is relatively high, at least in many areas. As long as the above outlined agricultural practices are continued, the future of terrestrial mammals of small and intermediate size on this portion of the peninsula appear to be secure. Our observations do not allow much speculation regarding larger mammals.

The erodibility and porous nature of limestone coupled with centuries of heavy rains during the annual wet season have produced an array of sites for the cavernicolous bats of the region. Even if some caves are commercialized, or otherwise exploited or disturbed by man, it appears that most bat species will not be placed in serious danger in the foreseeable future. The hot, humid nature of the caves will deter commercialization for the tourist industry, such as has become a problem in the southeastern United States, for example. Also, bats in these warm, humid caves react differently to disturbance than do bats in cool caves in temperate regions. In the warmer caves, most bats are airborne at the least disturbance and thus are not as vulnerable to being decimated enmass as has happened to colonies of temperate-zone bats. So long as intentional or unintentional chemical warfare is not waged against bats on the peninsula, we predict for them a reasonably secure future. However, a word of caution stems from the fact that we have an almost

incredible paucity of knowledge of the biology of many of the chiropteran species known from the peninsula. Thus, it is nearly impossible to forecast with confidence how their populations might react to a range of circumstances that is difficult to predict.

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