SPECIAL PUBLICATIONS
THE MUSEUM
TEXAS TECH UNIVERSITY

Biology of Bats of the New World Family
Phyllostomidae. Part II

Edited by
Robert J. Baker, J. Knox Jones, Jr., and Dilford C. Carter

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CONTENTS

INTRODUCTION .......................................................... 5

ENDOPARASITES .......................................................... 7
    John E. Ubelaker, Robert D. Specian, and Donald W. Duszynski,
    Department of Biology, Southern Methodist University; Department
    of Biology, Southern Methodist University, Dallas, Texas 75222;
    Department of Biology, The University of New Mexico, Albuquerque,
    87131.

ECTOPARASITES ......................................................... 57
    James P. Webb, Jr., and Richard B. Loomis, Department of Biology,
    California State University, Long Beach, 90840.

ORAL BIOLOGY .......................................................... 121
    Carleton J. Phillips, Gary W. Grimes, and G. Lawrence Forman,
    Department of Biology, Hofstra University; Department of Biology,
    Hofstra University, Hempstead, New York 11550; Department of
    Biology, Rockford College, Rockford, Illinois 61101.

ECHOLOCATION AND COMMUNICATION .................................. 247
    Edwin Gould, School of Hygiene and Public Health, The Johns
    Hopkins University, Baltimore, Maryland 21205.

THERMOREGULATION .................................................... 281
    John J. McManus, Department of Biology, Farleigh Dickinson
    University, Madison, New Jersey 07940.

FEEDING HABITS ........................................................ 293
    Alfred L. Gardner, U.S. Fish and Wildlife Service, National Fish
    and Wildlife Laboratory, National Museum of Natural History,
    Washington, D.C. 20560.

MOVEMENTS AND BEHAVIOR ............................................. 351
    M. Brock Fenton and Thomas H. Kunz, Department of Biology,
    Carleton University, Ottawa, Canada K1S 5B6 and Department
    of Mammalogy, Royal Ontario Museum; Department of Biology,
    Boston University, Boston, Massachusetts 02215.
INTRODUCTION

Because of their adaptive diversity and, in many instances, unique morphological attributes, bats of the family Phyllostomidae long have fascinated biologists. Known only from the New World, most genera of phyllostomatsids are limited distributionally to tropical environments, but some representatives occur as far north as the southwestern United States and others southward to the northern parts of Argentina and Chile; some species also are distributed on the Bahamas and islands of the Greater and Lesser Antilles. With the advent in recent years of improved methods of collecting bats, a tremendous wealth of information on phyllostomatids has been gathered, and it is the purpose of this publication, which ultimately will contain more than 20 individual chapters, to bring these data together in order to assess what now is known about the family and to provide a departure point for further studies.

Owing to the large number of contributions, all of which were solicited by us from persons we felt to be knowledgeable of the subject matter, and the fact that several contributions are necessarily lengthy, the decision was made to group chapters into three parts, each separately numbered as a Special Publication of The Museum at Texas Tech University. In order to establish a workable approach by which reference could be made consistently to taxa throughout the series, an annotated checklist by Jones and Carter (published in the first part of the series) was circulated to all authors. Each was asked to follow the nomenclature and systematic arrangement in the checklist or, alternatively, to document departures therefrom. This system, it is hoped, will allow readers to relate information from one chapter to another and one part to the next without the handicap of conflicting names for the same organism.

Manuscripts first were solicited from contributors in 1973. Most had been received by the end of 1974, and Part I of the series was published in 1976. As editorial work progressed, some authors provided up-dated information and all authors of chapters in Part II had the opportunity to insert limited materials at the time they received galley proofs early in 1977. Therefore, content is as current as reasonably could be anticipated for a project of this kind. Organization and editorial style follow that established for the Special Publications of The Museum at Texas Tech University. Otherwise, authors were allowed broad latitude concerning material to be included in their chapters. Accordingly, and for obvious other reasons, some chapters overlap others in content.

Even though some redundancy has resulted, we thought it best to have a section on the cited literature with each contribution. Citations to manuscripts in Part II and those scheduled for Part III of this collected series are carried in text as “this volume.”

For the convenience of readers who may not have seen Part I of the series (Spec. Publ. Mus., Texas Tech Univ., 10:1-218, 1976), the titles, authors, and pagination of its contents are as follows: Introduction (Baker, Jones, and Carter), p. 5; Annotated checklist, with keys to subfamilies and genera (Jones and Carter),
pp. 7-38; Zoogeography (Koopman), pp. 39-47; Chiropteran evolution (Smith), pp. 49-69; Collecting techniques (Tuttle), pp. 71-88; Care in captivity (Greenhall), pp. 89-131; Economics and conservation (C. Jones), pp. 133-145; Brain anatomy (McDaniel), pp. 147-200; and Lactation and milk (Jenness and Studier), pp. 201-218.

May 1977

Robert J. Baker
J. Knox Jones, Jr.
Dilford C. Carter
ENDOPARASITES

JOHN E. UBELAKER, ROBERT D. SPECIAN, AND DONALD W. DUSZYNSKI

The leaf-nosed bats of the New World family Phyllostomidae occur from the southwestern United States through tropical Central and South America. Members of this family are also found throughout the Antilles. The ecological associations of the species in this family seem to be rather broad; species are found in humid tropical to semiarid and arid subtropical environments. Diversity in feeding is readily apparent ranging from nectivores (Glossohaga), frugivores (Artibeus), sanguivores (Desmodus), to omnivores (Phyllostomus) (see review by Glass, 1970; Gardner, this volume).

To understand better the biology of phyllostomatid bats, it is worthwhile to examine their parasites. The distribution of parasites, especially endoparasites, is governed largely by climate, distribution of intermediate hosts, feeding habits of the hosts, evolutionary age, physiology, and availability of the host species. Because parasites often evolve with their host, the systematic and phylogenetic ages of particular groups of hosts can be determined, in some cases, directly from the systematics and assemblages of their parasites if appropriate precautions are taken.

The aims of this study were to collect and correlate as much information as possible concerning the endoparasites of the Phyllostomidae and present problems for future work. Specifically, this report includes a systematic review of all parasitic species of Protozoa, Acanthocephala, Pentastomida, Platyhelminthes, and Nematoda occurring in the Phyllostomidae: an addition of unpublished parasite collection records; and a preliminary appraisal of various factors that have influenced the dispersal and speciation in the endoparasites of leaf-nosed bats.

HISTORICAL REVIEW

Published works dealing with parasites of leaf-nosed bats are few. The earliest studies were probably those of Kolenati (1856) who examined bats in Brazil and described several nematodes of the genus Capillaria Zeder, 1800. Molin (1861) described and reported on the anatomy of Histiostrongylus coronatus from Phyllostoma sp. (not necessarily a species of Phyllostomus) collected in Brazil. Following these early reports of nematodes, Braun (1900) described several trematodes from Brazilian bats. Looss (1907) indicated, however, that Braun's descriptions were so inadequate that the species could not be identified. The trematodes of Brazilian bats were studied later in good detail by Travassos (1921, 1928, 1955).

Beginning in the 1930's, Perez-Vigueras initiated research on helminths of phyllostomatids collected in Cuba (1934, 1935, 1936, 1941a, 1941b, 1942). At about the same time, the nematodes of tropical American bats were studied ex-
tensively by Lent and Teixera de Freitas (1936, 1940) and Lent et al. (1945, 1946).

The first reports of helminths from North American phyllostomatids were by Caballero y Caballero (1942). His contributions to the helminth fauna of Mexican bats continued until recently. In 1960, he and Grocott reported on helminths in bats from Central American countries.

There are many reports of parasitic worms from tropical bats. The majority of these reports deal with descriptions of individual species and are presented in the systematic part of this report. In addition to the above mentioned reports, several brief surveys are available, namely, Chitwood (1938) and Stunkard (1938) in Yucatán, México, and Silva Taboada (1965) and Baruš and del Valle (1967) in Cuba.

With the exception of the haemoflagellates, the protozoan parasites of bats have not been studied well. Most published parasite surveys of phyllostomatid bats are concerned only with their parasitic helminths, as noted above, or with zoonotic bacterial, viral, and fungal organisms (for example, Grose and Marinkelle, 1966, 1968; Grose et al., 1968; Marinkelle and Grose, 1966). In only a few instances have general survey reports included information of the protozoan parasites of phyllostomids and these are usually of a public health nature in which attention is given to zoonotic forms.

Several reviews of parasites from bats in general are available. Stiles and Nolan (1931) listed all known parasites of bats, including ecto and endoparasitic forms. A general account of parasites of bats was presented by Allen (1939). Caballero y Caballero and Grocott (1960) published a significant work reviewing the trematodes from bats. Ubelaker (1970) published a general account of parasites from bats and in the following year, Baruš and Rysavy (1971) analyzed the biogeography of nematodes of the family Trichostrongylidae occurring in microchiroptera. Webber (1973) reviewed the helminths of bats north of the United States-México border.

**METHODS**

The majority of the specimens obtained for study were acquired by three collecting trips to Southern México and Central America. Collectors on these trips included Cesar Estrada R. (CER), Lawrence M. Hardy (LMH), J. Knox Jones, Jr. (JKJ), Timothy E. Lawlor (TEL), James D. Smith (JDS), Delbert L. Kilgore, Jr. (DLK) and John E. Ubelaker (JEU). Specimens indicated by DWD were collected by Donald W. Duszynski in Costa Rica.

Specimens collected in Mexico or Nicaragua were fixed in formalin or acetic acid-formalin-alcohol (AFA) and stored in 70 per cent ethanol; those collected in Costa Rica were fixed in warm 70 per cent ethanol and stored in 70 per cent ethanol and 5 per cent glycerine until studied.

Wherever possible, museum accession numbers are given for host specimens. The designation (KU) refers to the mammalogy collection, the Museum of Natural History, The University of Kansas, Lawrence. Due to the misidentification or name changes of hosts, the practice of depositing hosts in reputable museum collections is strongly encouraged.
[Editors’ note: Because the use of host names in the older parasitological literature often obscures host-parasite relations for those ill acquainted with the nomenclatural history of host taxa, we routinely replaced a junior synonym with a senior one. When some notation of such changes seemed necessary, we enclosed a brief explanation in brackets; otherwise, none was made. Also, misspelled names were corrected. We made no attempt to verify the identification of any species, although a notation was inserted when the identity of a host was improbable. A host name was enclosed in quotation marks to indicate that its original use in the parasitological literature could not be applied with certainty to any known taxon.]

All specimens to be studied by light microscopy were stored in 70 per cent ethanol and subsequently mounted on glass microscope slides. Soft-bodied specimens were stained in acetocarmine, cleared in xylene, and mounted in Canadian balsam prior to study. Nematode specimens were cleared either in warmed lactophenol or glycerine prior to study.

Specimens studied by scanning electron microscopy were prepared in the following manner. Fixed specimens were dehydrated in an ascending series of ethanol solutions to 70 per cent, transferred to 5 per cent glycerine-95 per cent ethanol solution from which the alcohol was allowed to evaporate, and cleared in 96.6 per cent glycerol-0.05 per cent potassium chloride-3.35 per cent distilled water, 24 to 48 hours prior to examination. Whole specimens or dissected portions of the helminths were mounted on metal specimen stubs with Duco cement, out-gassed in a vacuum evaporator for one hour or more, rotary coated with gold palladium (200 Å or less), and examined with an AMR 1000 scanning electron microscope.

**Phylum Protozoa**

The best present classification of the Protozoa is that proposed by Honigberg *et al.* (1964), as presented by Levine (1973), though we prefer not to use the latter’s “uniform endings of higher taxa” (Levine, 1958). Of the five subphyla utilized in this classification, two of these, Ciliophora and Sarcomastigophora, contain both free-living and parasitic forms, whereas in the remaining three, Apicomplexa, Microspora, and Myxospora, all species are parasitic. Only two of these subphyla (Apicomplexa, the coccidia, malaria, and toxoplasma-type organisms; Sarcomastigophora, the flagellates and amoebae) contain parasites frequently found in mammals. Unfortunately, there is a considerable paucity of information on the protozoan parasites of all bats, worldwide, and such studies would provide much new information to future workers.

**Subphylum Apicomplexa** Levine, 1970

**Class Sporozoa** Leukart, 1879

**Family Eimeriidae**

**Eimeria** sp.

*Type host.*—Any phyllostomatid bat.
Site of infection.—Endogenous stages usually in the intestinal epithelial cells; oocysts are found in the feces.

Remarks.—Although there are no records of Coccidia from phyllostomatid bats, we include this section to point out the immediate need for work in this area. Inasmuch as the Coccidia tend to be particularly host specific, the information from such studies could provide data to indicate and help us understand certain phylogenetic relationships.

There are 13 named species of bat eimerians, but it is questionable whether all should be considered valid species (Pelléry, 1974; Wheat, 1975). Of these 13 species, only *Eimeria eumops* from *Eumops tricolor* (Colombia), *E. macyi* from *Pipistrellus subflavus* (Alabama), and *E. rhynchonycteris naso* (British Honduras) have been reported in the Western Hemisphere (Lainson, 1968; Marinkelle, 1968; Wheat, 1975). Presumably, eimerians and related taxa (for example, *Klossia variabilis*, see Levine et al., 1955) have not been found in phyllostomatids because no one has bothered to look for them. The 13 reported species of bat eimerians are only a fraction of the number which must actually parasitize these mammals; *Eimeria* spp. have been described from only 12 of the 168 Recent genera (7 per cent) and 14 of the 853 living species (1.6 per cent) of bats recognized by Vaughan (1972). Although some species of *Eimeria* occur in more than one host, we also know that many hosts harbor two or more species that may be unique to them. If we conservatively assume that there is at least one *Eimeria* species per bat species, as was done for rodents (Levine and Ivens, 1965), we can estimate that there may be about 900 species of *Eimeria* alone in bats. The number described already is only 1.5 per cent of this number.

Family Plasmodiidae

**Polychromophilus deanei** Garnham et al., 1971

*Type host.*—*Myotis nigricans*.

*Site of infection.*—Red blood cells.

*Type locality.*—Pará, Brazil.

*Other records.*—This species was seen in the blood of *Glossophaga soricina* from Pará, Brazil, by Deane and Deane (1961), but their identification was both incorrect and incomplete (Garnham et al., 1971; Garnham, 1973).

Remarks.—Haemopiridian parasites of any sort are rare in New World mammals. According to Garnham (1973), the haemopiridian parasites of bats fall into at least four genera, *Plasmodium*, *Hepatozoon*, *Nycteris*, and *Polychromophilus*, with the first three being found only in bats of the Old World. The first report of a bat "malaria" on the American continent was by Wood (1952) in which he found what he called *Plasmodium* sp. in five *Antrozous pallidus* (Vespertilionidae) in California and in one *A. pallidus* and one *Pipistrellus hesperus* (Vespertilionidae) from the Chisos Mountains in Texas. He did not specify whether the California and Texas parasites were the same or different species.

Only one report exists of a haemopiridian in phyllostomatid bats, and that was by Deane and Deane (1961), who found what they also described as *Plas-
modium sp. After describing and picturing the parasite in considerable detail, they concluded their paper by stating they weren’t sure whether the forms they saw belonged to the genus Plasmodium or to some other genus within the “Haemoproteidae.” Garnham et al. (1971) described P. deanei from M. nigricans (Vespertilionidae) caught in the same general area of Para as the bats examined by Deane and Deane (1961) and speculated that the general morphological features of P. deanei and the Plasmodium sp. seen by the Deanes were quite similar. In a later report, Garnham (1973) synonymized P. deanei and the form seen a decade earlier by Deane and Deane (1961) and, after reviewing the original slides made by Wood (1952), also placed that “malarial parasite” into the genus Polychromaphilus. Thus, Polychromaphilus has been reported three times in the New World, twice from the Amazon region and once from California and Texas. The latter parasite is longer and more oval than P. deanei and the pigment in the female is more abundant.

Family Toxoplasmatidae

Toxoplasma gondii Nicolle and Manceaux, 1908

Type host.—Cienodactylus gondii.

Site of infection.—Trophozoites and cysts throughout the host’s tissues.

Type locality.—Foothills and mountains, Southern Tunisia, North Africa.

Other records.—Roever-Bonnet et al. (1969), using the Sabin-Feldman dye test for toxoplasmosis, found the sera of two Artibeus literratus from Tibú, Santander, Colombia to be positive for this parasite.

Remarks.—Literally thousands of records of T. gondii from over 50 vertebrate species have appeared in the literature since this parasite first was described (for review, see Frenkel, 1973). However, information on the incidence of T. gondii in bats is meager as few such surveys have been conducted worldwide (for example, Rifaat et al., 1967; Kaliakin, 1970) and we find only one report documenting, serologically, the incidence of T. gondii in phyllostomatid hosts (Roever-Bonnet et al., 1969). Toxoplasma gondii is almost ubiquitous in nature and the role of bats in the ecology and distribution of this most important parasite certainly should merit immediate future investigation.

Subphylum SARCOMASTIGOPHORA Honigberg and Balamuth, 1963

Class ZOOASTIGOPHOREA

Family Trypanosomatidae

Before beginning a discussion on the haemoflagellates, we must point out that the classification of the various species and the terminology associated with their developmental stages has changed considerably in the last several years. Thus, to be consistent with current trends of thought, we will follow the classification of the Trypanosomatidae as outlined by Levine (1973) and the uniform terminology of body forms introduced by Hoare and Wallace (1966).

The study of trypanosomes of bats is important because bats often live in proximity to humans and can migrate great distances; thus, they can act as links
between sylvatic, rural, and urban populations. According to Dias (1936a), trypanosomes of bats have been known since 1898 when Dionisi in Italy first isolated and described, but did not name, haemoflagellates that he found in the blood of three species of vespertilionid bats (*Miniopterus schreibersii*, *Vespertilio marinus*, *Vesperugo noctula*). Dias (1936a) also stated that in 1900 Durham examined the stomach contents of a mosquito that had just fed on the blood of *Phyllostomus* sp. from the state of Pará, Brazil, and found numerous trypanomastigote forms. Durham, apparently, did not describe these forms nor specifically identify the host.

The first name given to a bat haemoflagellate was in 1904 when Battaglia, in Italy, identified a very small trypanomastigote form from the blood of *Pipistrellus* sp. (Vespertilionidae) as *Trypanosoma vespertilionis*. This name has persisted and has been assigned since to trypanosomes of bats from Africa, the Americas, and Europe. Six years later, Cartaya (1910) in Cuba described the first trypanosome from bats in the Americas when he named *T. phyllostomae* from *Carollia perspicillata* (reported as “*Artibeus perspicillatus*”). However, the validity of this species is, today, suspect by many authors (Table 1). Since then, several reports have documented the occurrence of trypanosomes in phyllostomatids, but in most, the information presented was scanty or specific identification of those forms was not made. Thus to date, only six valid specific names (*T. cruzi*, *T. equinum*, *T. evansi*, *T. pessoi*, *T. pifiainoi*, and *T. vespertilionis*) and two of questionable value (*T. lineatus*, *T. phyllostomae*) have been attributed to trypanosomes from American phyllostomatids. When specific identifications were not made, the haemoflagellates from these hosts were identified as *Trypanosoma* sp., *T. cruzi*-like or *T. rangeli*-like.

In his review of bat trypanosomes, Dias (1936a) established two main groups: 1) the *vespertilionis* group—small trypanomastigote blood forms (14 to 20 microns) with a very large, round subterminal kinetoplast and a narrow undulating membrane; this group includes, among others, *T. cruzi*, *T. lineatus* (?), *T. phyllostomae* (?), and *T. vespertilionis*; and 2) the *megadermic* group—large and broad trypanomastigote forms (25 to 40 microns) with a small, round, or rod-shaped kinetoplast located far from the posterior end of the body, closer to the nucleus, and a broad, wavy, undulating membrane (Deane and Sugay, 1963); this group includes, among others, *T. pessoi* and *T. pifiainoi*. In addition to these two main groups of bat trypanosomes, there are other large trypanosomes that do not fit well into either group: *T. pteropi* from Australian flying foxes (from Marinkelle and Duarte, 1968); *T. rangeli*-like forms from *Artibeus lituratus* and *Glossophaga soricina* in Colombia (Marinkelle, 1966b); *T. evansi* from *Desmodus rotundus* in Panamá and Colombia (Ayala and Wells, 1974; Clark, 1948; Clark and Dunn, 1933; Dunn, 1932; Johnson, 1936a, 1936b); and *T. equinum* from *D. rotundus* in Argentina (Acosta and Romañá, 1938).

The trypanosomes that have been described from phyllostomatid hosts and the countries in which they were found are listed in Table 1. Additional pertinent information for each species is presented below.
### Table 1.—The trypanosomes of phyllostomatid bats. Experimental infections are indicated by an asterisk.

<table>
<thead>
<tr>
<th>Bat hosts</th>
<th>Locality</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Artibeus cinereus</em>, <em>Artibeus jamaicensis</em></td>
<td>Jarco, San José, Costa Rica</td>
<td>Esquivel <em>et al.</em>, 1967</td>
</tr>
<tr>
<td><em>Ar. jamaicensis</em></td>
<td>Pará, Brazil</td>
<td>Deane, 1964<em>b</em></td>
</tr>
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<td><em>Carollia perspicillata</em>, <em>Choeronycteris minor</em></td>
<td>Guararema, São Paulo, Brazil</td>
<td>Deane and Sugay, 1963</td>
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<tr>
<td><em>Desmodus rotundus</em></td>
<td>Cali, Colombia</td>
<td>Ayala and Wells, 1974</td>
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<td><em>Desmodus rotundus</em></td>
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<td></td>
</tr>
<tr>
<td><em>Artibeus lituratus</em>, <em>Phyllostomus hastatus</em></td>
<td>Tibú and Tolima, Colombia</td>
<td>Marinkelle and Duarte, 1968</td>
</tr>
<tr>
<td><em>Carollia perspicillata</em>, <em>Glossophaga soricina</em></td>
<td>Pará, Brazil</td>
<td>Deane, 1964<em>b</em></td>
</tr>
<tr>
<td><em>Carollia perspicillata</em>, <em>G. soricina</em></td>
<td>Río de Janeiro, Brazil</td>
<td>Dias <em>et al.</em>, 1942; Deane and Sugay, 1963</td>
</tr>
<tr>
<td><em>Carollia perspicillata</em>, &quot;Lonchoglossa ecutulata&quot;</td>
<td>San José, Costa Rica</td>
<td>Dias, 1940 (nor <em>T. heybergi-like</em>, see Deane, 1964<em>b</em>)</td>
</tr>
<tr>
<td><em>Desmodus rotundus</em></td>
<td>Pará, Brazil</td>
<td>Zeléndon and Vieto, 1957</td>
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<td><em>Desmodus rotundus</em></td>
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<td>Romaia, 1940 (in <em>Dias et al.</em>, 1942)</td>
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<td><em>Vespertilionis</em></td>
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<td></td>
<td><em>Trypanosoma cruzi</em></td>
<td>Clark and Dunn, 1932</td>
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<td><em>Artibeus jamaicensis</em>, <em>Uroderma bilobatum</em></td>
<td>Canal Zone, Panamá</td>
<td>Clark and Dunn, 1932</td>
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<td><em>Artibeus lituratus</em>, <em>Carollia perspicillata</em>, <em>Desmodus rotundus</em>, <em>Glossophaga soricina</em>, <em>Phyllostomus discolor</em>, <em>Phyllostomus hastatus</em></td>
<td>Western and central Colombia</td>
<td>Marinkelle, 1966<em>b</em>; Marinkelle and Grose, 1966</td>
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<td><em>Carollia perspicillata</em></td>
<td>Chilibrillo Caves, Panamá</td>
<td>Clark and Dunn, 1932</td>
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<td><em>Phyllostomus hastatus</em></td>
<td>Bella Vista, Panamá</td>
<td>Clark and Dunn, 1932</td>
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<td><em>Glossophaga soricina</em></td>
<td>Brazil</td>
<td>Dias, 1936<em>a</em></td>
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<td>Western and central Colombia</td>
<td>Marinkelle, 1966<em>b</em>; Deane, 1967</td>
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<td>Species</td>
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<td>Reference</td>
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<td>Carollia perspicillata, Desmodus rotundus, Glossophaga soricina, Mimon hemetii, Phyllostomus discolor, Phyllostomus hastatus, Uroderma bilobatum, Vampyrum spectrum</td>
<td>French Guiana</td>
<td>Floch et al., 1942</td>
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<td>Colombia</td>
<td>Renjifo-Salcedo et al., 1952; Marinkelle, 1966b</td>
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<td>Artibeus jamaicensis, Phyllostomus hastatus</td>
<td>Guaratiana, Yaracuy, Venezuela</td>
<td>Dias and Piñano, 1941</td>
</tr>
<tr>
<td>Carollia perspicillata, Chororhinus minor, Glossophaga soricina, Lonchophyllum mordax, Micronycteris megalotis, Phyllostomus elongatus</td>
<td>Marajo Island, Belem and Pará, Brazil</td>
<td>Dias et al., 1942; Deane, 1961, 1964a</td>
</tr>
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<td>Carollia perspicillata, Chororhinus minor, Phyllostomus hastatus</td>
<td>Pará, Brazil</td>
<td>Deane, 1964a, 1964b; Dias, 1940</td>
</tr>
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<td>Desmodus rotundus, Glossophaga soricina, Lonchophylla thomasi</td>
<td>Panamá</td>
<td>Wood and Wood, 1941</td>
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<td>Pará, Brazil</td>
<td>Garnham et al., 1971</td>
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<td>Phyllostomus hastatus</td>
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<td>Trypanosoma lineatus</td>
<td>Caracas, Venezuela</td>
<td>Iurbe and Gonzalez, 1916; W.Y., 1917</td>
</tr>
<tr>
<td>Vampyrops lineatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carollia perspicillata</td>
<td>Brazil</td>
<td>Dias, 1940 (= T. cruzi-like?, see Deane, 1964b)</td>
</tr>
<tr>
<td>Carollia perspicillata</td>
<td>Cuba</td>
<td>Cartaya, 1916 (= T. cruzi-like?, see Marinkelle, 1968b)</td>
</tr>
<tr>
<td>Carollia perspicillata</td>
<td>Guaratiana, Yaracuy, Venezuela</td>
<td>Dias and Piñano, 1941 (= T. cruzi-like?, see Marinkelle, 1968b)</td>
</tr>
<tr>
<td>Species</td>
<td>Collection Site</td>
<td>Reference</td>
</tr>
<tr>
<td>-------------------------------------------</td>
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</tr>
<tr>
<td>Trypanosoma vespertilionis</td>
<td>Rio de Janeiro, Brazil</td>
<td>Dias, 1940</td>
</tr>
<tr>
<td>Carolia perspicillata,</td>
<td>Brazil</td>
<td>Dias et al., 1942 (see Deane, 1964a)</td>
</tr>
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<td>&quot;Lonchoglotta caudata&quot;</td>
<td>San José, Costa Rica</td>
<td>Zeledón and Vieto, 1957, 1958</td>
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<td>Carolia perspicillata, Glossiphaga soricina, &quot;Lonchoglotta caudata&quot;</td>
<td>Colombia</td>
<td>Mazzotti, 1946</td>
</tr>
<tr>
<td>Phyllostomus hastatus</td>
<td>Colombia</td>
<td>See Marinkelle, 1966b</td>
</tr>
<tr>
<td>Trypanosoma spp.</td>
<td>Limón, Costa Rica</td>
<td>Zeledón and Rosabal, 1969b</td>
</tr>
<tr>
<td>Carolia perspicillata, Lonchophylla nordax</td>
<td>Brazil</td>
<td>Romaña, 1940 (in Dias and Pifano, 1941)</td>
</tr>
<tr>
<td>&quot;Trachops elongatus&quot;</td>
<td>Brazil</td>
<td>Dias and Pifano, 1942</td>
</tr>
<tr>
<td>Artibeus jamaicensis*</td>
<td>Panamá</td>
<td>Clark and Dunn, 1933</td>
</tr>
<tr>
<td>Carolia perspicillata*</td>
<td>Panamá</td>
<td>Dunn, 1932; Clark and Dunn, 1933; Johnson, 1936a, 1936b</td>
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<tr>
<td>Glossiphaga soricina*</td>
<td>Arauca and Cali,</td>
<td>Ayala and Wells, 1974</td>
</tr>
<tr>
<td>Phyllostomus hastatus*</td>
<td>Valle de Cauca, Colombia</td>
<td>Ayala, 1972 (in Ayala and Wells, 1974)</td>
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<tr>
<td>Desmodus rotundus*</td>
<td>Argentina</td>
<td>Acosta and Romaña, 1938; Hoare, 1965</td>
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<tr>
<td>Desmodus rotundus*</td>
<td>Trypanosoma equinum</td>
<td>Marinkelle, 1966b; Tamsitt and Valdivieso, 1970</td>
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<tr>
<td>Desmodus rotundus*</td>
<td>Central and western</td>
<td>&quot;not Trypanosoma cruzi-like&quot;</td>
</tr>
<tr>
<td>Artibeus literatus, Glossiphaga soricina</td>
<td>Colombia</td>
<td>Garnham et al., 1971</td>
</tr>
<tr>
<td>Choeroniscus minor</td>
<td>Pará, Brazil</td>
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Trypanosoma (= Schizotrypanum) cruzi Chagas, 1909

Type host.—Panstrongylus megistus.
Site of infection.—In the intestine of the triatomid bug (originally), but also intercellularly in the blood (trypomastigote form) and intracellularly in the reticuloendothelial and other tissue cells (amastigote form) of vertebrate hosts.
Type locality.—Brazil.
Other records.—See Table 1.
Remarks.—Trypanosomes morphologically similar to T. cruzi have been recorded from more than 100 species of mammals (Deane, 1964a). Technically, forms identified as this species should be restricted to those which produce amastigote bodies in the organs of inoculated laboratory animals or in tissue cultures. In addition, the length of the trypomastigote blood form (approximately 20 microns), its nuclear index (approximately 1.4 to 1.6), its ability to develop in triatomid bugs, and whether or not the bat host(s) came from endemic areas of Chagas' disease should all be utilized as supportive evidence in such identifications (Deane, 1961). Only three reports (Table 1) use much of the above criteria to demonstrate conclusively the presence of T. cruzi, either naturally or experimentally, in American leaf-nosed bats.

Trypanosoma cruzi-like

Remarks.—Many of the bats in most of the countries of the Americas are hosts to trypanosomes structurally identical to T. cruzi (See Marinkelle, 1965). It is now generally accepted that these forms should be referred to as T. cruzi-like when only blood forms are studied or if they fail to produce amastigote bodies in living cells (Marinkelle, 1966b). However, Marinkelle (1968b) stated also that the majority of T. cruzi-like forms (vespertilionis group) are capable of forming amastigotes in cells of mammals. Deane (1964a), on the other hand, disagreed with this view and summarized well the difficulties encountered in working with bat trypanosomes: "The bat strains, however, remain a problem. At least some bats of the endemic area of Chagas' disease do harbour flagellates indistinguishable from T. cruzi, on the basis of morphology, biology and virulence and even immunologically. But most bats harbour strains which cannot, at present, be identified to the agent of Chagas' disease: they are of little or no virulence for laboratory animals and, besides, some strains do not seem to develop well in triatomid bugs and others show morphological differences that are said to be constant." Dias (1936a) offered somewhat of a compromise position by suggesting the trypanosomes of bats can, after repeated passage, change their virulence and lose the ability to infect other hosts. A translation of his original statements (p. 75, in Portuguese) follows: "One extremely interesting question that should be better investigated is that of the behavior of virulent T. cruzi in bats that are natural hosts to trypanosomes. Experiments done to date show that these mammals (at least some species) are very resistant, if not refractory, to infection by strains that are very pathogenic to other animals. One of our experiments demonstrated that before the trypanosomes are destroyed they experience an abrupt
and remarkable attenuation of virulence in bats. If, by means of repeated passages, one succeeds in obtaining infections that are more and more prolonged, finally adapting the trypanosome to the bat, it is possible that this adaptation will be made at the cost of the loss of infectiveness to other animals, because of a real effect which the organic environment of the mammal exercises on the flagellate. If this could be verified, _T. cruzi_ will have been transformed into _T. vespertilionis_, just as _T. vespertilionis_ can be identified as _T. cruzi_ in those rare circumstances in which its inoculations into animals are positive."

Additional confusion in naming such forms stems from: the highly variable nature of structural dimensions during different phases of infection by a single strain of _T. cruzi_; the wide variation in nuclear indices reported for _T. cruzi_ (from 0.95-1.63 by Baretto, 1965); and the possible influence of temperature on the morphology and pathology of various trypanosomes (Marinkelle, 1966a, 1968b). Such information points out the need for much additional work before the _T. cruzi_-like forms in bats can begin to be accurately separated.

Some of the first reports of _T. cruzi_-like parasites from bats in Latin America were by Dias and Pifano (1941, 1942) in Venezuela. However, Zeledón and Víeto (1958), based on their biometrical study of two lab strains of _T. cruzi_ (from mice and triatomids) and of _T. vespertilionis_ isolated from a _Glossophaga soricina_ caught near San José, Costa Rica, considered the forms seen by Dias and Pifano (1942) to be different from _T. cruzi_ and _T. vespertilionis_. Zeledón and Víeto (1958) and later Marinkelle (1968b), in a retrospective look at the literature, considered as _T. cruzi_-like the following phyllostomatid bat trypanosomes: those from _Carollia perspicillata_ and described in Cuba by Cartaya (1910) as _T. phyllostoma_; the "phyllostomae" strain from _Carollia perspicillata_ in Venezuela by Dias and Pifano (1941); the Brazilian strains from _C. perspicillata_ and _Phyllostomus hastatus_ studied by Deane (1964a); and the strains isolated from 11 species of phyllostomatids in Colombia (see Table 1) by Marinkelle (1966b, 1968b). Additional records to _T. cruzi_-like forms found in American phyllostomatids are listed in Table 1.

**Trypanosoma equinum** Voges, 1901

_Type host._ — "Horses."

_Site of infection._ — Extracellular blood parasite.

_Type locality._ — It originates in South America and occurs as far south as the Argentina provinces of St. Fe and Corrientes" (see Voges, 1901).

_Other records._ — See Table 1.

_Remarks._ — This species differs structurally from _T. evansi_, from which it probably arose, only in lacking a kinetoplast (Levine, 1973). _Trypanosoma equinum_ infects cattle in an asymptomatic form, but produces a severe disease in horses called Mal de Caderas throughout much of South America, especially Brazil. It is unique (as is _T. evansi_) in that it has evolved to utilize the vampire bat, _Desmodus rotundus_, as a parallel host and as a vector of the disease (Hoare, 1965). In Argentina, it was demonstrated experimentally that vampire bats be-
come infected with *T. equinum* from horses and can transmit it by feeding on healthy horses (Acosta and Román, 1938).

**Trypanosoma evansi** (Steel, 1885)

*Type host.*—“Horses.”

*Site of infection.*—Extracellular blood parasite.

*Type locality.*—Punjab, India.

*Other records.*—See Table 1.

*Remarks.*—Trypanosoma evansi (= *T. hippicum*) has a wide distribution in Latin America being prevalent in México, all of Central America, Venezuela, and Colombia, where it causes a disease called Murrina in horses (Hoare, 1965). Hoare (1957) stated that mechanical transmission of *T. evansi* (and of *T. equinum*) probably evolved as a secondary adaptation when it separated from its African ancestor *T. brucei* and lost its original intermediate host, the tsetse fly. After these two species became established in the New World, they acquired, in addition to blood sucking flies (Tabanidae), a new type of vector, the vampire bat. Vampires are ideal vectors because their infection from cattle harboring small numbers of parasites is ensured by the large amount of blood taken during a meal (16 to 50 milliliters) (Hoare, 1965). The high rate of reproduction of the parasite within the vampire’s body increases the chances of successful transmission to new hosts. Therefore, vampires play an important role in the spread of bovine Murrina among horses in Latin America.

Dunn (1932) first documented that the vampire bat *Desmodus rotundus* was a natural vector of *T. evansi* on the Isthmus of Pananá, and Clark and Dunn (1933) were able to transmit this trypanosome to other phyllostomats (Table 1), but all specimens so infected, including the vampires, were highly susceptible to disease and died within a few weeks. Clark and Dunn apparently never found any phyllostomatids with “spontaneous” (= natural?) *T. evansi* infections, but felt that the vampire bat, inasmuch as it could be infected experimentally and fed with equal freedom on equine and bovine animals, might be an important vector in transmitting this parasite from reservoir cattle hosts to highly susceptible horses and mules. Johnson (1936a, 1936b) and Hoare (1957) also demonstrated that vampire bats acquire and transmit *T. evansi* under experimental conditions, but we found records of only 20 individual vampire bats with natural infections (Ayala and Wells, 1974; Clark, 1948; Johnson, 1936a, 1936b).

**Trypanosoma lineatus** Iturbe and Gonzalez, 1916

*Type host.*—*Vampyrops lineatus.*

*Site of infection.*—Extracellular blood parasite.

*Type locality.*—Venezuela.

*Other records.*—None to date.

*Remarks.*—Since this species was originally described, it has been mentioned on only three occasions in the literature. The first was a rather scathing review by one of the editors of Tropical Disease Bulletin (W. Y., 1917) and the other two times (Zeledón and Viento, 1958; Marinkelle, 1968b) the authors considered
this form too T. cruzi-like to merit its own specific status. The validity of this species is, therefore, questionable. [Vamptrops lineatus is not known to occur in Venezuela, and the identification of the host is probably erroneous. Eds.]

Trypanosoma pessoi Deane and Sugay, 1963

In Venezuela, Dias and Pifano (1941) isolated a megaderma-type trypanosome (from Myotis nigricans) for the first time in the New World as these forms were previously known only from bats in Africa. Since then, several large unnamed trypanosomes of the megaderma group have been reported from phyllostomatids in the Western Hemisphere (Table 1), but only Deane and Sugay (1963), Esquival et al. (1967), and Marinkelle and Duarte (1968) described and pictured these parasites. Since its original description, this species has been reported in several species of phyllostomatids (Deane, 1964a; Esquival et al., 1967). Trypanosoma pessoi differs from the vespertilionis group (particularly T. cruzi) not only in size, but also because xenodiagnosis, hemacultures, laboratory animals, and tissue sections and smears are always negative for other developmental stages (for example, amastigote forms) of the parasite.

Trypanosoma phyllostomae Cartaya, 1910

Type host.—Carollia perspicillata.

Site of infection.—Extracellular blood parasites.

Type locality.—Cuba.

Other records.—See Table 1.

Remarks.—Most of those who work with bat trypanosomes believe this species to be too T. cruzi-like to distinguish it as a separate species (see Table 1).

Trypanosoma pifanoi Markinelle and Duarte, 1968

Type hosts.—Artibeus lituratus and Phyllostomus hastatus.

Site of infection.—Extracellular blood parasite.

Type localities.—Tibú and Tolima, Colombia.

Other records.—None to date.

Remarks.—This is only the second species of the megaderma group to be found in the Americas. Like Trypanosoma pessoi, developmental stages of this species could not be isolated in tissue sections of inoculated laboratory mice nor was multiplication observed in tissue cultures of mouse fibroblast cells or in the triatomid Rhodnius prolixus by xenodiagnosis (Marinkelle and Duarte, 1968). Attempted transmission of this species to Carollia perspicillata was unsuccessful, but blood forms isolated from a specimen of Artibeus lituratus were grown in NNN culture media and these culture forms closely resembled the blood and culture forms of Trypanosoma cruzi. Also, when 5000 NNN culture forms were inoculated intracoelomically into three species of triatomids, the parasite (when compared with control T. cruzi-inoculated bugs) proved highly fatal for the insects. Only three of 264 triatomids so inoculated lived for four weeks postinoculation (PI) and at 30 days PI their hemolymph had numerous, long, slender,
Trypanosoma rangeli-like epimastigote forms (Marinkelle and Duarte, 1968). This species differs from T. pessoai in size and by the absence of a twist of the posterior of the body.

Trypanosoma rangeli-like

Remarks.—Only Marinkelle (1966b) has reported what he called T. rangeli-like trypomastigote forms from American phyllostomatids. He found three bats (Table 1) harboring such parasites, and xenodiagnosis with the triatomids R. prolixus and Cavernicola pilosa showed abundant development of epimastigote stages of this parasite in the rectal ampulla of the bugs. Neither anterior station development nor signs of hemolymph infection took place and attempts to infect laboratory mice with these forms were unsuccessful.

Trypanosoma vespertilionis Battaglia, 1904

Type host.—Pipistrellus sp.
Site of infection.—Extracellular blood parasite.
Type locality.—Italy.
Other records.—See Table 1.

Remarks.—Since the original description of this parasite from vespertilionid bats in Europe, it has been observed on several occasions in bats of the Americas (for example, Deane, 1961), but few reports exist of its occurrence in phyllostomatids (Table 1). This species can easily be distinguished from others within the vespertilionis group by its small size (14 to 16 microns), its large nuclear index (2.6 to 2.7), and its apparent inability to infect laboratory animals or triatomid bugs.

Trypanosoma spp.

Remarks.—Unidentified forms of trypanosomes have been found in phyllostomatids on many occasions. In the majority of these records, the organisms seen were reported to belong to the megadermac group, but no illustrations of the parasite or structural data were provided (Table 1).

Phylum Acanthocephala

Family Oligacanthorhynchidae

Neoncicola novellae (Parona, 1890)

Type host.—Artibeus jamaicensis.
Site of infection.—Small intestine.
Type locality.—Puerto Rico.
Other records.—None to date.

Remarks.—The acanthocephalan fauna of tropical American bats is restricted to a single species described from A. jamaicensis collected in Puerto Rico. It has apparently not been recorded since its original description. Schmidt (1972a) included seven species in the genus, all with 30 proboscis hooks. These parasites
have been reported in Carnivora, Chiroptera, and ducks (?) in South America, Malaysia, USSR, Puerto Rico, and Africa.

The life cycle of *N. novellae* is unknown. In a related genus, *Prosthenorchis*, species such as *P. elegans* and *P. spirala* are reported to use cockroaches (*Blatella germanica*, *Rhyparobis madagascariensis*, and *Blabera fusca*) as well as beetles (*Lasioderma serricorne* and *Siegobium panicum*) as intermediate hosts. Presumably similar insects serve as intermediate hosts for *N. novellae*. If this is true, the host bat becomes infected by eating a cockroach or beetle containing an infective larva, the cystacanth. It should be emphasized that intermediate hosts listed above represent experiments based on captive animals; the intermediate hosts in nature are not known.

Pathology due to acanthocephalans, in general, is influenced by numerous factors including the size, shape, and armature of the proboscis, number of parasites present, general health of the host prior to infection, and ability of the host to overcome secondary infection by pathogenic organisms (see Schmidt, 1972b). Inasmuch as the effect of *N. novellae* is unknown in *Arirbius*, a general discussion of pathology, diagnosis, treatment, and control of related species is not included here (see Schmidt, 1972b).

**Phylum Pentastomida**

**Family Porocephalidae**

**Porocephalus crotali** (Humboldt, 1808)

*Type host.*—*Crotalus durissus.*

*Site of infection.*—Body cavity.

*Type locality.*—Unable to locate.

*Other records.*—See below.

*Remarks.*—Members of the phylum Pentastomida, often referred to as tongue worms, are of uncertain systematic position, although evidence is accumulating that they are related to the brachiuran crustaceans. The genus *Porocephalus* is among the most highly evolved of the pentastomes. All species parasitize snakes as adults, and most may utilize a mammal in their development as does *P. crotali*, the only species recorded from bats (Sef, 1969).

*Porocephalus crotali* occurs as an adult in various species of snakes, and has been reported as nymphs encysted in the liver of *Phyllostomus discolor* from Cumaná, Venezuela, and Brazil (see Penn, 1942; Sambon, 1922; Shipley, 1898).

The life cycle of *P. crotali* has been studied intensively by Esslinger (1962a, 1962b, 1962c). Adult bats probably can be infected by ingesting eggs that contaminate food. From experiments with albino rats, it is known that the larvae hatch in the intestine and migrate through the wall into the viscera and mesenteries, leaving a trail of host neutrophils. After reaching the liver or other organs, they molt and eventually form sixth stage nymphs that show marked sexual differentiation. Development of the sixth stage nymph is completed in three months and it is then infective to the snake definitive host. Infection occurs by ingestion of the infected bat host, which may be a more common occurrence than previously suspected (Gillette and Kimbrough, 1970).
Pathology of pentastomes to their bat hosts probably is related directly to the development of the two pairs of hooks on the head. During metamorphosis to the sixth stage nymph, the adult hooks develop from papillae representing the atrophied appendages of the primary larvae. The median and lateral hooks project and have blades that extend above the surface of the head and serve to anchor the nymph to the tissue. As seen in Fig. 1, the lateral hooks project conspicuously from the surface and undoubtedly cause the primary destruction of host tissue. As the parasite develops in the liver, and in probable response to the hooks, a granulomatous lesion forms. At least four distinctive progressions of the disease can be determined: an initial macrophage proliferation with eosinophils, epithelioid, and giant cells accumulating in the area of the lesion lasting about three weeks; clonic development with involvement of fibroblastic tissue, plasma cells, and lymphocytes during the second and third months; reduction in inflammation during the fourth month; and production of a dense hyaline fibrous capsule by the sixth month. Again, it must be emphasized that the life cycle and pathology as determined by Esslinger (1962a, 1962b, 1962c) did not employ bats. *Poroccephalus crocuti* is also recorded in man (Stiles and Nolan, 1931).

**Phylum Platyhelminthes**  
Class *Trematoda*  
Family *Acanthocephalidae*

**Anenterotrema auritum** Stunkard, 1938

- **Type host.** *Micronycteris megalotis.*  
- **Site of infection.** Small intestine.  
- **Type locality.** Cueva de Xmahit Tekax, Xconsacab, Tiximin, Yucatán, México.

**Anenterotrema eduardocaballeroi** (Freitas, 1960)

- **Type host.** *Eumops glaucinus.*  
- **Site of infection.** Small intestine.  
- **Type locality.** São Paulo, Brazil.  
- **Other records.** Travassos *et al.*, (1969) gave the following host records from Brazil: *Molossus rufus, M. major crassicaudatus*, and *Phyllostomus elongatus.*

**Anenterotrema freitasi** Caballero y Caballero, 1964

- **Type host.** *Micronycteris hirsuta.*  
- **Site of infection.** Small intestine.  
- **Type locality.** Costa Rica.

**Anenterotrema liliputianum** (Travassos, 1928)

- **Type host.** *Peropteryx canina.*  
- **Site of infection.** Small intestine.  
- **Type locality.** Angra dos Reis, Brazil.
Anenterotrema stunkardi Caballero y Caballero and Grocott, 1960

Type host.—Phyllostomus hastatus.
Site of infection.—Small intestine.
Type locality.—Panamá.

Remarks.—All known species of Anenterotrema have been found in the small intestine of their hosts. Members of this genus are unique because, unlike most digenetic trematodes, they lack a digestive tract. This evolutionary structural modification most certainly restricts their habitat selection in modern day hosts. Yamaguti (1969) examined histologically the parenchymal cells of A. euritum and later (1971) stated that the nuclei of these cells were involved in nutritional activity. No glandular-secretory cell types have ever been reported (Yamaguti, 1969).

Although five of the six species of Anenterotrema occur in phyllostomatid bats, they are not specific. Anenterotrema freitasi and A. stunkardi are both recorded from a single host species and are known only from the original descr-
tions. It is probable that additional collections will indicate a general lack of host specificity.

The biology of this genus is completely unknown. Inasmuch as these trematodes are so unusual morphologically, additional studies are needed.

Family Dicrocoeliidae

**Athesmia parkeri** Perez-Vigueras, 1942

*Type host.*—*Artibeus jamaicensis.*

*Site of infection.*—Small intestine.

*Type locality.*—Province Pinar del Río, Cuba.

*Remarks.*—The species is recorded only from the type host in the original description. Teixera de Freitas (1962) considered this species conspecific with *A. heterolecithodes* (Braun, 1899) Looss, 1899, common in the bile duct of a variety of birds. The only other species in mammals, *A. foxi* Goldberger and Crane, 1911, occurs in primates. The ecology, pathology, and life cycle of *A. parkeri* are unknown.

**Parametadelphis compactus** Travassos, 1955

*Type host.*—*Microcyneteris benni.*

*Site of infection.*—Bile duct and bladder.

*Type locality.*—Cachimbo, Pará, Brazil.

*Remarks.*—This trematode has been reported only in the original description. Nothing is known of its biology.

Family Lecithodendrium

**Lecithodendrium pricei** Perez-Vigueras, 1940

*Type host.*—*Artibeus jamaicensis.*

*Site of infection.*—Small intestine.

*Type locality.*—Santa Maria del Rosario, Habana Province, Cuba.

*Remarks.*—Although the pathology and ecology are not known, Koga (1954) reported briefly on the life cycle of *Lecithodendrium lagenifoeme* (Ogata, 1947). Virgulate cercariae develop in an aquatic snail, *Semisulcospira libertina*, and encyst in *Stenostyche grissipennis*. Bats are infected by ingesting the metacercariae transmitted by the trichopteran second intermediate host. The genus *Lecithodendrium* contains numerous species occurring in bats and chameleons. At least 19 species occur in bats but all species except *L. pricei* are found in bats from Eurasia.

**Limatulum aberrans** Caballero y Caballero and Bravo Hollis, 1950

*Type host.*—*Macrotus waterhousii.*

*Site of infection.*—Intestine.

*Type locality.*—Cuicatlán, Oaxaca, México.

*Other records.*—Nicaragua: *Phyllostomus discolor* (KU 97445) collected at Hacienda San Isidro, 10 km. S Chinandega, 10 m. (TEL 480).
Limatulum isthmicus Caballero y Caballero, 1964

_Type host._—Mierycteris hirsuta.
_Site of infection._—Small intestine.
_Type locality._—Costa Rica.

Limatulum oklahomense Macy, 1931

_Type host._—Tadarida brasiliensis.
_Site of infection._—Small intestine.
_Type locality._—Aetna, Kansas, and Freedom, Oklahoma.
_Other records._—Mexico: _Macrotus waterhousii_, Cuicatlán, Oaxaca; _Natalus mexicanus_, Acotman (Caballero y Caballero and Bravo Hollis, 1950); Paraguay: _Myotis nigricans_, Chaco, (Lent et al., 1945); United States of America: _Myotis grisescens_, Kansas (Ubelaker, 1966).

Remarks.—_Limatulum aberrans_ and _L. isthmicus_ apparently are restricted to phyllostomatid bats. Additional records are needed, however, before specificity can be established. Seven species occur in the genus and all except _L. okabei_ (Koga, 1954) Yamaguti, 1958, occur in New World bats. The ecology of this genus is unknown.

Family Urot remotidae

Urotrama scabridum Braun, 1900

_Type host._—Molossus major crassicaudatus.
_Site of infection._—Small intestine.
_Type locality._—Brazil.
_Other hosts._—Noctilio leporinus, _N. labialis_, Molossus ater, Promops centralis, Phyllostomus hastatus, Lasiurus intermedius, Myotis nigricans, Phyllostomus sp.; also in numerous bats in North America as reviewed by Webster (1973) and Caballero y Caballero (1960). Webster (1971) reported that Peronotus macleayii and Tadarida brasiliensis from Jamaica were also hosts to this parasite.

Remarks.—Caballero y Caballero (1942) reviewed the systematics of this genus and concluded that the following species are synonyms of _U. scabridum_: _U. lasiurense_ Alicata, 1932 (see also Chandler, 1938), _U. minutum_ Macy, 1933, and _U. shillingeri_ Price, 1931. Keys to this complex of species were presented by Macy (1933). Caballero y Caballero (1942) further considered _Urot remotum_ Macy, 1933 synonymous with _U. scabridum_ and Caballero y Caballero and Grocott, (1960) considered _U. aelleni_ Baer, 1957, parasitic in _Pipistrellus nasus_ Cote D’Ivoire as synonymous with _U. scabridum_. Inasmuch as body shape, a more posterior position of the ovary from the acetabulum, lobed testes, and vitellaria that begin posterior to the acetabulum are all specific characters, it is doubtful that _Urot remotum_ is distinct. It is more reasonable to consider this species as _Urotrema attenuatum_ (Macy, 1933) Caballero y Caballero, 1942, and distinct from _U. scabridum_.

Biology of the Phyllostomatidae
Class Cestoda

Family Anoplocephalidae

**Oochoristica immatura** Arandas Rego, 1963

*Type host.*—*Glossophaga soricina.*

*Site of infection.*—Small intestine.

*Type locality.*—Brazil.

*Remarks.*—*Oochoristica immatura* was assigned originally to the genus *Mathevetoaen* by Arandas Rego (1963). However, Della Santa’s (1956) synonymy of this genus with *Oochoristica* appears valid (see Flores-Barreto et al., 1958, and Prudhoe and Manger, 1969).


Family Hymenolepididae

**Vampirolepis elongatus** Arandas Rego, 1962

*Type hosts and localities.*—*Glossophaga soricina,* Rio de Janeiro, state of Guanabara; *Phyllostomus hastatus,* Conceição da Barra, state of Espírito Santo; *Molossus ater,* Tingua e São Goncalo, state of Rio de Janeiro, Brazil.

*Site of infection.*—Small intestine.

*Other records.*—*Glossophaga soricina:* MEXICO: Chiapas, Ruinas de Palenque, 300 m. (KU 102308); NICARAGUA: 3 km N Sabana Grande, 50 m. (KU 97589); Dariali, 5 km. N, 14 km. E Condega, 940 m. (KU 97533).

Specimens of *Artibeus lituratus* from Cali, Colombia (collected by M. E. Thomas) contained several cestodes of this species. The specimens differ slightly in some measurements and at the present time they are provisionally considered as *Vampirolepis elongatus.* Specimens from this latter collection have been deposited in the United States National Museum Helminthological Collections, Beltsville, Maryland.

*Remarks.*—*Vampirolepis elongatus* belongs to the subfamily Hymenolepidinae Perrier, 1897, and represents one of 27 species in the subfamily recorded from bats. Five species of *Vampirolepis* are known from the Western Hemisphere: *V. chiropterophila* Perez-Vigueras, 1941, in *Molossus tropidorhynchus* from Cuba; *V. decipiens* (Dising, 1850) in *Pteronotus rubiginosa,* and *Eumops pereotis* from Brazil; *V. chistensoni* (Macy, 1931) in *Myotis lucifugus* and other bats in North America; *V. gertschi* (Macy, 1947) in *Myotis californicus* from North America and *V. roulabushi* (Macy and Rausch, 1946) in various bats in North America. An excellent review of host records of *Vampirolepis* spp. from North American bats is available (Webster, 1973).

*Vampirolepis elongatus* is most closely related to *V. chiropterophila* but differs principally in measurements of the rostellum and eggs. *Vampirolepis elongatus* is potentially dangerous to its hosts for the rostellum interrupts the integrity of the intestinal epithelium and may produce ulcerous conditions in infected animals.
The surface of *Vampirolepis elongatus* is clearly similar to other hymenolepidid cestodes in that it is cellular and covered with a dense microvillar surface that presumably aids in the absorption of available nutrients from the host (see Ubelaker et al., 1973). Examination of the strobila by scanning electron microscopy reveals that even the terminal proglottids (filled with eggs) are covered by a dense absorptive surface (Fig. 2). As groups of proglottids become gravid, they detach and are passed out with the feces. Although intermediate hosts
of other hymenolepidiid cestodes involve various insects, the life cycles of all *Vampirolepis* are unknown. Kochseder (1969) suggested that *Hymenolepis grisea* (van Beneden, 1873) had a higher incidence in younger animals (*Myotis myotis*, *M. emarginatus*, *Rhinolophus ferrumequinum*, and *Barbastella barbastellus*) than older ones.

**Phylum NEMATODA**

**Family Dipetalonematidae**

**Litomosoides artibeii** Esslinger, 1973

*Type host.*—*Artibeus cinereus.*  
*Site of infection.*—Thoracic or abdominal cavity.  
*Type locality.*—Vicinity of Buenaventura, Valle, Colombia.

**Litomosoides brasiensis** Lins de Almeida, 1936

*Type host.*—*Myotis* sp.  
*Site of infection.*—Thoracic or abdominal cavity.  
*Type locality.*—Brazil.  
*Synonymy.*—Esslinger (1973) synonymized the following species with *L. brasiensis*: *L. carolliae* Caballero y Caballero, 1944, and *L. caballeroi* Garcia-Rodrigo, 1954.

*Other records.*—The following are those listed by Esslinger, 1973: *Carollia perspicillata* in Brazil (Sandground, 1934), Mexico and Panamá (Caballero y Caballero, 1944), Costa Rica (Jimenez-Quiros and Arroyo, 1960), Venezuela (Garcia-Rodrigo, 1959; Diaz-Ungria, 1963), and Colombia (Esslinger, 1973); “*Carollia subflavus*” in Colombia (Martin, 1969, personal communication); *Glossophaga* sp. in Brazil (Arandas Rego, 1961a); *Glossophaga soricina* in Brazil (Arandas Rego, 1961a); *Phyllostomus* sp. in Venezuela (Diaz-Ungria, 1963); and an unidentified phyllostomatid bat in Brazil (Arandas Rego, 1961a).

*Remarks.*—*Filaria spiculatum* was poorly described from specimens of “*Phyllostoma*” sp., *Carollia perspicillata*, and *Sturnira lilium* in Brazil (Molin, 1858). Although positive identification cannot be determined until the original specimens are reexamined, they are probably *Litomosoides brasiensis*.

**Litomosoides caliensis** Esslinger, 1973

*Type host.*—*Sturnira lilium.*  
*Site of infection.*—Unknown, microfilariae in blood.  
*Type locality.*—Vicinity of Cali, Valle, Colombia.  
*Other records.*—None to date.

**Litomosoides chandleri** Esslinger, 1973

*Type host.*—*Artibeus jamacicensis.*  
*Site of infection.*—Thoracic or abdominal cavity.  
*Type locality.*—Vicinity of Buenaventura, Valle, Colombia.  
*Other records.*—Vicinity of Cali, Valle, Colombia (Esslinger, 1973).
Litomosoides colombiensis Esslinger, 1973

_Type host._—_Vampyrops dorsalis._
_Site of infection._—Unknown.
_Type locality._—Vicinity of Buena Ventura, Valle, Colombia.
_Other records._—_Artibeus jamaicensis_ in the vicinity of the type locality also were found to be infected (Esslinger, 1973).

Litomosoides fosteri Caballero y Caballero, 1947

_Type host._—_Glossophaga soricina._
_Site of infection._—Thoracic or abdominal cavity.
_Type locality._—Panamá.
_Other records._—None to date.

Litomosoides guiterasi (Perez-Vigueras, 1934)

_Type host._—_Artibeus jamaicensis._
_Site of infection._—Body cavity.
_Type locality._—Santa Clara and La Havana, Cuba.
_Synonymy._—Esslinger (1973) listed the following synonymies: _Finlaynema guiterasi_ Perez-Vigueras, 1934; _L. hamletti_ Sandground, 1934; and _L. penai_ Jimenez-Quiros and Arroyo, 1960.
_Other records._—_Glossophaga soricina_ in Brazil (Sandground, 1934), in México (Chitwood, 1938) and in Colombia (Esslinger, 1973); _Glossophaga_ sp. in Brazil (Arandas Rego, 1961b); _Tadarida laticeps_ and _T. brasiliensis muscula_ in Cuba (Baruš and del Valle, 1967); and _Pteronotus parnellii_ in Jamaica (Webster, 1971). We recovered a single specimen of this species in _Glossophaga soricina_ (KU 102354) from Las Margaritas, 1500 m., Chiapas, México (DLK 358, 23 July 1965).

Litomosoides feontitavazqueziae Caballero y Caballero, 1939

_Type host._—_Macrotus waterhousii._
_Site of infection._—Body cavity.
_Type locality._—México.

Litomosoides tesli Esslinger, 1973

_Type host._—_Carollia perspicillata._
_Site of infection._—Thoracic or abdominal cavity.
_Type locality._—Vicinity of Buga, Valle, Colombia.
_Remarks._—Filarid nematodes of the genus _Litomosoides_ are common in leaf-nosed bats; of the 12 recognized species within this genus (Esslinger, 1973), nine are reported from phylllostomatids and the existing records seem to indicate that these parasites are relatively stenoxenous. Of the 10 species found in bats, seven are recorded from a single host species and another, _Litomosoides colombiensis_, is recorded from only two host genera, _Artibeus_ and _Vampyrops_. Only two species, _Litomosoides brasiliensis_ and _L. guiterasi_, have been recorded from
more than one family of bats. Although these adult filariids tend to be relatively host specific, a given bat may serve as the definitive host for several members of this genus, for example, *Arthimus jamaicensis* has been found to host *Litomosoides chandleri*, *L. colombiensis*, *L. guiterasi*, and *Litomosoides* sp. of Chitwood (1938).

The adult parasites occur in the body cavity of bats. Mature females give birth ovoviviparously to microfilariae, which migrate to the circulatory system and are picked up from the peripheral blood by mites that serve as the vector.

Unidentified microfilariae have been reported from numerous bats including *Carollia castanea*, *C. perspicillata*, *Glossophaga soricina*, *Phyllostomus* sp., and *P. hastatus*. Such microfilariae probably represent members of the genus *Litomosoides*, but no author prior to Esslinger (1973) has attempted to identify these nematodes on the basis of larval structures alone.

Family Trichostrongylidae

**Biacantha desmoda** Wolfgang, 1954

_Type host._ — *Desmodus rotundus*.

_Site of infection._ — Small intestine.

_Type locality._ — Trinidad, West Indies.

_Other records._ — We found this species in several *Desmodus rotundus* at La Pacifica, Costa Rica (DWD 166-LP-8, 168-LP-12, 169-LP-13, 170-LP-14, 176-LP-6, 12 July 1967), and it has also been reported from *D. rotundus* from Jalpa, Zacatecas, and San Bals, Mexico (Wolfgang, 1956).

_Remarks._ — Specimens of this species are identified easily by the two asymmetrically placed cephalic hooks (Fig. 3) and a series of longitudinal ridges that extend the entire length of the body (Fig. 4).

**Bidigiticauda vivipara** Chitwood, 1938

_Type host._ — *Arthimus jamaicensis*.

_Type locality._ — Punz Cave, Oskutzeab, Yucatán, México.

_Site of infection._ — Small intestine.

_Other records._ — *Arthimus jamaicensis* COSTA RICA: La Pacifica (DWD 162-LP-48, 12 July 1967) and the Osa Peninsula (DWD 253-OP-42, 28 July 1967); MEXICO: (KU 102469) Chiapas, Finca San Salvador, 17 km. SE San Clemente, 1000 m. (JDS no. 927, 4 August 1965); NICARAGUA: (KU 9779) 2 km. N Sabana Grande, 50 m. (JKJ no. 4559, 15 July 1964); (KU 97726) San Antonio, 15 m. (JKJ, 6 July 1964); (KU 97773) 14 km. S Boaco, 200 m. (JKJ no. 4569); (KU 97804) 11 km. S, 3 km. E Rivas, 50 m. (TEL, 24 July 1964); (KU 97785) Moyogaipa, NW end Isla de Ometepe, 40 m. (JDS, 31 July 1964); (KU 977130) Finca Tepeyac, 10.5 km. N, 9 km. E Matagalpa, 960 m. (TEL no. 591, 7 August 1964).

_Arthimus lituratus_ MEXICO: (KU 1025329) Chiapas, Ruinas de Palenque, 300 m. (JDS no. 721, 17 June 1965); (KU 192469) Chiapas, 4 km. NE Pichucaltoco, 100 m. (DLK no. 254, 30 June 1965).

_Remarks._ — The characteristic posterior extremity of this species is presented in Fig. 5, but the functional significance of the divided appendages is unknown.
Fig. 3.—Scanning electron photomicrograph of anterior end of *Biaenitha desmoda* from small intestine of *Desmodus rotundus* collected at La Párvica, Costa Rica. The irregular surface is an artifact resulting from alcohol fixation. Note platelike teeth in vestibule (arrow). (X 765)

Fig. 4.—Scanning electron photomicrograph of body surface of *Biaenitha desmoda*. Ridges (arrow) are raised above the general body surface. (X 1175)
Fig. 5.—Scanning electron photomicrograph of posterior end of body of Bidigiicada vivipara. (X 675)

Fig. 6.—Scanning electron photomicrograph of head of Bidigiicada vivipara. Papillae (arrow) and teeth in vestibule (clear arrow) are evident. (X 2840)
The cephalic characters, including the six cephalic papillae and the teeth in the vestibule, are also shown (Figs. 6, 7).

_Cheiropteronema globocephala_ Sandground, 1929

*Type host.—* *Artibeus jamaicensis.*

*Site of infection.—* Stomach.

*Type locality.—* Yucatán, México.

*Other records.—* *Artibeus jamaicensis:* **Costa Rica:** Osa Peninsula, Costa Rica (DWD 253-OP-42, 28 July 1967); **Mexico:** Ebizt Cave, Oxxutzcab Yucatán (Chitwood, 1938); (KU 1024620) Chiapas, 12 km W (Sabana de) San Quintín, 274 m. (JDS no. 849, 14 July 1965); (KU 102471) Chiapas, Finca San Salvador, 14 km SE San Clemente, 1000 m. (JDS no. 979, 4 August 1965); **Nicaragua:** (KU 97700) 2 km. N Sabana Grande, 50 m. (TEL no. 488, 15 July 1964); (KU 97730) San Antonio, 15 km. (TEL no. 435, 6 July 1964); (KU 97718) Hacienda San Isidro, 10 km. S Chinandega, 10 m. (JDS no. 482, 11 July 1964); (KU 97772) 14 km. S Boaco, 220 m. (CER no. 19, 18 July 1964).

*Artibeus litteratus:* **Mexico:** (KU 1025310) Chiapas, Ruinas de Palenque, 300 m. (DLKJ no. 396, 17 June 1965); (KU1025690) Chiapas, 4 km. NE Pichucalco, 100 m. (JDS no. 783, 2 July 1965); **Nicaragua:** (KU 97816) Daraiti, 5 km. N, 14 km. E Condega, 940 m. (TEL no. 361, 24 June 1964).
Artibeus phaeotis: COSTA RICA: Osa Peninsula (DWD 268-OP-48, 28 July 1967); MEXICO: (KU 102591) Chiapas, Ruinos de Palenque, 300 m. (JDS no. 740, 29 June 1965); NICARAGUA: (KU 97830) 11 km. S, 3 km. E Rivas, 50 m. (JKJ no. 457, 24 July 1964); (KU 97828) San Antonio, 15 m. (JKJ no. 4616, 7 July 1964).

Artibeus solitarius: MEXICO: (KU 102583) Chiapas, Finca San Salvador, 14 km. SE San Clemente, 1000 m (JDS no. 970, 7 August 1965).

Carollia perspicillata: COSTA RICA: Osa Peninsula (DWD 239-OP-01, 27 July 1967); NICARAGUA: (KU 976410) 6 km. E Moyagalpa, NW end Isla de Omotepe, 400 m. (TEL no. 612, 11 August 1964).

Remarks.—The original report of Chitwood (1938) is the only published record of this parasite. The records cited above represent new hosts and distributional records. There is no information on the biology or pathology of this species. The specimens found in Artibeus jamaicensis from Costa Rica (DWD 253-OP-42) were examined by scanning electron microscopy to confirm some aspects of the original description (Figs. 8, 9).

Glyptostonglyus collaris nomen nudum

Type host.—Macrotus californicus.
Site of infection.—Small intestine.
Type locality.—Southern California.

Remarks.—This parasite is listed by Voge (1956) as in the process of being described by Neilland. We can find no other published record.

Histiostrongylus coronatus Mo in, 1861

Type host.—Phyllostomus discolor.
Site of infection.—Small intestine.
Type locality.—Mato Grosso region, Brazil.

Other reports.—Phyllostomus discolor: MEXICO: (KU 102293) Chiapas, Finca San Salvador, 15 km. SE San Clemente, 1000 m. (JDS 934, 5 August 1965); NICARAGUA: (KU 97478) 3 km. N Sabana Grande, 50 m. (TEL no. 346, 21 June 1964); (KU 97425) Hacienda San Isidoro, 10 km. S Chinandega, 10 m. (TEL no. 466, 11 July 1964); (KU 97463) 14 km. S Boaco, 220 m. (LMH no. 2575, 18 July 1964); (KU 97484) 11 km. S, 3 km. E Rivas, 50 m. (TEL, 24 July 1964).

Phyllostomus hastatus: NICARAGUA: (KU 97478) 3 km. N Sabana Grande, 50 m. (TEL no. 346, 21 June 1964); (KU 97416) Darrai, 5 km. N. 14 km. E Condega, 940 m. (JKJ no. 4463).

Phylonycteris poeyi: CUBA: Jamaica, near Habana (Perez-Vigueras, 1941); the cave of William Palmer, Guanajay, Pinar del Rio (Baruš and del Valle, 1967).

This species also was reported from the stomach and small intestine of Pteronotus fuliginosus torrei taken at San José del Lago, Mayajigua, Las Villas Province, Cuba (Baruš and del Valle, 1967).

Histiostrongylus octacanthus Lent and Freitas, 1940

Type host.—Phyllostomus hastatus.
Fig. 8.—Scanning electron photomicrograph of *Cheirapteronema globocephala* from *Arthroleptus lituratus* from Nicaragua. Cephalic collar (clear circle) is collapsed. Lateral papillae (arrow) are prominent. (× 2890)

Fig. 9.—Scanning electron photomicrograph of *Cheirapteronema globocephala*. Higher magnification of head showing mouth opening. (× 2940)
Site of infection.—Small intestine.

Type locality.—Fazenda Bento, state of Rio de Janeiro and Campo Grande, Mato Grosso, Brazil.

Other records.—Phyllostomus hastatus: Nicaragua: (KU 97418) Daraili, 5 km. N, 14 km. E Condega, 940 m. (TEL no. 396, 25 June 1964); (KU 97416) same location (KJ no. 4463, 23 June 1964).

Artibeus jamaicensis: Nicaragua: (KU 97800) 11 km. S, 3 km. E Rivas, 50 m. (CER no. 41, 24 July 1964).

Remarks.—Based primarily on the shape of the spicules, Perez-Vigueras (1941a) renamed H. octacanthus as the type of a genus, Parahistiostrongylus. Yamaguti (1961) and Baruš and Rysavy (1971) did not accept the new genus based on spicule characteristics, and we consider it as a member of the genus Histiostrongylus.

Records obtained from the Index Catalogue of Medical and Veterinary Zoology at Beltsville, Maryland included a report of H. paradoxus Travassos, 1918, from P. spiculatum as referenced by Travassos, 1920. We have not verified this report.

Torrestrongylus torrei Perez-Vigueras

Type host.—Macrotus waterhousii.

Site of infection.—Small intestine.

Type locality.—Cueva del Rincon de Guanabo, Habana Province, Cuba.

Other records.—This species has also been reported by Baruš and del Valle (1967) in Pieromotus macleayii from Caba San José del Lago, Mayajigua, Las Villas Provence, Cuba.

Tricholeiperia leiperi Travassos, 1937

Type host.—Trachops cirrhosus.

Site of infection.—Small intestine.

Type locality.—Brazil.

Other reports.—Caballero y Caballere (1951) also reported this species in T. cirrhosus from Mexico (in Index Catalogue, USDA, Beltsville, Maryland, not verified).

Unidentified strongylid nematodes

Host.—Glossophaga soricina.

Site of infection.—In embryo.

Type locality.—Arapuá in eastern Mato Grosso, Brazil.

Remarks.—Hamlett (1934) identified these nematodes only as being hookworms. These specimens undoubtedly belong to the family Trichostrongylidae, but without a reexamination of Hamlett’s specimens, no further conclusions can be made.
Family Trichuridae

Capillaria sp.

*Type host.*—*Micronycteris megalotis.*
*Site of infection.*—Small intestine.
*Type locality.*—Yucatán, México.

Capillaria cubana Teixera de Freitas and Lent, 1937

*Type host.*—*Aribeus jamaicensis.*
*Site of infection.*—Stomach.
*Type locality.*—Santa Clara, Habana, Cuba.

*Other reports.*—Baruš and del Valle (1967) reported this species in *Molossus major tropidorhynchus* collected at Santiago, Cuba.

Capillaria phyllonycteris Baruš and del Valle, 1967

*Type host.*—*Phyllonycteris poeyi.*
*Site of infection.*—Intestine.
*Type locality.*—The cave of William Palmer, Guanajay, Cuba.

Capillaria pintoi Teixera de Freitas, 1934

*Type host.*—Unidentified bat.
*Site of infection.*—Intestine.
*Type locality.*—Brazil.

*Other records.*—This species may occur in phyllostomatid bats.

Capillaria pusilla Travassos, 1914

*Type host.*—*Stenira lilium.*
*Site of infection.*—Intestine.
*Type locality.*—Manguinhos, Rio de Janeiro, Brazil.

*Other records.*—None to date, but Teixera de Freitas (1934) redescribed the species based on the type specimens from the Instituto of Oswaldo Cruz, Brazil.

Capillaria viguersi Teixera de Freitas and Lent, 1937

*Type host.*—*Macrotus waterhousii.*
*Site of infection.*—Small intestine.
*Type locality.*—Rincón de Guanabo, Cuba.

*Other records.*—None to date.

*Remarks.*—The capillarid complex is difficult to assess. Descriptions are frequently based on few specimens. Until more information is available on species variation, the above species in bats are considered valid.
DISCUSSION

The early studies of von Ihering (1891) on the specificity of a parasite species, or complex of related species, in a particular taxa of hosts has suggested to many authors that parasites can possibly indicate phylogenetic relationships and geographic distribution of hosts. As much as concepts are often based only on collection records, the use of parasites as evolutionary tags should be used with appropriate caution. In this context the comments of Mayr (1957) are timely: “We are dealing here with something very basic, with the whole principle of phylogeny, with the principle of this study of parallel phylogeny, and we must be awfully sure of these tools we use, that we do not misuse them, and we must, at all times, allow for an occasional transfer of parasites, and we must allow for different rates of evolution, and we must realize that the comparative anatomy is something more reliable. Two kinds can exchange their parasites, nothing prevents this, but I have not yet seen two kinds exchanging their heads, their wings or their legs. These have come down from its ancestors and not from another kind that nested in a hole right next to it.”

In bats, ectoparasitic arthropods have received the greatest attention in examining phylogenetic information based on host-parasite relationships. In the phyllostomatid bats under consideration here, ecological factors are of paramount concern, especially when two or more host species come into close physical proximity either in roosting together or in occupying the same site at different times of the year (Wenzel and Tipton, 1966).

Among ectoparasitic arthropods, the wing mites of the family Spinturnicidae (Acarina, Mesostigmata) have attracted the most attention because most members show modified life cycles with reduced nymphal stages and the development of ovoviviparity (Baer, 1951; Rudnick, 1960). Although much has been written on this complex of mites, the works of Machado-Allison (1965, 1967), Radovsky (1967), and Dusabek (1967, 1969a, 1969b) are important references concerning the parallel course of evolution of bats and their ectoparasites (also see Webb and Loomis, this volume).

Bat flies of the family Streblidae are reported to suggest interesting relationships, but these ectoparasites are not as host specific as are the spinturnicids (Wenzel et al., 1966).

Although Metcalf (1929) was among the earliest to point out the aid of protozoan parasites in problems of taxonomy, geographical distribution, and paleogeography of host species, protozoa have been studied little in bats. In particular, some species of Eimeria are so markedly host specific that Doran (1953) demonstrated that E. mohavensis was restricted to the kangaroo rat, Dipodomys panamintinus, but not found in D. merriami even though both rats occupied the same geographical area and presumably have similar feeding habits. Inasmuch as collections of coccidians are so easy to obtain under field conditions (oocysts are found in fecal material), it is surprising that only three species are recorded from bats in the Western Hemisphere.

The haemoflagellates of bats have been rather extensively investigated, though, perhaps, they are still not well understood. The study of blood sporozoans (for
example, malarial parasites) of phyllostomatids, however, is an area about which virtually nothing is known. Again, such organisms are also easy to obtain under field conditions.

Only a single adult acanthocephalan is recorded from phyllostomatid bats. Inasmuch as that parasite is known only from the original report, it is difficult to determine any degree of host specificity. The genus *Neoncicola* possesses species widely distributed in carnivores. Baruš (1973) reported an acanthella of *Pachiaccess* sp. in the body cavity of *Taphozous nudiventris* and an acanthella of *Moniliformis* sp. in the body cavity of *Otonycteris hemprichi* from Egypt. Baruš suggested that bats exhibit reservoir parasitism of an active accumulating type. Whether or not this is true for acanthocephala cannot be ascertained until additional reports are available.

The remarks concerning the acanthocephala are also generally true for the pentastomids. If the few available reports are indicative, reservoir parasitism is involved here also.

The potential value of trematodes as indicators of host phylogeny or zoogeography has been suggested by Szidat (1955, 1956a, 1956b) and effectively demonstrated in some hosts by Kabata (1963), Margolis (1965), and a number of other workers (see reviews by Kabata, 1963, and Cameron, 1964). Although trematodes are reasonably common in phyllostomatid bats, they generally lack specificity in these hosts.

The genus *Acentrotrema* seems to be mainly associated with the leaf-nosed bats with some members occurring in the Molossidae. There are no life cycles available for any trematode species in phyllostomatid bats. Until studies involving allometric growth (Martin, 1969) and individual variation are made and additional distribution records are available, this parasitic fauna will be of little use in examining host phylogeny. Because the various members of *Acentrotrema* lack a digestive tract, the establishment of this parasite as a laboratory model would allow important advances in the biology of trematodes, especially in nutrition.

Only a single species of cestode, *Vampirolepis elongatus* is of interest in light of this discussion, for it appears to be restricted to the Phyllostomidae except for a single report in *Molossus ater*. The numerous records from Brazil, Nicaragua, Colombia, and southern Mexico, suggest this organism is the major tapeworm of leaf-nosed bats. Inasmuch as this organism is not rare in occurrence, studies on life cycle, pathology, and so forth may be feasible. In the only life cycle known of tapeworms in bats, Kochseder (1969) recovered cysticercoids within the intestinal mucosa suggesting auto-Infection of *Hymenolepis grisea*, perhaps similar to that of *H. nana*.

Ingilis (1965) examined patterns of evolution in nematodes. According to this author, generally, parasitic nematodes are not host specific but they tend to occur in animals with similar feeding and ecological habitats. Baruš and Rysavy (1971) evaluated morphological relationships, specificity, and geographical distribution of trichostrongyloid nematodes in their respective bat hosts. Their results suggested to them that phylogenetical development of these parasites and hosts proceeded along parallel lines. Because more information is available concerning these nematodes they are reanalyzed here.
The first morphological group of nematodes listed by Baruš and Rysavy (1971) included the genera Strongylacanthia and Biacanthia; the former species occurring in Rhinolophidae, the latter species occurring in Desmodus and Natalus. We prefer to consider Biacanthia as belonging to the second group for reasons presented below. Because of morphological features exhibited by Strongylacanthia, this genus is the most primitive. Dougherty (1951) and Chaubaud (1965a, 1965b, 1965c, 1965d) present arguments that the trichostrongylids evolved from primitive strongylids and the placing of Strongylacanthia in the Ancylostomatidae reflects this relationship. Both seem to have existed before the Paleocene (Patterson, 1957) and perhaps split as early as the Eocene. It is tempting to suggest that the origin of trichostrongylids of bats occurred in Eocene times in the Megachiroptera. Subsequently, and probably closely correlated with the origin and radiation of the Microchiroptera, these nematodes gave rise to the second group of nematodes described below.

The second group of nematodes according to Baruš and Rysavy (1971), included the genera Spinostrogylus, Histiostrongylus, Neohistiostrongylus, and provisionally Cheiroperonema. This complex (excluding Choeperonema) is characterized principally in having a reduced cephalic vesicle, sclerotized spine-like hooks on the head, and a general conical tail, usually with spines.

The genus Biacanthia is known only from the Neotropical region with B. desmodi recorded from Desmodus rotundus from Mexico, Costa Rica, and Trinidad. A second species, B. silvae, is recorded from Natalus lepidus from Cuba.

The distribution of species of Histiostrongylus from Phyllostomus, Phyllonycteris, and Pteronotus argues that the latter and its relatives should be reexamined as possible members of the phyllostomatid complex of bats. The other genera in the second group, Neohistiostrongylus and Spinostrogylus, occur in Old World bat hosts.

The remaining genera of bat nematodes show little specificity. Although several species are recorded from only a single host species, additional records are badly needed before confidence can be placed on the degree of host specificity.

At present, it is impossible to make definitive conclusions on the evolution of any bat species by examining endoparasites. Such work shows promise, however, particularly in the nematodes where certain genera show relationships with the hosts: Cheiroperonema and Bidigiericauda with Artibeus; Histiostrongylus and Torrestrongylus with vespertilionids. Based on such relationships (however tenuous) Baruš and Rysavy (1971) speculated that the phyllostomatids served as a stem host group for development of the trichostrongylids of New World bats.

Phyllostomatid bats are similar to other groups of Chiroptera in serving as intermediate, reservoir, or definitive hosts. Their role as intermediate hosts is minimal. Although Porocephalus crotali functions as a larval parasite in Phyllostomus discolor and is later transmitted to the snake definitive host, it has not been reported in bats in the last 50 years.

According to the classification suggested by Odeng (1968), bats in general are "eurexeverse, stationary hosts." This classification would hold true for phyllostomatid bats also. Most endoparasites use phyllostomatid bats as definitive
hosts and not as transitory bioreceptor hosts as suggested for other groups of bats by Rysavy and Barus (1965), Barus and Tenora (1967), or Shults and Davydan (1955). Additional collections should clarify these relationships.

**Summary**

The endoparasites of phyllostomatid bats are reviewed for the first time. A historical review emphasizes the lack of systematic collections of parasites from this group of bats. The major parasitic groups reviewed include the Protozoa, Acanthocephala, Pentastomida, Trematoda, Cestoda, and Nematoda.

New host and distributional records are as follows (a single asterisk indicates that a parasite was known previously from a given host; double asterisks, known previously from a given locality): **Trematoda**: _Limagula aberrans_ in _Phyllostomus discolor_ from Nicaragua. **Cestoda**: _Vampyrolepis elongata_ in _Glossophaga soricina_ from Nicaragua and Mexico, and in _Artibeus lituratus_ from Colombia. **Nematoda**: _Bacanthera desmoda_ in _Desmodus rotundus*_ from Costa Rica; _Bidigiticauda vivipara_ in _Artibeus jamaicensis*_ from Costa Rica, Nicaragua, and Mexico, and in _Artibeus lituratus_ from Mexico; _Cheiroteronema globocephala_ in _Artibeus lituratus_ from Mexico** and Nicaragua, _Carollia perspicillata_ from Costa Rica and Nicaragua, _Artibeus jamaicensis*_ from Nicaragua and Costa Rica, _Artibeus phaeotis_ from Nicaragua, Costa Rica, and Mexico, and in _A. toltecus_ from Mexico; _Histiostrongylus coronatus_ in _Phyllostomus discolor_ from Mexico and Nicaragua, and in _Phyllostomus hastatus_ from Nicaragua; _H. ocellata_ in _Phyllostomus hastatus_ and in _Artibeus jamaicensis_ from Nicaragua; _Litomosoides brasiliensis_ in _Carollia subflavus_ from Colombia; _Litomosoides guitteras_ in _Glossophaga soricina_ from Mexico.

Scanning electron photomicrographs are presented for _Vampyrolepis elongata_, _Cheiroteronema globocephala_, _Bacanthera desmoda_, _Bidigiticauda vivipara_, and _Porocephalus crostalii_. _Porocephalus crostalii_ is reported from _Eptesicus fuscus_ for the first time.

**Addendum**

After the present review was submitted, several articles have been published, and others brought to our attention, which should be mentioned here. Marinkelle (1976) reviewed the biology of all bat trypanosomes and listed four subgenera, including 20 species, as occurring in these mammals. His first subgenus, _Megatrypanum_, included the large, broad forms listed in the _megadermae_ group of this review (_T. pessati_, _T. pifanoi_). He divided the smaller forms of the classical _vespertilionis_ group into two subgenera, _Schizotrypanum_ (_T. cruzi_, _T. cruzi-like_, _T. phyllostomae_, _T. vespertilionis_) and _Herpetosoma_ (_T. lineatus_). His fourth subgenus, _Trypanozoon_, included _T. evansi_. He emphasized, as did we, that the forms in the subgenus _Schizotrypanum_ are difficult to separate into defined species.

An excellent review of cestodes in the genus _Hymenolepis_ from bats in North America and Hawaii was written by Rausch (1975). This paper critically evaluated the taxonomic status of the hymenolepid cestodes and added a new
species, *H. lasionycteridis*, from eight species of bats in North America and Hawaii. Rausch (1975) also discussed briefly the zoogeography of cestodes of bats.

Chabaud and Bain (1974) described a new genus and species of muspiceid nematode, *Lukonema lukoschusi*, from *Noctilio leporinus*, *Tonatia carrikeri*, *Carollia perspicillata*, *Desmodus rotundus*, *Saccapteryx leptura*, and *Eptesicus melanopterus* collected in Surinam and French Guiana. The biology, host-parasite relationship, and life-history of *L. lukoschusi* also are discussed in this paper.

Other papers that merit attention include those by Caballero-Deloya (1971), Durette-Desset and Chabaud (1975), and Chabaud and Durette-Desset (1975). The first paper redescribed *Bidigiicauda vivipara* collected from *Artibeus lituratus palmarum* in Guerrero, México. The latter two papers reviewed nematodes from European bats, analyzed the trichostrongyloid nematode fauna of bats, proposed a hypothesis for the origin of these nematodes, and indicated a possible phyletic relationship between the Tupaiidae and the Chiroptera.

Teixera de Freitas and Machado de Mendonca (1960, 1963) assigned several species of nematodes from bats to the genus *Parallitoschius*, but Durette-Desset and Chabaud (1975) considered *Parallitoschius* to be synonymous with *Allinoschius*. We have not been able to locate the original papers of Teixera de Freitas and Machado de Mendonca (1960, 1963) for confirmation.

ACKNOWLEDGMENTS

We wish to thank Dr. J. Knox Jones, Jr., for encouraging us to participate in this volume. Many of the parasite records were obtained by J. E. Ubelaker who participated with Dr. Jones in collections in Nicaragua in the summer of 1964 and southern México in 1965 under United States Army Research and Development Command, The University of Kansas, Contract DA 49 193 MD 2215. Specimens collected in Costa Rica were obtained when D. W. Duszynski was supported in part by an NSF-Ford Foundation summer fellowship in conjunction with the Organization for Tropical Studies and in part by Training Grant 5T1 AI 94-08 from the NIAID, NIH, United States Public Health Service.

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Thanks are also due to Mr. Maurice E. Thomas, Tulane University, New Orleans, for allowing us to examine specimens of cestodes from *Artibeus littatus* from Colombia. To the many additional collectors, contributors of specimens, and individuals who assisted in the identification, we are deeply grateful for their generous cooperation. Special thanks are due Dr. J. Teague Self, Department of Zoology, University of Oklahoma, Norman, and Ms. Lindy Andersen and Mr. John D. Kimbrough, Department of Biology, Southern Methodist University, Dallas. Drs. Edelberto J. Cabrera and Marke W. Talley, Department of Biology,
The University of New Mexico, were of invaluable aid in assisting with the translation of the Portuguese and Spanish literature.

LITERATURE CITED


### Appendix 1—Parasite-host records Species are arranged in alphabetical order, and experimental infections are indicated by an asterisk.

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- Anoploestes illipatanum
- Phyllodromia elongata
- Anoploestes iiifurcatum
- Phyllodromia hastatus

**Dicrocoeliidae**

- Arthrodriatia parkeri
- Arthrodriatia jamacensis
- Paramastigophorus compactus
- Mucronocystis behal

**Lecithodendriformes**

- Lecithodendron pricei
- Arthrodriatia jamacensis
- Limastylum aberans
- Macropus waterhousei
- Phyllodromia disolor
- Limastylum ithaeicus
- Mucronocystis hirsuta
- Limastylum oklahomensis
- Macropus waterhousei

**Urotrematidae**

- Urotremia scabridum
- Phyllodromia sp.
- Phyllodromia hastatus

**Cestoda**

- Anoplocephalidae
  - Ochotilobia imminuta
  - Glossophaga soricina

- Hymenolepidae
  - Vampirorhynchus elongatus
  - Arthrodriatia lituratus
  - Glossophaga soricina
  - Phyllodromia hastatus

**Nematoda**

- Dipetalonematidae
  - Litomosoides sp.
  - Arthrodriatia jamacensis
  - Glossophaga soricina
- Litomosoides arthrodriatia
  - Arthrodriatia lituratus
  - Vampyrurus doryalis
- Litomosoides brasilensis
  - Carollia perspicillata
  - Carollia subflavus
  - Glossophaga sp.
  - Glossophaga soricina
  - Phyllodromia sp.
- Litomosoides caliensis
  - Squamella litiun
- Litomosoides chandleri
  - Arthrodriatia jamacensis
  - Litomosoides colombiensis
  - Arthrodriatia jamacensis
  - Vampyrurus doryalis
  - Litomosoides fosteri
  - Glossophaga soricina
  - Litomosoides guatamalensis
  - Arthrodriatia jamacensis
  - Glossophaga sp.
  - Glossophaga soricina
  - Litomosoides leoninae
  - Macropus waterhousei
  - Litomosoides testi
  - Carollia perspicillata

- Filaridae
  - Filaria serpentina
  - Carollia perspicillata
  - Phyllodromia sp.
  - Sturnira litiun

- Trichostomylidae
  - Biacanthus desmoda
  - Desmodus rotundus
  - Didelphica vivipara
  - Arthrodriatia jamacensis
  - Arthrodriatia lituratus
  - Chiropterinema globiceps
  - Arthrodriatia jamacensis
  - Arthrodriatia lituratus
  - Arthrodriatia phaeotus
  - Arthrodriatia toltecus
  - Carollia perspicillata
  - Glyptostomylis collaris
  - Macropus californicus
  - Histiostomylus sp.
  - Phyllodromia hastatus
  - Histiostomylus cornutus
  - Phyllodromia sp.
  - Phyllodromia disolor
  - Phyllodromia hastatus
  - Histiostomylus octocantus
  - Arthrodriatia jamacensis
  - Phyllodromia hastatus
  - Torresstrongylus torrei
  - Macropus waterhousei
  - Tricholegeria leperei
  - Trachypus euripus
  - Unidentified strongylid nematodes
    - Glossophaga soricina

- Trichuridae
  - Capillaria sp.
  - Microcotylenchus megalotis
  - Capillaria cubana
  - Arthrodriatia jamacensis
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1 (Possibly a *lapins culmi* for *Capillos abrunius*. Eds.)
APPENDIX 2.—Host-parasite list. Taxa are arranged in alphabetical order, and experimental infections are indicated by an asterisk.

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Protozoa
Trypanosoma cruzi-like
Trypanosoma sp. (vesperilionis-type)
Lonchophylla thomasi
Protozoa
Trypanosoma cruzi-like
Macrotrix californicus
Nematoda
Glyptostrogyulus collaris
Macrostomatida
Nematoda
Capillaria siguiens
Lithosomoides koninulovzeae
Torrestrogyulus torrei
Protozoa
Trypanosoma vesperilionis
Trematoda
Lanistomum abercrombii
Lanistomum oklahomensis
Miomycteris belini
Trematoda
Paranectophylax compacnas
Miomycteris melolotis
Protozoa
T. cruzi-like
Nematoda
Capillaria sp.
Trematoda
Aneterotrema auritum
Miomycteris hirsuta
Trematoda
Aneterotrema frechasi
Lanistomum ishiumae
Mimon benetti
Protozoa
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Phyllomycter sp.
Nematoda
Capillaria phyllophylaxis
Histostrogyulus cornutus
Phylllostomus sp.
Nematoda
Filaria serpicatum
Lithosomoides brasilienis
Trematoda
Urocrema scabridum
Phylllostomus discolor
Nematoda
Histostrogyulus cornutus
Peniastomida
Porocephalus crotali
 Protozoa
Trypanosoma cruzi
Trypanosoma cruzi-like
Trematoda
Lanistomum abercrombii
Phylllostomus elongatus
Protozoa
Trypanosoma cruzi-like
Trematoda
Aneterotrema eduardoscabelleroi
Aneterotrema liliputianum
Phylllostomus hastatus
Cestoda
Vamiprolepis elongatus
Nematoda
Histostrogyulus cornutus
Histostrogyulus occidentalis
Histostrogyulus sp.
Protozoa
"piroplasma"
Trypanosoma cruzi
Trypanosoma cruzi-like
Trypanosoma cruzi
Trypanosoma pfasoi
Trypanosoma vesperilionis
Trematoda
Aneterotrema stunkardi
Urocrema scabridum
Stenira liophous
Nematoda
Capillaria picilia
Filaria serpicatum
Lithosomoides carinatus
Trichophylaxius cirrhatus
Nematoda
"Trichophylaxius"
Protozoa
Trypanosoma aequo.
Trypanosoma sp. (vesperilionis-type)
Urocrema bilobatum
Protozoa
Trypanosoma cruzi
Trypanosoma cruzi-like
Vampyrops dorsalis
Nematoda
Lithosomoides colombiensis
Vampyrops lineatus
Protozoa
Trypanosoma lineatus
Vampyrum spectrum
Protozoa
Trypanosoma cruzi-like

1 Possibly a lapsus calami for Ceratia subrufa. Eds.
ECTOPARASITES

JAMES P. WEBB, JR., AND RICHARD B. LOOMIS

Phyllostomatid bats harbor an assemblage of ectoparasites numbering more than 230 species that represent 15 families of acarines and two families of dipteran insects. Among all chiropteran families, only the vespertilionids, with 18 acarine and six insect families, have more parasites. Streblids account for the greatest number of species of any of the phyllostomatid-infesting groups, having 83, comprising 20 genera. The nycteribiids are represented by 13 species in the genus Basilica. The remainder consists of 150 species of mites and ticks presently recognized in 49 genera. We found no substantiated literature records of siphonapterans, anoplurans, cimicids, or polycatenids regularly associated with phyllostomatids, although fleas were listed as questionable parasites of Venezuelan phyllostomatids (Tipton and Machado-Allison, 1972), two species of Hesperoctenes (polycatenids) were mentioned (Hoffmann, 1972) from Glossophaga and Artibeus species, and H. funarius (Westwood) was reported (Maa, 1961) from Venezuelan Phyllostomus hastatus. In addition, Gerberg and Goble (1941) recorded two species of mallophagan lice from leaf-nosed bats, including Physconelloides (near galapogensis) recovered from a Panamanian Carollia perspicillata and thought by the authors to represent a possible bird-bat association. Geomydectes geomydis, which normally infest pocket gophers, was also mentioned from a Mexican Leptonycteris nivalis. Other insects, for example culicids, psychodids, and ceratopogonids, which may be associated with bats were not included in this review.

A comprehensive worldwide list of bats and their acarine parasites, including phyllostomatid-associated mites and ticks, was compiled by Anciaux de Faveaux (1971). Additional recent citations are listed under each family.

MACRONYSSIDAE Oudemans, 1936

Sixteen species of macronyssid mites comprising six genera have been described from phyllostomatid bats. Radfordiella Foaseca, Parichoronystus Radovsky, Macronyssoides Radovsky, and Chiroceetes Herrin and Radovsky are in the Macronyssus-group and are considered by Radovsky (1967) and Herrin and Radovsky (1974) to be the more primitive and closely aligned with the laelapine stock, whereas the Streatonyssus-group has more highly specialized representatives. Nycteronyssus desmodus Saunders and Yunker (1973), based on a single female from a Diaemus youngi, was considered by its authors as possibly of another dermanyssoid family.

Radovsky (1967:59) suggested that the macronyssids evolved from progenitors that closely resembled extant laelapids because certain features are common to Neolaelaps Hirst and Neolaelpas Womersley in the Laelapinae and to Bewesiella Domrow, Ichoronyssus Kolenaii, and Parichoronystus in the Macronyssidae. This relationship between the laelapines and macronyssids seems to suggest a relatively recent association with bats.
Parasitic development by an invading organism on a new host is one of diversification. *Parichoronyssus* and the others of this group apparently are now in the early phases of this process. A number of the *Radfordiella* species have adapted, as depicted by the protonymal stage, to a higher level of specialization. *Radfordiella monophylli*, *R. ricola*, and *R. anourea*, all described by Radovsky *et al.* (1971), are known only from protonyms found in the soft palate tissue of several phyllostomatid species. Each of these species may cause dental and peridental destruction in bats (Phillips; 1971; Phillips *et al.*, 1969; Radovsky *et al.*, 1971) and at least one bat, *Leptonycteris sanborni*, may have evolved certain tongue modifications that prohibit the establishment of mites in their mouths (Greenbaum and Phillips, 1974). In most other species, the protonyms and adults feed on skin tissues or blood while situated in the fur, rarely on the naked wing or patagial membranes. When compared with species of either *Macronyssoides* or *Parichoronyssus*, the occupation of the intraoral niche by three species of *Radfordiella* suggests a longer affiliation with phyllostomatids. Blood feeding may occur in *Macronyssoides* (Radovsky, 1967: 12), possibly accounting for its large number of host species as seen in *M. kochi*. Once adapted to hematophagy, the procurement of new hosts seems less difficult than in the case of adaptation to dermal histophagy, which involves exposure to a greater variation in nutritional and other components.

*Chirocectes* is represented by *C. lonchophylla* and is known from a single female specimen. Herrin and Radovsky (1974) included this species with subgroup C of the *Macronyssus*-group based on chaetological criteria. Other stages of the life cycle are unknown.

Although *Steatonyssus joaquinii* (Fonseca) has been recorded from *Glossiphaga soricina*, it probably is more commonly found on vesperilionids as demonstrated by its occurrence on *Myotis alsaceaens* from Paraguay (Radovsky, 1967) and numerous other records of *Steatonyssus* species from vesperilionids (Anciaux de Faveaux, 1971).

Bat macronyssids are probably in or near the bat roosts when not on the host. Mating, however, most likely occurs on the host. Only unembryonated eggs have been found (Radovsky, 1967: 13) in most species of *Macronyssus, Macronyssoides*, and *Radfordiella*; however, Radovsky (1967) postulated that ooviviparity may occur in some species of *Macronyssus*. Aside from morphological correlations and overlap of features of egg development, relationships may be drawn between hosts and geographic ranges of *Macronyssus* species and the phyllostomatid-parasitizing macronyssid genera. *Macronyssus* has a cosmopolitan distribution as do its primary vesperilionid hosts. One line probably provided the common origin of *Radfordiella, Chirocectes, Parichoronyssus, Macronyssoides*, and *Macronyssus*. Evidence for the rise of these genera from a *Macronyssus*-like progenitor may be seen in the relationship found today between Old World species of *Macronyssus* and Old World vesperilionid, rhinolophid, and hipposiderid bats. *Macronyssus granulosus* (Kolenati), *M. longimanus* (Kolenati), *M. rhinolophi* (Oudemans), and *M. coreanus* (Ah) all are found on vesperilionids and on rhinolophids or hipposiderids, or both. In the New World, remnants of *Macronyssus*-vesperilionid associations may still be found in the numerous reports of *M.*
crobyi (Ewing and Stover) on vespertilionids, especially species of *Myotis*. *Macronyssus jonesi* (White) is known from North American vespertilionids as is *M. unidens* Radovsky, which also has been recorded (Radovsky, 1967) from the phyllostomatid *Leptonycteris nivalis*.

Host specificity coupled with the adaptive strategies of certain macronyssids, for example, species of *Radfordiella*, on phyllostomatids suggests a long host association and a New World origin, possibly on vespertilionids.

**Spinturnicidae Oudemans, 1902**

Sixteen species of wing mites in one genus, *Periglischrus* Benoit, presently are recognized as parasites of phyllostomatids and are numerous and widespread from México and the Antilles to Paraguay.

*Cameronieta* was established as morphologically distinct from *Periglischrus* by Machado-Allison (1965) and its apparent host specificity on species of *Pteronotus* and *Mormoops* prompted Machado-Allison (1967) to suggest separate familial status for the mormoopids. Later, Smith (1972) separated mormoopids from phyllostomatids on the basis of various morphological criteria and referred to Machado-Allison’s (1967) statements about parasite-host relationships for additional support. An apparent parallel to the *Periglischrus-Cameronieta* divergence in the New World may be seen in two Old World genera, *Eyndhovenia* Rudnick (1960) monotypic with *E. euryalis* (Canestrini), is found principally on rhinolophids, whereas *Paraperiglischrus* Rudnick (1960) is known both from rhinolophids and hipposiderids.

*Spinturnicids* on both phyllostomatids and Old World rhinolophids and hipposiderids probably arose from a line common with that of *Spinurnix* Von Heyden. *Spinurnix* is nearly cosmopolitan, primarily on vespertilionids, especially species of *Myotis* and *Eptesicus*, genera common to both the Old and New World. Although not recorded from Neotropical leaf-nosed bats, at least two species of *Spinurnix* have been recorded from rhinolophids (Anciaux de Faveaux, 1971). An Old World origin for the spinturnicids seems to be suggested by the diversification of taxa and by the geographic and taxonomic ranges of their hosts. Dispersal of wing mites to the New World probably occurred on vespertilionids with subsequent infestation of phyllostomatids.

Additional information regarding the new taxa and parasite records from phyllostomatids may be found in Dusbabek, 1970; Dusbabek and Lukoschus, 1971b; Hoffmann et al., 1972; Kingston et al., 1971; Machado-Allison and Antequera, 1971; Tamsitt and Fox, 1970b; Whitaker and Easterla, 1975; and Whitaker and Wilson, 1974.

**Spelaehrynchidae Oudemans, 1902**

Originally described as a tick, *Spelaehyrnchus praecursor* Neumann served shortly thereafter as the type genus for the family Spelaehrynchidae. The original specimens have been searched for and are presumed lost (Fain et al., 1967). Considered for some time to be closely related to ixodids, later workers (Baker
and Wharton, 1952; Fain et al., 1967) have placed this group in the Mesostigmata. Two of the three known species are found only on phyllostomatids.

*Spelaecorhynchus praecursor* has been reported (Anciaux de Faveaux, 1971; Dusbabek, 1970; Hoffmann and de Barrera, 1970; Tamsitt and Fox, 1970b) from leaf-nosed species taken in Puerto Rico, Cuba, México, Dominican Republic, Colombia, and Venezuela. *Monophyllus redmeni* from Puerto Rico (Tamsitt and Fox, 1970b; Tamsitt and Valdivieso, 1970) is the only known host for *S. monophylli*. Fain et al. The species *S. chilonycteris* Fain et al. is based on a single female from *Pheronotus rubiginosus*, a mormoopid, taken in Guatemala (Fain et al., 1967). Two female specimens of *Spelaecorhynchus* species *incipetae sedis* also were mentioned by Fain et al. (1967) from Brazilian *Carollia brevicauda*.

Both *S. praecursor* and *S. monophylli* have been removed from the lower portion of the ear, often from the tragus, and usually embedded deep in the skin.

Only female spelaecorhynchids have been collected although larvae have been dissected from gravid females. Fain et al. (1967) postulated that the males of these mites are free-living nidicoles, although parthenogenesis also may be a possibility.

The origin of *Spelaecorhynchidae* may be from the laelapoids and the highly specialized features that make it distinguishable from extant relatives are described as fixation to its hosts (Fain et al., 1967). This restriction to the hosts may reflect an inability to adapt to new hosts and may account for the small numbers of spelaecorhynchids encountered today.

**Ixodidae** Murray, 1877

Two genera and two species of ixodid ticks have been reported from leaf-nosed bats in the New World.

*Amblyomma longirostre* (Koch) is known from a single nymphal record recovered from a Venezuelan *Artibeus lituratus* and also was listed (Jones et al., 1972) from a number of prehensile-tailed porcupines and a squirrel, *Sciurus granatensis* from Venezuela. In addition, Cooley and Kohls (1944) reported *A. longirostre* (as *A. avecolens* Cooley and Kohls) as occurring on birds from Texas, Belize (formerly British Honduras), and Panamá.

A single larva of *Ixodes downsi* (Kohls, 1957) was listed from *Anoura geoffroyi* and a male, female, and three nymphs were found crawling on a cave wall in Trinidad. As mentioned further by Kohls, this larval tick represented the first bat record for the genus *Ixodes* from the New World, but it is unknown whether *I. downsi* regularly parasitizes bats. Jones et al. (1972) subsequently have recorded a number of cases of *Ixodes* species from *Artibeus jamaicensis* and two species of *Stenura* from Venezuela.

Species of *Amblyomma* and *Ixodes* are generally not bat affiliates and the records from phyllostomatids probably represent accidental associations, although three species of *Ixodes* apparently are usual parasites of Old World leaf-nosed and vespertilionid species (Anciaux de Faveaux, 1971).
ARGASIDAE Canestrini, 1890

Nine species of *Ornithodoros* Koch and two species of *Antricola* Cooley and Kohls are the soft ticks presently known from phyllostomatid hosts. *Ornithodoros viggerasi* Cooley and Kohls has been placed in the subgenus *Subparimus* Clifford, Kohls, and Sonenshine; six species belong to the subgenus *Alectorobius* Pocock; and two species, *O. mimon* Kohls, Clifford, and Jones (1969) and *O. peruvianus* Kohls, Clifford, and Jones are unassigned to subgenus. Only a single larva of *O. mimon* has been recovered from a phyllostomatid, *Mimon crenulatum* from Bolivia, whereas 38 specimens were removed from a number of Uruguayan *Eptesicus brasiensis*. The larvae of *O. peruvianus* have been reported by Kohls et al. (1969) to resemble superficially *O. (Alectorobius) kellyi* Cooley and Kohls. The species *O. (A.) puertoricensis* Fox has been recovered from lizards, various mammals, including burrow dwellers, and a number of emballonurid, molossid, mormoopid, and noctilionid bats, and there is a questionable record (Jones et al., 1972) from a Venezuelan *Artibeus lituratus*.

Looking at host-parasite relationships, indications are that the members of the subgenus *Alectorobius* may have arisen from a line closely related to the Old World *Pavlovskyella*, as each subgenus parasitizes a wide variety of hosts such as reptiles, birds, and burrowing and nonburrowing mammals. The mode of distribution from the Old to the New World, where *Alectorobius* may have originated and radiated, is unclear, but avian or rodent hosts, or both, are suspect transporters. However, because members of both subgenera are found on birds, *O. (A.) capensis* Neumann, taken from marine birds that live in tropical and temperate regions world-wide, and *O. (A) denmarki* Kohls, Sonenshine, and Clifford, also from marine birds living on islands of Pacific and Caribbean waters, are of particular note. The possibility of the original migration of *Alectorobius* progenitors via a bat carrier common to both the Old and New Worlds seems remote, at least relative to present day distributional patterns of *Ornithodoros* species. Even though specimens of *Alectorobius* have been collected from vesperilionid, emballonurid, and molossid bats of the New World, only one record of this subgenus has been recorded (Anciaux de Faveaux, 1971) from any Old World representatives of these bat families.

Already adapted to feeding on a wide variety of mammalian hosts, invading species of the *Alectorobius* line adjusted to using bats, especially phyllostomats, as hosts. A number of mainland ticks developed as species limited to the phyllostomatid host type, then apparently spread to adjacent Caribbean islands, and then from island to island in the Antillean chain. An example of this is provided by *O. (A) aztec* Matheson, which has been reported from México, Panamá, Venezuela, and from the islands of Trinidad, Jamaica, and Cuba (Kohls et al., 1965; Anciaux de Faveaux, 1971; Jones et al., 1972).

*Ornithodoros* (*Subparimus*) *viggerasi* differs greatly from the other species of *Ornithodoros* (Clifford et al., 1964). However, its affinity for certain bats suggests an origin from the Antillean *Alectorobius* line, as *O. viggerasi* parasitizes Cuban *Phyllonycteris poeyi* and *Brachyphylla nana*, and Puerto Rican *Erophylla bombifrons* (Tamsitt and Fox, 1970b), all phyllostomatids. A strong
association with mormoopids is indicated by the records of O. viguerasi on Pteronotus from Cuba and Jamaica, and on Pteronotus and Mormoops from Trinidad. Furthermore, Pteronotus parnellii has yielded a number of these ticks in Panamá (Fairchild et al., 1966), as have Mormoops megalophylla and species of Pteronotus from Venezuela (Jones et al., 1972).

The species of Antricola seem to exhibit the same host and general distributional patterns of O. viguerasi on the mainland and Caribbean islands. Two of these, A. marginatus (Banks) and A. silvai Cerný, have been taken from Phyllomycteris poeyi, endemic to Cuba (Hall and Kelton, 1959), but are also known from Cuban mormoopid species (Anciaux de Faveaux, 1971), and A. silvai was recorded by Jones et al. (1972) from Venezuelan Mormoops megalophylla and Pteronotus. Mainland phyllostomatids have not yielded Antricola, which may suggest that Antricola arose from island-inhabiting Ornithodoros types on phyllostomatids or on mormoopids. Island-hopping mormoopids may have brought the ticks to the mainland where A. mexicanus seems specific to mormoopid species such as Mexican and Panamanian Pteronotus in addition to being found in bat caves in Guatemala and Mexico (Fairchild et al., 1966). Antricola coprophilus (McIntosh), although never recorded from a chiropteran host, is known from caves and mines in Arizona and Texas inhabited by vespertilionid bats (Cooley and Kohls, 1944), and numerous A. granasi de la Cruz (1973) were recorded from a cave in Cuba.

The overall trend of development of species and distributional patterns seems to indicate an origin of a line of phyllostomatid-infesting Ornithodoros (Alectorobius) species in southern Central America or northeastern South America. Radiation has occurred northward into Mexico and the southwestern United States, eastward onto the Caribbean islands, and southward into other parts of South America. The northern and southern distributional patterns appear to be reflections of one another with adaptations by these ticks to more temperate-ranging bat species such as certain vespertilionids and molossids. In the north, O. (A.) yumatensis and O. (A.) rossi, both parasitic on tropical and subtropical phyllostomatids, parasitize vespertilionid bat species as far north as Arizona (Cooley and Kohls, 1944; Kohls et al., 1965; Jones et al., 1972). Southward, the species O. (A.) bolivienis, for instance, has been recovered from Bolivian Myotis nigricans and Molossus major (Kohls and Clifford, 1964), and O. erectus is known (Kohls et al., 1969) from Venezuelan Épitesicus furinalis.

Ereynetidae Oudemans, 1931

Five species of speleognathine ereynetids all of the genus Speleochir Fain are known to infest the nasal passages of phyllostomatid bats: Speleochir atikeni Fain (1966) from Anoura geoffroyi taken in Trinidad; S. brasiliensis Fain and Aitken (1969) from Vampyrodex caracciolo and Artibeus jamaicensis; S. barbutata Fain and Aitken (1970) from Mimon crenulatum of Brazil; S. phyllostomii (Clark, 1967) from Phyllostomus hastatus of Colombia; and S. caroliiae Fain and Lukoschus (1971) taken from Carollia perspicillata in Surinam.
Some ereynetids are free-living predators, but most are adapted to a mucosal environment and the origins of the Ereynetidae seem to lie with a ground or plant-living ancestor that adapted to mucosal secretions or mucosal secreting environs. Rodents are the most numerous and widely represented mammalian hosts although many bird species also harbor speleognathines. A common, relatively recent, ancestral history seems to be suggested for both mammalian and avian ereynetids as both types are well represented and included together in the Speleognathinae.

Comparisons of rodent and bat host records have revealed certain related patterns. For instance, species of Paraspeleognathopsis Fain are known from Africa, Europe, Korea, and Australia from different species of murid rodents; species of Speleorodens Fain have been reported from Africa, Europe, the United States, and Panamá from sciurid rodents; and from Australia and Panamá from murid rodents; and cricetid rodent records are cited from Panamá, Trinidad, Brazil, and Holland (Fain, 1970b). A similar Old and New World distributional pattern for species of the same genus is exhibited by Neospeleognathopsis on vespertilionid bats from Europe (Belgium) and from the United States. All but one of the species of Speleochir are known from Neotropical phyllostomatids, S. daboisi (Fain) is from an African Nycteris.

Interpretation of these patterns leads to the assumption that two possible routes of dispersal may have been involved. The Old World murid rodents apparently provided a possible dispersion mechanism as they spread worldwide, with speleognathines secondarily infesting sciurids, cricetids, and other mammals. The other possible route centers with the vespertilionid bats, which may have transported speleognathines to the Neotropics where the leaf-nosed bats became hosts and sites of development for these mites.

The genus Speleochir appears to have originated in the New World on phyllostomatid bats, from Old World progenitors carried to the Neotropics by one form or another. The occurrence of congeneric species in two widely separated regions—S. daboisi in Africa and the five Neotropical Speleochir species—may suggest a greater distribution for nycterid bats in the geological past or that the generic position of S. daboisi is in need of reevaluation.

MYOBIIDAE Megnin, 1877

More than 50 species of myobid fur mites are recorded from chiropteran hosts. Eudusubakekia Jameson contains nine of these species that are known exclusively from leaf-nosed species. Five species of Eudusubakekia have been found on Cuba or Isla de Pinos (Dusbabek, 1967), a small island near Cuba: E. cernyi (Dusbabek) from Brachyphylla rana, E. danieli from Phyllonycteris poemy, E. samsanaki from Macrotes waterhousii, and E. viguerasi from Artibeus jamaicensis. Jameson (1971) subsequently named two species, E. lepidoseta from Sturina litium and E. phyllostomi from Phyllostomus discolor taken in Nicaragua. Later, Vomero (1972) described E. arganoi from Desmodus rotundus taken in San Luis Potosí, México, and Fain (1972) described E. urodermae from a single Brazilian Uroderma magnirostrum. Two other, E. jimenezii (Dusbabek)
and *E. suguei* (Dusbabek) are found on species of Cuban *Pteronois*, a mormo-oid genus. The genus *biannella* (Dusbabek and Lukoschus, 1973) contains *I. martae* (known from seven females and three tritonymphs) from a Surinam *Mimon crenulatum*.

Each of these myobiids has been taken in association with an individual phyllostomatid bat species. The recent recovery of a female *E. viguerasi* (identified by Dr. E. W. Jameson, Jr.) from *Artebus jamaicensis* from Veracruz, México, suggests a recent connection between the mainland *A. jamaicensis* and insular *A. jamaicensis* on Cuba.

A cheyletoid ancestry for the Myobiidae was proposed by Dusbabek (1969) who also suggested a close phylogenetic affinity among *Eudusbabekia*, *Ewingana*, and *Ugandobia*, all found on bats. Species of *Ewingana* are parasites principally of molossids found in the Old and New Worlds. *Ewingana molossi* Dusbabek from *Molossus molossus* and *E. yaguaajayensis* Dusbabek from *Tadarida latiscutata*, both from Cuba, may indicate a host link between the Old and New Worlds.

Evidence for a vespreptilionid transport system may be seen in the relationship between Old World *Neomyobia* Radford and species of vespreptilionid and leaf-nosed bats. *Neomyobia chiropteralis* (Michael) has been found on *Pipistrellus pipistrellus*, *Eptesicus nilsonii*, and *Rhinolophus hipposideros* in Europe and several other *Neomyobia* species are reported from European, African, and Asian *Rhinolophus* species. These associations may parallel those between vespreptilionids and phyllostomatids in the Neotropics. Additionally, several species of *Pterarctus* are known from the Old and New Worlds from vespreptilionids and one, *P. chatinolectus* (Womersley), is known from Australia, North America, and Czechoslovakia (Ancaux de Faveaux, 1971).

A New World origin is suggested for species of *Eudusbabekia* specifically, but the bat-infesting myobiids in general probably arose in the Old World, as there is seemingly less taxonomic differentiation and host specificity exhibited by the myobiids on New World chiropterans when compared to their Old World counterparts.

**Demodicidae Nicolet, 1855**

Three species of demodicid mites (*Demodex*), all from Surinam, are known from *Phyllostomus hastatus* (D. phyllostomatis Leydig, 1859) and *Carollia perspicillum* (D. carolliae Desch et al., 1971 and D. longissimus Desch et al., 1972). It seems likely that many other chiropterans harbor *Demodex* mites, as only these three phyllostomats, six vespreptilionids, and a molossid are recorded hosts (Ancaux de Faveaux, 1971; Desch et al., 1972; Fain, 1960; Lukoschus et al., 1972).

A commensalistic cheyletoid ancestor was hypothesized (Nutting, 1964, 1965) for demodicid mites, the intermediate, less specialized forms of which are exemplified today by species of *Stomatodes* Fain and *Rhinodex baeri* Fain. Both *Stomatodes galagoensis* Fain and *R. baeri* occupy intraoral and nasal cavities of *Galago senegalensis*, a lorises primate, whereas the other three *Stomatodes* species inhabit the same microhabitat of a pteropod, a nycterid, and several
vespertilionid bat species. Because they are only slightly modified morphologically, it seems that these mites invaded the relatively stable nasal and oral cavities early in demodicid phylogeny and have changed little since. The association of more primitive Stomatodex species with five bat species that range from Central Africa to Europe suggests a comparatively long affiliation by demodicids with chiropterans. The origins then of Demode May have been with bat hosts in the Old World.

Vespertilionids are the most numerous and widespread host bats of Demodex species and are recorded from the Old and New Worlds (Anciaux de Faveaux, 1971). The tumors or small papules on the skin from which the phyllostomatid-infesting Demode May recovered be tissue reactions, suggesting a recent incorporation of leaf-nosed bats as hosts, perhaps by demodicids previously associated with vespertilionid bats. Nutting (1964:443) has expressed doubts about recent interspecific transfer. He further stated that phylogenetic patterns and species specificity are indeterminable.

Psorergatidae Dubinin, 1955

Three of the 11 species of Psorergatoidea Fain are presently known (Lukoschus et al., 1973) to infest phyllostomats—P. lonchorhiniae from Lonchorhina aurita from Venezuela, and P. glosophagae from Glosophaga soricina and P. artibe from Artibeus lituratus, both from Surinam. In the Old World, the species of this genus occur on rhinolophid and hipposiderid bats throughout Europe and into Africa, one species is found on vespertilionids in Africa and another species was taken from molossids in Surinam, which may indicate some evidence for a vespertilionid or molossid host link between the Old and New Worlds.

The Psorergatoidea species are intradermal inhabitants of the ears and wings of their hosts, apparently feeding on dermal tissues. Host tissue reaction has been observed and discussed (Lukoschus et al., 1973), and is especially pronounced in the phyllostomatid hosts of P. glosophagae and P. artibe, and in P. molossi (found on Molossus molossus), perhaps suggestive of a relatively recent invasion of these hosts. This possibility and the fact that P. rhinolophi Fain has adapted to nasal membranes, wings, and ears, and is widespread on eight species of rhinolophid bats in Europe and Africa may suggest an Old World origin for the group.

Nutting (1965) noted the possibility that psorergatoids arose from a cheyletoid ancestor common with the basal stock that produced the demodicids, myobiids, and several other families parasitic on vertebrates. The Psorergatoidea group shows close affinities with the species of Psorergates Tyrrell, which are restricted to nonchiropteran mammals. Movement of Psorergates-like species onto bats from rodents or other small mammals may account for the seemingly strong similarities between species of the two mite genera. It is also feasible that the Psorergatoidea taxa evolved along with the chiropterans from insectivore-parasitizing ancestors as there are many species of Psorergates known from extant species of insectivores. However, this seems unlikely as one would expect to find
the psorergatids more widely distributed on bat hosts and greater differences between species of _Psorergates_ and _Psorergatoidea_.

**Trombiculidae** Ewing, 1944

Trombiculid mites (including Leeuwenhoekiinae) are parasitic on many kinds of vertebrates, including bats. More than 1560 species are known from temperate and tropical regions of the world. The larval stage, commonly called a chigger, is a frequent ectoparasite and occasionally an endoparasite of phyllostomatids.

Most of the trombiculid literature concerning bats can be found in Anciaux et al. (1971). Several regional papers include those on México (Loomis, 1969), Panamá (Brennan and Yunker, 1966), Surinam (Brennan and Lukoschus, 1971; Brennan and van Bronswijk, 1975), Trinidad (Brennan and Jones, 1960), and Venezuela (Brennan and Reed, 1973, 1974, 1975; Reed and Brennan, 1975). Major taxonomic papers deal with the genera _Beamerella_, _Hooperella_, and _Tecomatana_ (Vercammen-Grandejean, 1967), _Chiroptella_ and _Leptotrombidium_ (Vercammen-Grandjean and Langston, 1971), _Loomisia_ (Brennan and Reed, 1972), _Microtrombicula_ (Webb and Loomis, 1971), _Nycterinastes_ (Brennan and Reed, 1973), _Panaseia_ (Brennan, 1969a), and _Perissopalla_ (Brennan, 1969b, 1970). The generic status of certain taxa has been questioned by Vercammen-Grandjean et al. (1973); however, they are recognized as subgenera.

There are 51 species, belonging to 22 genera of two subfamilies (Trombiculinae and Leeuwenhoekiinae) known from phyllostomatids. Records of three species seem to be based on accidentals or errors in handling—_Blankaartia sinamaryi_ normally parasitizes birds, _Pseudoschoengastia bulifera_ is abundant on small mammals, especially rodents, and _Trombicula dumii_ is known from a variety of terrestrial mammals (Brennan and Yunker, 1966). Occasional records of accidental records include seven species of the abundant and widespread genus _Eutrombicula_ (Brennan and Reed, 1974), and _Leptotrombidium homaxialum_ known to regularly infest rodents and rabbits. _Xenodontacarus serratus_ Loomis and Goff (1973) was described from a single larva taken from a Mexican _Artibeus lituratus_, the only record of a _Xenodontacarus_ from a bat.

The remaining 40 trombiculids regularly infest bats of the Americas and are documented from phyllostomatids. These consist of species in the genera _Alexfainia_ (one of two known species), _Beamerella_ (two of three), _Chiroptella_ (one of three American species), _Hooperella_ (three of four), _Loomisia_ (five of six), _Microtrombicula_ (three of about 20 American species), _Nasicola_ (one species), _Nycterinastes_ (two species), _Paraschoschoengastia_ (two of five), _Perasceia_ (three of 12), _Perates_ (one of two), _Perissopalla_ (six of 12), _Spelaeocola_ (two of five), _Tecomatana_ (two), _Wagenoaria_ (one), _Whartonia_ (four of eight American species), and _Xenodontacarus_ (one of four).

The usual life cycle consists of the egg, deutovum, a parasitic larva (which attaches to the host, feeds on lymph and histolyzed tissue, and then leaves the host after engorgement), inactive protonymph, active and predateous
deutonymph, inactive tritonymph, and the figure-eight-shaped predaceous adult, either male or female. The parasitic larval stage is relatively brief, whereas the free-living nymphs and adults must have the proper substrate and prey. A good host will pick up the larva, provide a favorable parasitope and nourishment, and deliver it after engorgement to a suitable drop-off site, frequently the original or a similar microhabitat in which the larva was picked up.

The larvae usually attach singly or in clusters on or in the ears (Microtrombicula, Speleocola, Tecomatiana, and Xenodontacarus), wings and tail membranes (Beamerella, Chiropetella, Hooperella, Loomisia, Perissopalla, Perates, Parasecia, Whartonia, and some Tecomatiana and Parascoschoengastia), toes (Perates), and nasal passages (Alexfania and Nasicola). Chiggers are occasionally found on the head, lips, body area, and the genitalia. The enlarged larva is oval in shape, rarely larger than one millimeter in length, and may be red (Beamerella, Hooperella, Tecomatiana, Whartonia), orange (Perissopalla, Loomisia), yellow (Chiropetella, Nasicola, Parasecia, Perates), to whitish (Speleocola, Parasecia).

Emergence of the unfed larvae of most temperate and many tropical chiggers is seasonal, either correlated with temperature in alternately hot and cool regions, or synchronized with wet or dry periods.

Modifications in larval morphology that seem correlated with chiropteran hosts include greater sclerotization of legs and palpi, projections on certain leg and palpal segments (Vercammen-Grandjean, 1967), and enlarged and serrated cheliceral blades on those that attach externally (but usually there is a moderate blade on those that attach within ears and small blades on intranasal species). The oval-shaped larvae may be red or orange in larger ectoparasites and yellow or nearly white in those that normally attach deep in the ears or are free in the nasal passage.

Virtually all of the seven most frequently parasitized phyllostomatids (Artibeus, Carollia, Desmodus, Glossophaga, Macrotus, Miconycteris, and Phyllostomus), as well as other heavily infested tropical American bats, such as Balantiopteryx plicata, Mormoops, and Pteronotus pammelii, are regular or wholly inhabitants of caves and rock crevices. The remaining host phyllostomats normally roost in hollow trees. In addition, nearly all of these hosts usually roost in clusters or large colonies.

Although most free-living stages of these and similar genera are known only from laboratory-reared material, most if not all of those listed probably inhabit cracks in rocks or decaying wood (frass). Closely related species in the genera Parasecia and Microtrombicula are known to inhabit decaying logs, stumps, and dead standing trees. Other Microtrombicula and Whartonia are associated closely with rock crevices in cliffs and caves. Bats taken in caves and mines were infested heavily with larvae of the genera Beamerella, Hooperella, Loomisia, Microtrombicula, Perissopalla, Speleocola, Tecomatiana, and Whartonia.

Bats recovered from bridges, houses, and other artificial structures rarely possess trombiculids, nor are they found on bats that usually or always roost among leaves on living branches of trees.
None of the well-known genera and few of the species have been recorded only from phyllostomatids, although most of them are known only from bats, including emballonurids, molossids, mormoopids, and vespertilionids. Genera associated with bats and of probable Neotropical origin consist of Nasica, and Speleocola (members of a world-wide group including Microtrombicula), Loomisia (a distinct group), Perissopalla (possibly related to Old World genera including Riedlelia and Trisetica, according to Vereammen-Grandjean et al., 1973), and the distinct American trombiculine taxa consisting of Beamerella, Hooperella, Tecomatana, Alexsantia, Nycterizastes, and Peruca. Leeuwenhoekiine genera consist of Wagenhaeria (closely resembling the genus Sasaaratus, which is abundant on desert and tropical American terrestrial mammals); Xenodontacarus serratus, one of four known species in a group regularly on small terrestrial mammals; and Whartonia, which is world-wide in distribution and found on many different kinds of bats. Whartonia nudosetosa and W. pachywhartonii represent typical species and are restricted to the New World tropics, whereas Whartonia glemani and W. guerrerensis are mostly northern Neotropical. These Whartonia also have been found on a wide variety of American bats including emballonurids, molossids, and mormoopids, and all American genera of leeuenhoekiines seem to be northern in origin and mostly northern Neotropical in distribution.

Bats, including a number of phyllostomatids, are common hosts of Paraschoscoengastia and Paraselia, which seem to be acquired by hosts in hollow trees and other roosting sites associated with decaying wood. Paraschoscoengastia aemulata and P. megastyrax are recorded only from bats, as is Paraselia soucouyant; however, Paraselia longicalcar and P. manueli also are known from a number of other small mammals and birds (Brennan, 1969a).

Rosensteinidae Cooreman, 1954

The subfamily Nycteriglyphinae Fain consists of two genera and 13 species (Anciaux de Faveaux, 1971) associated with bats or bat roosts. Only one of these, Nycteriglyphus sturnirae Fain (1963), based on a single tritonymph, has been found in association with a phyllostomatid (a Brazilian Sturniridae Lilium). Dusabek (1967b) subsequently reported a male and female N. sturnirae from Molossus molossus taken on Isla de Pinos, Cuba.

Labidocaridae Gunther, 1942

The family Labidocaridae consists of eight genera previously placed in the families Listrophoridae or Chirodiscidae. Species of four genera have been reported from phyllostomatids. Alabidocarpus furmani was listed from Trinidad (Pinichponge, 1963a) from Anoura geoffroyi and also from A. geoffroyi and Glossophaga soricina taken in Nicaragua (McDaniel, 1970). Other Nicaraguan species include A. nicaraguense from Uroderma bilobatum and A. jonesi from Vampyrops helleri. Three species of Paralabidocarpus Pinichpongse have been recorded exclusively from phyllostomatids. Paralabidocarpus arubae Pinichpongse (1963b) was originally described from mites on Antibeus lituratus.
from Trinidad and later reported (Tamsitt and Fox, 1970a) on A. lituratus and Stenodermatidae rufium taken in Puerto Rico. Subsequently, de la Cruz et al. (1974) described P. stenodermi from S. rufum and P. foixi from Arilbeus jamaicensis, both from Puerto Rico. Lawrenceocarpus microplus Dusbabek and de la Cruz was originally described from specimens obtained from the mormooid Piero-
notus fuliginosus taken in Havana Province of Cuba (McDaniel, 1970). A later record of L. microplus was noted by Tamsitt and Fox (1970a) from Brachy-
phylia cavernarum collected in Puerto Rico, which were also the host and locality records for the species L. puertoricensis de la Cruz, Tamsitt, and Val-
divieso (1974). Fain (1970b) has reported some recent records from Surinam phyllostomatids and McDaniel (1972) reported numerous labidocarpids from Venezuelan leaf-nosed species.

Labidocarpids have anterior appendages specialized for clasping individual hairs in the fur of their mammalian hosts. Food habits have not been noted, but, as with other listrophoroids, they probably feed on dermal tissues and se-
cretions at the base of the hair.

The life cycle includes a hexapod larval stage, which after parturition may molt either into a nymphal male or female. The nymphal male molts again to become an adult, whereas the nymphal female undergoes another molt in which the ecdysium remains around her, thus forming a puparium or chrysalis. During mating, the male claps a hair while a female is attached to his posterior end in copulo with the anterior end of each facing in opposite directions. How the male and copulatory female initially unite is unclear as the legs of the puparium have no apparent morphological adaptive quality for holding fast to hair or skin and, before pupal formation, are of little locomotive value to the nymph because of their diminutive size. Furthermore, the fate of the copulatory female after disengagement from the male is questionable for the same reasons. The “three-legged,” fully chitinized stage with the next stage developing inside as seen by Lawrence (1952:137) was possibly a representative of a separate species in which the short or nearly absent legs of the nymphal female are character-
istic of that taxon. Ovoviviparity is seen in these mites for fully formed larvae have been observed inside normal females (McDaniel, 1970) and mature fe-
males give birth shortly after shedding the pupal skin.

The genera Labidocarpus, Alabidocarpus, and Olabidocarpus, which paras-
itize phyllostomatids, have both New and Old World species. All three also have representatives in vespetilionid bats either in the New World (Labido-
carpus) or in both the New and Old Worlds (the other two genera). The relatively greater differences among the seven genera in México, Central America, or South America suggest the site of origin was in the New World. Only a single monotypic genus is known from the Old World. Furthermore, phyllostomatids harbor the greatest number of labidocarpid species, suggesting a relatively long association.

Additional evidence for the initial establishment of labidocarpids on phyl-
lostomatids may be implied in the Old and New World distribution of the mite species. If they had invaded the Old World rhinolophids or hipposiderids or
vespertilionids of either realm in the beginning, we would expect to see a much broader range of these host species, something that is not in evidence. If originally on New World molossids, then why are they not found on Old World free-tailed bats? The accumulated evidence seems to indicate a New World origin for labidocarpid mites on phyllostomatid bats with radiation to the molossids, noctilionids, and vespertilionids followed by dissemination to the Old World rhinolophids and hipposiderids via the cosmopolitan vespertilionid species.

Chiorrhynchobiidae Fain, 1967

This sarcopitiform family consists of two species known only from phyllostomatids. Chiorrhynchobia uodermae Fain (1967) was based on a single female from a Panamanian Uroderma bilobatum, and the seven females of C. matsoni Yunker (1970) were attached by their mouthparts to the trailing edge of the wing membrane of a single Anoura geoffroyi netted in Zulia, Venezuela.

Sarcoptidae Trouessart, 1892

One genus of sarcopitid mite is known from phyllostomatid bats. Chirnysoides was proposed by Fain (1959) to include C. caparti recovered from Artibeus jamaicensis, C. amazonae from Carollia perspicillata, C. brasiliensis from Strepsirrhini ilium (all from Brazil), and C. venezuelae from a Venezuelan Tornatia venezuelae. Fain (1962) later described C. carolliae from Panamanian Carollia perspicillata and C. castanea. Only phyllostomatids were known to be hosts for Chirnysoides until Fain and Lukoschus (1971b) transferred Notoedres noctilionis to Chirnysoides and erected a new subgenus (Nycteridoctopes) for it. Chirnysoides noctilionis is known from Cuba and Surinam from noctilionid bats. Two other species, C. surinamensis and C. zanderyensis both taken from Surinam Carollia perspicillata were placed in a separate subgenus, Nycteridoctopes.

Known parasitopes for Chirnysoides species are the skin of the leading or trailing edges of wings or ears.

The Chirnysoides species group may have arisen from stock common to that including the species of Notoedres. Certain evidence suggests an Old World origin for the Notoedres group, possibly from an ancestral line that includes the genera Chirnysus and Nycteridoctopes. Support for this idea seems to be implied by several things. There are many more species of Notoedres in the Old World and they are found on a greater variety of bat hosts. A number of species of Nycteridoctopes and Chirnysus are inhabitants of the bucal cavity in some bats, a condition that may be seen with other groups of acarines that have long associations with their hosts. Nycteridoctopes and Notoedres have representatives on pteropods, rhinolophids, hipposiderids, molossids, and vespertilionids in the Old World and numerous species are known from vespertilionids in the New World. The developmental sequence in the phylogeny of these mites seems to indicate an early establishment on pteropods followed by a movement onto rhinolophids and then to vespertilionids, which carried them to the New World to phyllostomatids.
GASTRONYSSIDAE Fain, 1956

Phyllostomonyssus conradiyunkeri Fain (1970c) of the subfamily Rodhainyssinae Fain, is the only gastronyssid reported from phyllostomatids. It has been found in the nasal passages of Venezuelan Artibeus lituratus and Uroderma bilobatum, Vampyrops helleri, and A. lituratus from Surinam (Fain and Lukoschus, 1972). Leaf-nosed bats may have acquired this mite from associations with vespertilionids. The few additional reports of rodhainyssines from the New World include the vespertilionid Histiotus velatus from Brazil and Chile, the molossid Eumops australis from Surinam, and the emballonurid Balantiopteryx plicata from Mexico (Anciaux de Faveaux, 1971). All were infested with species of Rodhainyssus Fain, a genus also known from Europe and Africa.

From the description and discussion by Fain (1956, 1970c) Phyllostomonyssus conradiyunkeri appears to be more specialized than any species of Rodhainyssus. The loss of the apical tarsal seta, the reduction in length of the post-ventral opisthosomal setae, and development of large clawlike extensions of tarsi III and IV, all seem to parallel the specializations of Gastronyssus bakeri Fain, a parasite of the gastric and intestinal mucosa of pteropodid bats.

NYCTERIBIIDAE Samouelle, 1819

Nycteribiids are wingless, spiderlike, and obligately hematophagous, parasitic flies of bats. Little is known about the biology of nycteribiid batflies except that all species are larviparous and pupation immediately follows larviposition (Guimarães, 1968). Two genera, Basilia Ribeiro and Hershkovitzia Guimarães and D’Andretta are found in the American Neotropics, but only Basilia has representatives (12 species) on phyllostomatids. New World species principally parasitize vespertilionid bats (Guimarães, 1968) and it is assumed that nycteribiids entered North America on members of that family. Theodor (1957) noted that the closest relatives of Basilia belong to an Old World group that, except for one species, is totally tropical. Thus, the evidence suggests an Old World tropical origin for nycteribiids where adaptation and radiation has led to a nearly cosmopolitan occupation of chiropteran hosts. Apparently, the success of streblid batflies in the New World has affected the ability of nycteribiids to invade niches provided by Neotropical bats.

Additional literature regarding nycteribiids are generally of a taxonomic nature and include Ferris (1924), Guimarães (1946, 1966, 1972), Guimarães and D’Andretta (1956), Peterson and Maa (1970), and Whitaker and Easterla (1975).

STREBLIDAE Kolenati, 1863

Streblid batflies are hematophagous, pupiparous, and obligate parasites of bats found in both the Old and New World tropics. In the Americas, Wenzel (1970) recognized a total of 94 batfly species in 23 genera. The present account lists 83 species in 20 genera from New World leaf-nosed bats.

Wenzel et al. (1966;636-649) have provided an extensive discussion of host-parasite relationships, including host specificity, parasite fauna, and ecology.
of parasitism. They concluded that streblid distribution in habitats and on hosts was due, to a degree, to ecological factors; few have been found on bats commonly restricted to forest habitats for example, whereas cave dwelling bats generally harbored more streblids in species and in number. Bats in long established roosts also tended to have more streblids. It was further suggested that within the host’s preferred habitat, however, host specificity was great even though the same streblid species may be found on a number of other species of bats. Earlier, Ross (1961) stated the same situation for several Nearctic phylliostomatid and two vespertilionid species. His observation of the apparent noninfestation of molossids cohabiting with infested vespertilionid and leaf-nosed bats may be due to recent streblid dispersal to these temperate regions as a number of molossids serve as hosts for batflies in the tropics (Jobling, 1949; Wenzel, 1970; Wenzel et al., 1966).

Although Jobling (1949) stated that streblids probably arose from an ancestor that was not blood sucking, it seems more likely that they originated from hematophagous, calyptrate, muscoid flies as Theodor (1957) has postulated, and that the adaptation was originally to bats.

Theodor (1957) further stated that because of a complete lack of streblid fossils no conclusions about the evolution and phylogeny could be drawn regarding batflies and their hosts. Certain observations may be made, however. For instance, the greatest differentiation of species (94) and genera (23) has occurred in the New World as compared to 62 species and 4 genera of the Old World (Wenzel, 1970). Indicative of this great taxonomic range is the spectrum of morphological features of New World streblids from the generalized calyptrate taxa to the small-winged and flightless flies (certain species of Strebla, for example) and to the wingless species of Paradoecidiria. Further reflections of adaptations by Neotropical batflies may be seen in the polytylenoid appearance of Strebla and other species and in the siphonapteroid Nycterophila. These diversifications seem to indicate a New World origin for streblid batflies. The endoparasitic mode of Ascodipteron on Old World bats may merely reflect an adaptation to competitive factors with other ectoparasites, such as nycteribiids.

Additional evidence for New World origins may be seen in the hyperparasitic relationship between certain streblids and the trombidid mite, Monunguis streblida, first noted by Wharton (1938) as an ectoparasite on streblids—Megistopoda aranea (Coquillett) and Trichobius dugesii Townsend—from caves in Yucatán, México. From other material obtained from California State University, Long Beach, more specimens of M. streblida have been recovered from Nycterophila (identified by Dr. B. V. Peterson) taken from Macrotus waterhousii from Sinaloa, México.

We assume the streblid-bat association occurred before the mite-fly relationship, and M. streblida probably encountered the streblids on the cave floor where the parasitic flies emerged from the puparia. It would seem probable that the mite is a relatively recent parasite on streblids as it does not exhibit host specificity or selectivity. It is probably also more closely associated with a suitable cave environment, large colonies of bats, and adequate populations of suitable streblids.
Other published papers regarding streblids include those of Guimarães (1944), Peterson and Hürka (1974), Peterson and Ross (1972), Reddell (1970), Starrett and de la Torre (1964), and Whitaker and Esterla (1975).

**DISCUSSION**

Ectoparasites are recorded from 39 of 49 genera (89 of 136 species) of phyllostomatids. There are two general host-parasite categories: either the parasite remains on the host throughout the entire life cycle (for example, demodicids, myobiids, and spintruncids), or it spends part of the cycle off the host in the bat roost (for example, argasids, ixodids, macronyssids, and trombiculids) and may parasitize a variety of bats and even other vertebrates that trespass into its territory. *Nycteriglyphus sturnirae*, a rosensteiniid mite, is a commensal with two species of leaf-nosed bats.

For part-time ectoparasites, the host is visited at least once, and sometimes two to three times. This type moves onto the available host, attaches to some part of the body, and commences feeding. The feeding site is termed the parasitope (Fain and Vercammen-Grandjean, 1953; Wrenn and Loomis, 1967) and seems to be selected by the parasite although it may be influenced by grooming or scratching behavior of the host.

The microbiotope refers to the area of normal activity of each parasite, which may be on the entire surface of the host for batflies, or in a single dermal pore by demodicid mites. Others, such as soft ticks and macronyssids, also must survive in microhabitats off the host.

The parasitope and microbiotope may be virtually the same for endophilic demodicid, sarcoptid, and psorergatid mites. Myobiids and labidocarpsids have microbiotopes where they clasp individual hairs, and their feeding parasitope is visited periodically at the base of the hairs. Spintruncid mites and the batflies have extensive microbiotopes. Wing mites usually are found on the wing and leg membranes and rarely invade the fur, whereas batflies move over much of the body surface. Argasids and most trombiculids find and climb onto the host and move quickly to feeding sites, so the parasitope and biotope are essentially the same. They remain at these feeding sites and on the host for relatively brief periods. Gastronyssids, ereynetids, and some trombiculids occupy the respiratory passages, and certain macronyssids (*Radfordiella*) are found in peridontal tissues. The females of chilorrhynchobiids have been recovered from wing membranes and spelaeorhynchids were embedded in the skin of the ear.

Three feeding categories are suggested for these ectoparasites: hematophagy, histophagy, and mucophagy. The hematophagous soft and hard ticks, the two families of batflies, spintruncids, and some macronyssids derive most if not all of their nourishment from blood meals. The remaining parasites, except for intranasal and intraoral taxa, feed on dermal tissues, fluids, or skin secretions. Those inhabiting oral and respiratory cavities apparently feed on mucus, although histophagy also has been suggested. Protonymphs of several species of *Radfordiella* feed on tissues surrounding teeth, resulting in extensive damage in some instances.
The highest degree of niche and host specialization occurs in ectoparasites of birds and bats and is attributed to their relative ecologic and geographic isolation (Wenzel and Tipton, 1966). Furthermore, the degree of host specificity is correlated with the extent to which a parasite is host limited. Examples of familial specificity of ectoparasites include Streblidae, Nycteribiidae, Polystenidae, and Spinturnicidae and certain trombiculid species exhibit host-species restriction. However, most literature on phyllostomatid ectoparasites does not contain carefully documented information about host-parasite relationships. An approach to bypass the shortcomings of a host-parasite list is to find two or more separate studies listing a particular parasite from a specific bat species or other taxa. On this basis, it appears that few phyllostomatid infestors are monoxenous. Examples of monoxenous, however, include Periglischrus herrerai taken only from Desmodus rotundus and Speleochir phyllostomis recovered solely from Phyllostomus hastatus, both of which corroborate Wenzel and Tipton’s (1966) idea of higher host specificity in host-limited taxa. The usual hosts for several streblids appear to be Artibeus jamaicensis for Megistopoda aranea, Glossophaga soricina for Trichobius dugesii, Carolina perspicillata for T. jublingi, Phyllostomus hastatus for T. longipes and P. discolor for Streblia hertigi. Macronyssoides kochi noted from A. jamaicensis and Desmodus rotundus with single records from A. toltec, A. aztecus, A. littoratus, Brachyphylia nana, Glossophaga soricina, and Phyllostomus poeyi is oligoxenous and apparently agrees with the development of polyhaematophagy in ectoparasites that are not host-limited. The phyllostomatid-limited spinturnicids of the genus Periglischrus are seemingly in conflict with this latter idea, however, as they exhibit extensive polyhaematophagy, and are highly host-limited. Thus, selection for polyhaematophagy is not always restricted to ectoparasites that are not host-limited and in this case the parasites are not typically oligoxenous but rather exhibit subfamilial specificity (see Table 1) and are, therefore, stenoxenous. This host specificity is consistent with the subfamilial status of the vampire bats and other groups. Taxa of four other ectoparasitic families, Streblidae, Labidocarpidae, Sarcoptidae, and Gastronyssidae, also seem to show subfamilial specificity (see Table 1) and all are highly host limited.

New World leaf-nosed bats roost in caves, cliff crevices, trees, hollow tree trunks, or burrows, or in artificial structures such as culverts, buildings, or bridges (Humphrey and Bonaccorso, this volume). In general, fewer ectoparasites are found on those bats residing in man-made structures than on bats found in natural habitats, especially for species of habitat-dependent trombiculids, macronyssids, streblids, and nycteribiids.

Most phyllostomatids roost singly or in small clusters although there are exceptions such as the colonial species of Phyllostomus, Desmodus, Brachyphylia, Phylonycteris, and Erophylla. A correlation may possibly be drawn between the large number of diverse ectoparasites and the more gregarious bats, especially Desmodus rotundus, Phyllostomus discolor, and P. hastatus, which host a wide range and number of ectoparasites. Artibeus jamaicensis, Carolina perspicillata, and Glossophaga soricina also are colonial and also harbor large numbers of
<table>
<thead>
<tr>
<th>Parasite</th>
<th>Phyllostomatinae</th>
<th>Glossopteridinae</th>
<th>Carphidiinae</th>
<th>Stereopteridinae</th>
<th>Phyllonycterinae</th>
<th>Desmodontinae</th>
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*Questionable or accidental occurrence

Ectoparasites, most of them not host-limited. The extensive infestation of these bats may be explained by their colonial habits and their practice of cohabiting with other species of bats, sometimes, as with C. perspicillata, actually mixed with colonies of other bat species or in the same roost with other cavity-inhabiting bats (Pine, 1972). Carollia perspicillata may be the focus of infestation for these and other bat species through cohabitation as it is probably the most widespread and abundant species of colonial fruit-eating bat in the Neotropics. Fifty-eight species of ectoparasites are recorded form C. perspicillata, 18 of which are shared entirely or partially with A. jamaicensis, G. soricina, and D. rotundus. Although colonial, Leptonycteris and Choeronycteris harbor few ectoparasites, probably because of their migratory habits as they are flower feeders and migrate to stay in the “dry season” (Humphrey and Bonaccorso, this volume), extending into temperate regions where there are fewer parasitic arthropods.
Most of the phyllostomatid-infesting families of ectoparasites seemingly originated in the Old World; many probably were transported by vespertilionid bats to the New World where transfer to phyllostomatsids and other bats occurred. Evidence for this mode of exchange may be seen in the macronyssids, spinturnicids, myobiids, sarcopsids, gastronyssids, and nycteribiids. Molossids may have been important for dissemination of the psorergatids from the Old World although vespertilionids once again are inferred strongly as the transport mechanism. Vespertilionids are likewise the major possible means of early dispersal to the New World for demodicids and ereynetids even though rodents, especially murids in the case of the ereynetids, may also have been significant transporters. Either rodent or avian hosts, or both, provided the ways and means for movement of the argasids to the New World. Emballonurids seem to have been important in older parasite transfer between the Old and New Worlds, particularly in the temperate climates and especially with the trombiculids and gastronyssids. The families Streblidae, Labidocaridae, Spelaeorhynchidae, and probably Chirohynchobiidae apparently arose in the New World. See Table 2.

Present day geographic distribution of certain ectoparasites possibly may be explained by the effects of continental proximity during early geologic times (Traub, 1972). Generally, however, today’s geographic placement of nearly all families of phyllostomatid ectoparasites may be explained by Palaearctic migrational patterns of vespertilionid bats in late Cenozoic times or by over-water migration on birds of long-distance flight. Continental drift separated the land masses of Laurasia, Africa, and South America between 70 and 105 million years ago during the Cretaceous (Cracraft, 1974), forming water barriers to chiropteran and other vertebrate migrations in later periods. The earliest bat fossil from the early Eocene of Wyoming (Jepsen, 1966) is similar to extant microchiropterans. Even if bats had existed as early as the Paleocene (Vaughan, 1972), the oceanic gaps between continents still would have been a restrictive boundary to bats as most species generally do not traverse even small expanses of salt water.

Movement of tropical lowland mammal hosts, especially of rodents, and their parasites between South and Middle America apparently has been without great obstacles (Wenzel, 1972). Ectoparasites reflect the extensive range of a number of leaf-nosed species, several recorded from México to Peru and Brazil, and a free exchange between Mexican and South American tropical species may be seen with several examples: the streblid Megistopoda oranea found on Artibeus jamaicensis collected from México, Central America, and northern South America; the spinturnicid Periglischrus iheringi from A. jamaicensis from México, several Caribbean islands, and Venezuela; and the trombiculid Loomisia desmodus from Glossophaga soricina recovered from México, Nicaragua, Panamá, and northeastern South America. Others show an interchange between Central and South America, for example, Trichobius joblingi (streblid) from five Central American countries, Trinidad, Tobago, and northern South America. Because phyllostomatids are principally tropical species, the adjacent temperate climates represent barriers to them and their ectoparasites. The
Table 2.—New World bat families and their ectoparasites. A single asterisk indicates a probable accidental record; a double asterisk indicates a commensal group; and a triple asterisk indicates a single record only.

<table>
<thead>
<tr>
<th>Parasitic group</th>
<th>Emballonuridae</th>
<th>Noctilionidae</th>
<th>Phyllostomidae</th>
<th>Mormoopidae</th>
<th>Natalidae</th>
<th>Furipteridae</th>
<th>Thyropteridae</th>
<th>Vespertilionidae</th>
<th>Megasoricidae</th>
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temperate ectoparasitic fauna on bats, such as on species of the Myotis nigricans complex, shows little restriction to the temperate areas in the tropics in contrast to the rodent parasites (Wenzel, 1972), which is to be expected because of the volant nature of their hosts.

The distribution and numbers of the ectoparasitic taxa on phyllostomatid species may give some information regarding the relative duration of host-parasite associations. For instance, if one or two genera comprising only a few species of parasites are generally widespread on leaf-nosed bats, as in the case of the demodicids and psorergatids, then it may be assumed that the phyllostomatid-parasite relationship is a relatively recent one. In those with many species and genera, for example, macronyssids and labidocarps, a longer period of as-
sociation is suggested. If the ectoparasites are represented by only a few genera containing numerous species, they probably have been affiliated for an intermediate period of time. Based on this interpretation, it appears that the streblid butterflies with 20 genera and 82 species have had the longest association with phyllostomatid bats.

Fleas, polycenids, and cicimics do not appear to be normal parasites of phyllostomatids, nor are they found regularly on Neotropical species of furipetids, emballonurids, mormoopids, natalids, noctilionids, or thyropterids. However, polycenids are found almost exclusively on molossids and there are a few species of fleas and cicimics on the Neotropical members of the Molossidae and Vespertilionidae. These associations may suggest a recent arrival of these parasites from the Old World on members of these two advanced and widespread groups.

**PARASITE-HOST LIST**

Ectoparasites, and hosts for each, are listed alphabetically by genus and species. A single asterisk indicates an unpublished record from the Chigger Laboratory, California State University, Long Beach; two asterisks indicate an unpublished record from The Museum, Texas Tech University, Lubbock. Geographic origin of records is given if known. Since this list was prepared, four publications (Brennan and van Bronswijk, 1975; Brennan and Reed, 1975; Herrin and Yunker, 1975; Reed and Brennan, 1975) have appeared that should be consulted for additional records.

**Alabidocarpus furmanii** Pinichpongse (LABIDOCARPIDAE)
- Anouara cuadrae, Venezuela
- Anouara geoffroyi, Nicaragua and Trinidad
- Carolitia brevicauda, Venezuela
- Carolitia perspicilla, Venezuela
- Glossopha ga longirostris, Venezuela
- Glossopha ga soricina, Nicaragua
- Vampyrops helleri, Venezuela

**Alabidocarpus guyanensis** Fain
- Artibeus cinereus, Surinam

**Alabidocarpus Jonesi** McDaniel
- Vampyrops helleri, Nicaragua and Venezuela

**Alabidocarpus nicaraguensis** McDaniel
- Uroderma bilobatum, Nicaragua
- Uroderma magnirostrum, Venezuela

**Alabidocarpus phyllostomi** Fain
- Phyllostomus hastatus, Surinam

**Alexfainia chilonycetos** Yunker and Jones (TROMBICULIDAE)
- Carolitia perspicilla, Panamá

**Amblyomma sp.** (IXODIDAE)
- Artibeus jamaicensis, Venezuela
- Artibeus littatus, Venezuela
- Carolitia brevicauda, Venezuela
- Carolitia perspicilla, Venezuela
- Chiroderma villosum, Venezuela
- Choerotniscus monor, Venezuela
- Glossopha ga longirostris, Venezuela
Glossophaga soricina, Venezuela
Sturnira lilium, Venezuela
Uroderma bilobatum, Venezuela
Vampyrops helleri, Venezuela
Amblyomma longirostre (Koch)
Arthneus lituatus, Venezuela
Anastrebla mattadeni Wenzel (STREBILDAE)
Anoura sp., Venezuela
Anoura caudifer, Colombia
Anoura curtata, Panamá
Anoura geoffroyi, Panama and Venezuela
Anastrebla modestini Wenzel
Anoura geoffroyi, Guatemala, México, Panamá, and Triád
Anastrebla nycteridis Wenzel
Linchophylla robusta, Panamá
Anatrichobius scorzaei Wenzel (STREBILDAE)
Linchophylla robusta, Panamá
Antricola sp. (ARGASIDAE)
Leptonycteris curasoae, Venezuela
Antricola margarettae (Banks)
Phyllonycteris poeyi, Cuba
Antricola silvai Cerný
Phyllonycteris poeyi, Cuba
Aspidoptera buscki Coquillett (STREBILDAE)
Arthneus sp., Puerto Rico
Arthneus jamaicensis, Colombia, Cuba, Guatemala, México, and Panamá
Arthneus lituatus, Panamá
Carollia perspicillata, Panamá
Chiroderma villosum, Panamá
Phyllostomus discolor, Panamá
Vampyressa nymphaea, Panamá
Aspidoptera delatorrei Wenzel
Carollia perspicillata, Panamá
Sturnira lilium, Guatemala and Panamá
Aspidoptera phyllostomatis (Perty)
Anoura geoffroyi, Trinidad?
Arthneus sp.
Arthneus lituatus
Phyllostomus sp., Brazil
Sturnira lilium, Paraguay
Basilia sp. (NYCTERYGIDAE)
Centurio senex
Basilia antrozoai (Townsend)
Leptonycteris sanborni
Basilia astochia Peterson and Maa
Vampyrops helleri, Colombia
Basilia belderii Rondani
Phyllostomus sp., Brazil
Arthneus jamaicensis, Brazil
Basilia bequaerti Guimarães and D’Andretta
Micronycteris megalotis
Basilia constricta Guimarães and D’Andretta
Macrophyllium macrophyllum
Tonatia sylvicola
Uroderma bilobatum
Basilia corynorhini (Ferris)
Leptonyeris nivalis, Texas
Basilia ferrisi Schuurmans-Stekhoven
Desmodus rotundus, Venezuela
Basilia hughscotti Guimarães
Chiropterus auritus, Brazil
Basilia myotis Curran
Uroderma bilobatum
Basilia rondani Guimarães and D’Andretta
Artibeus jamaicensis
Hylomycteris underwoodi
Basilia speiseri (M. Ribeiro)
Anoura geoffroyi
Carollia perspicillata, Brazil
Phyllostomus sp.
Basilia tiptoni Guimarães
Mycon crenulatus, Panamá and Venezuela
Basilia wenzeli Guimarães and D’Andretta
Artibeus jamaicensis, Panamá
Lynchorchis aurita, Venezuela
Beamerella acutascuta Brennan (Trombiculidae)
Carollia sp., Costa Rica*
Carollia perspicillata, Nicaragua*, Panamá, and Trinidad
Glossophaga soricina, México*
Lynchophylla concava, Costa Rica*
Micronycteris hirsuta, Panamá and Trinidad
Micronycteris nigroauris, Panama
Phyllostomus discolor, Nicaragua*
Beamerella subacutascuta Vercammen-Grandjean
Micronycteris hirsuta, Trinidad
Blankaartia sinnamaryi Floch and Fauran (Trombiculidae)
Phyllostomus hastatus, Panamá
Chirnysoides sp. (Sarcoptidae)
Carollia perspicillata, Brazil
Chirnysoides amazonae Fain
Carollia perspicillata, Brazil
Chirnysoides brasiliensis Fain
Surnia lilium, Brazil
Chirnysoides caparti Fain
Artibeus cinereus, Panamá
Artibeus jamaicensis, Brazil, México**, and Panamá
Artibeus toleucus, México**, and Panamá
Chiroderma salvini, Panamá
Desmodus rotundus, Panamá
Vampyressa pusilla, Panamá
Vampyrops caracolai, Panamá
Vampyrops vitatus, Panamá
Chirnysoides carolliae Fain
Carollia sp., Panamá
Carollia perspicillata, Panamá and Surinam
Carollia subrida, Panamá
Glossophaga soricina, Surinam
Micronycteris megalotis, Surinam
Chirnysoides surinamensis Fain and Lukoschus
Carollia perspicillata, Surinam
Biology of the Phyllostomatidae

Chironyssoides venezuelae Fain
Tomia venezuelae, Venezuela

Chironyssoides zanderyensis Fain and Lukoschus
Carollia perspicillata, Surinam

Chiropterus lonchophylla Herrin and Radovsky (Macronyssidae)
Lonchophylla robusta, Venezuela

Chiroptera myops Vitzthum (Tombuculidae)
Artibeus jamaicensis, México

Chiropternychia matsoni Yunker (Chiropternychidae)
Anoura geoffroyi, Venezuela

Chironyssoides urodermae Fain
Uroderma bilobatum, Panamá

Demodex caroliæ Desch, Lebel, Nutting, and Lukoschus (Demodicidae)
Carollia perspicillata, Surinam

Demodex longissimus Desch, Nutting, and Lukoschus
Carollia perspicillata, Surinam

Demodex phyllostomatis Leydig
Phyllostomus hastatus, Surinam

Eldounia breviceps Cutten (Streetidae)
Lonchophylla robusta, Panamá

Eudubabekia arganii (Vomero) (Myobiidae)
Deomadas rotundus, México

Eudubabekia cernyi (Dusbabek)
Brachyphylla nana, Cuba

Eudubabekia danieli (Dusbabek)
Phyllotis chrysocephalus, Cuba

Eudubabekia lepidoseta Jameson
Stenura tillyi, Nicaragua

Eudubabekia phyllostomi Jameson
Phyllostomus discolor, Nicaragua

Eudubabekia rosikeyi (Dusbabek)
Monophyllus cubanus, Cuba

Eudubabekia samsinaki (Dusbabek)
Macrotrus waterhousii, Cuba (Isla de Pinos)

Eudubabekia urodermae Fain
Uroderma magnirostrum, Brazil

Eudubabekia viguerasi (Dusbabek)
Artibeus jamaicensis, Cuba (Isla de Pinos) and México

Eutrombicula alfreddivesi (Oudemans) (Trombiculidae)
Artibeus aztecas, México

Eutrombicula alfreddivesi, Costa Rica

Eutrombicula batafas (Linnaeus)
Micronycteris megototis, Venezuela
Uroderma bilobatum, Trinidad

Eutrombicula goeldii (Oudemans)
Artibeus cineres, Trinidad
Carollia brevicauda, Venezuela
Glossophaga longirostris, Venezuela
Phyllostomus discolor, Venezuela
Phyllostomus hastatus, Venezuela

Stenura tillyi, Venezuela

Eutrombicula mactachatranii Brennan and Reed
Vanoups kelleri, Venezuela

Eutrombicula pacae (Fich and Fauran)
Carollia brevicauda, Venezuela
Eurombicula variabilis Brennan and Reed
Macrophyllium macrophyllum, Venezuela

Eurombicula webbi Brennan and Reed
Artibeus jamaicensis, Venezuela

Exastinia dovisi (Pessôa and Guimarães) (Streblidae)
Anoura sp., Venezuela
Anoura cultrata, Panamá
Anoura geoffroyi, Brazil, Colombia, Panamá, Trinidad, and Venezuela
Sturnira lilia

Hooperella sceopteryx Brennan and Jones (Trombiculidae)
Artibeus jamaicensis, Costa Rica*
Desmodus rotundus, Trinidad
Glossophaga soricina, Costa Rica*
Glossophaga commissarisi, México*

Hooperella spinirostra Vercammen-Grandjean
Micronycteris megalotis, Brazil

Hooperella vesperuginis (Brennan and Jones)
Artibeus jamaicensis, México, Nicaragua*, and Trinidad
Artibeus lituratus, Mexico*
Carollia sp., Panamá
Carollia castanea, Nicaragua*
Carollia perspicillata, Nicaragua*, Surinam, and Trinidad
Carollia subrubra, México* and Nicaragua*
Chiropterus auritus, Nicaragua*
Desmodus rotundus, Nicaragua* and Trinidad
Glossophaga alticola, México* and Nicaragua*
Glossophaga commissarisi, Nicaragua*
Glossophaga soricina, México*, Nicaragua*, Panama, and Surinam
Micronycteris niras, Trinidad
Micronycteris megalotis, Trinidad
Phyllostomus discolor, Nicaragua*
Sturnira lilia, Nicaragua*
Vampyrus spectrum, Panamá and Trinidad

Ioannela martae Dusbabek and Lukoseh (Myobididae)
Mimos crenulatum, Venezuela

Ixodes sp. (Ixodidae)
Artibeus jamaicensis, Venezuela
Sturnira lilia, Venezuela
Sturnira ludovici, Venezuela

Ixodes dorsalis Kohls
Anoura geoffroyi, Trinidad

Labidocarpus lukosechi Fain (Labidocarpidae)
Micronycteris megalotis, Surinam

Lawrenceocarpus lobus McDaniel (Labidocarpidae)
Carollia perspicillata, Nicaragua

Lawrenceocarpus microplius Dusbabek and de la Cruz
Brachyphylla cavernarum, Puerto Rico

Lawrenceocarpus phyllostomus McDaniel
Micronycteris niras, Venezuela
Phyllostomus discolor, Venezuela

Lawrenceocarpus puertoricensis de la Cruz, Tamsitt, and Valdivieso
Brachyphylla cavernarum, Puerto Rico

Leptotrombidium hamaxiaium (Brennan and Dalmat) (Trombiculidae)
Artibeus jamaicensis, Costa Rica*
Artibeus toltecus, Panamá
Loomisia alcithoeae Brennan and Reed (Trombiculidae)
Carolia sp., Venezuela

Loomisia desmodus (Brennan and Dalmat)
Anoura Geoffroyi, Venezuela
Artibeus toltecus, Costa Rica* and Nicaragua*
Carolia sp., Venezuela
Carollia castanea, Costa Rica*
Carollia perspicillata, Colombia, Nicaragua*, Surinam, Trinidad and Venezuela
Carollia subrufa, Nicaragua*, Panamá, and Venezuela
Desmodus rotundus, Guatemala, Nicaragua*, and Venezuela
Erophylla sezekorni, Bahamas
Glossophaga longirostris, Venezuela
Glossophaga soricina, México, Nicaragua*, Panamá, Surinam, and Venezuela
Lonchophylla robusta, Costa Rica* and Venezuela
Microcytherus megacrotis, Panamá and Trinidad
Monon ezeudex, México
Sturira lituus, Venezuela
Trachops cirrhosus, México*
Vamyprops vittatus, Costa Rica*

Loomisia sprossi (Brennan)
Carollia castanea, Nicaragua*
Glossophaga soricina, México
Lonchophylla concava, Costa Rica*
Macrocytherus californicus, California

Loomisia univari (Brennan)
Glossophaga soricina, México*

Loomisia junkeri Brennan and Reed
Carolia sp., Venezuela

Macronysoidea sp. (Macronysidae)
Enchisthenes hartii, Panamá
Uroderma biobatum, Panamá
Vampyressa puilla, Panamá

Macronysoidea conciliatus Radovsky
Vamyprops vittatus, Panamá

Macronysoidea kochi (Fonseca)
Artibeus aztecanus, Panamá
Artibeus jamaicensis, Cuba, Panamá, and Trinidad
Artibeus lituratus, Brazil, Colombia, and Trinidad
Artibeus toltecus, Panamá
Brachyphylla nova, Cuba
Desmodus rotundus, Brazil and Trinidad
Glossophaga soricina, Trinidad
Phylonycteris poeyi, Cuba

Macronyssus undens Radovsky (Macronysidae)
Leptosycteris sanborni, Arizona

Mastoptera guimaraesii Wenzel (Streblidae)
Carolia perspicillata, Panamá
Phyllostomus sp., Panamá
Phyllostomus hastatus, Colombia and Panamá

Mastoptera minuta (Costa Lima)
Phyllostomus hastatus, Colombia
Tonatia sp., Bolivia, Colombia, Ecuador, Peru, and Surinam
Tonatia nicaraguana, Panamá
Tonatia sylvicola, Brazil and Panamá
**Megistopoda** sp (Streblidae)

*Artibeus cinereus*, Trinidad

**Megistopoda aranea** (Coquillett)

*Artibeus jamaicensis*, Brazil, Costa Rica, Colombia, Cuba, El Salvador, Guatemala, México, Panamá, Puerto Rico, Surinam, Trinidad, and Venezuela

*Artibeus lituratus*, Colombia, Panamá, and Trinidad

*Carollia perspicillata*, Panamá

*Desmodus rotundus*, Panamá

*Phyllostomus sp.*, Brazil and Cuba

*Phyllostomus discolor*, Panamá

**Megistopoda pilatei** Macquart

*Vampyrops lineatus*, Brazil, Cuba, México, and U.S.A.

**Megistopoda proxima** (Séguy)

*Sturnira lilium*, Colombia and Panamá

*Sturnira ludovici*, Costa Rica

**Megistopoda theodori** Wenzel

*Sturnira ludovici*, Panamá

**Metelasmus pseudopterus** Coquillett (Streblidae)

*Artibeus jamaicensis*, Panamá

*Artibeus lituratus*, Panamá and Paraguay

*Carollia perspicillata*, Panamá

*Vampyressa nympheu*, Panamá

**Microtrombicula boneti** (Hoffmann) (Trombiculidae)

*Artibeus toltecus*, México

*Desmodus rotundus*, México

*Erhophyllum sezekorni*, Bahamas

*Glossophaga soricina*, México

*Micronycteris megalotis*, Curaçao

*Phyllostomus hastatus*, Panamá

**Microtrombicula carmenae** (Brennan and Jones)

*Artibeus jamaicensis*, Panamá

*Phyllostomus discolor*, Costa Rica, Nicaragua, and Trinidad

*Phyllostomus hastatus*, Panamá

*Sturnira ludovici*, Costa Rica and Panamá

*Sturnira mordax*, Costa Rica

**Microtrombicula sturnirae** Webb and Loomis

*Sturnira lilium*, México and Nicaragua

*Sturnira ludovici*, Costa Rica and Panamá

*Sturnira mordax*, Costa Rica

**Nascola anneraexi** Brennan and Yunker (Trombiculidae)

*Phyllostomus hastatus*, Venezuela

**Neotrichobius delicatus** (Machado-Allison) (Streblidae)

*Artibeus cinereus*, Panamá and Trinidad

*Artibeus jamaicensis*, Panamá

*Phyllostomus hastatus*, Surinam

*Uroderma bilobatum*, Panamá

*Vampyressa pusilla*, Panamá and Venezuela

**Nycteriglyphus sturnirae** Faiv (Rossneisteinidae)

*Sturnira lilium*, Brazil

**Nycterinastes primus** Brennan and Reed (Trombiculidae)

*Anoura sp.*, Venezuela

*Anoura geoffroyi*, Venezuela

*Carollia perspicillata*, Venezuela

*Desmodus rotundus*, Venezuela
Biology of the Phyllostomatidae

Glossophaga soricina, Venezuela
Lionycteris spurrilli, Venezuela
Lonchorhina aurita, Venezuela

Nycterinastes secundus Brennan and Reed
Andura geoffroyi, Costa Rica* and Venezuela
Lonchophylla robusta, Costa Rica*

Nycteronyssus desmodus Herrin and Radowsky (Macronyssidae)
Diaemus youngi, Venezuela

Nycterophila sp. (Streblidae)
Macrota waterhousei, México*

Nycterophila coxata Ferris
Artibeus jamaicensis
Brachyphylla cavernarum, British West Indies
Macrota californicus, Arizona and California
Macrota waterhousei, México

Nycterophila purnelli Wenzel
Carollia perspicillata, Panamá
Macrota waterhousei, Cuba

Ornithodoros sp. (Argasidae)
Leptonycteris curasoae, Venezuela
Lonchothrix ovinoceros, Venezuela
Macrota californicus, Arizona
Mimos crenatum, Venezuela
Seminaria filium, Venezuela
Trachops cirrhosus, Venezuela

Ornithodoros azteci Matheson
Artibeus jamaicensis, Cuba, México, and Venezuela
Brachyphylla nana, Cuba
Carollia sp., Venezuela
Desmodus rotundus, México, Panamá, Trinidad
Glossophaga longirostris, Venezuela
Glossophaga soricina, Venezuela
Lonchothrix aurita, Cuba, Jamaica, Trinidad, and Venezuela
Macrota leucopus, Venezuela
Macrota waterhousei, Cuba
Phyllostomus hastatus, Venezuela
Trachops cirrhosus, Venezuela

Ornithodoros brodii Matheson
Artibeus jamaicensis, México
Carollia sp., Venezuela
Carollia perspicillata, Panamá and Venezuela
Chiropteropus auritus, México
Lonchothrix aurita, Venezuela
Trachops cirrhosus, Panamá

Ornithodoros dusseaueki Cervi
Artibeus jamaicensis, Cuba (Isla de Pinos)

Ornithodoros hasei (Schulze)
Artibeus jamaicensis, Venezuela
Artibeus lituratus, Costa Rica
Brachyphylla cavernarum, Guadeloupe* and Martinique
Carollia sp., Venezuela
Carollia perspicillata, Venezuela
Chiroderma salvini, Venezuela
Glossophaga longirostris, Venezuela
Lonchophylax aurita, Venezuela
Lonchophylax ariminensis, Venezuela
Macrolophus waterhousii, Jamaica**
Mimom crumata, Venezuela
Phyllonycteris aphylla, Jamaica**
Phyllonycteris hastatus, Venezuela
Stenolaema lutea, Venezuela
Stenolaema ludovici, Venezuela
Tonatia sylvicola, Panamá
Uroderma biobatum, Panamá
Uroderma magnirostrum, Venezuela
Vampyrops helleri, Panama

Ornithodoros mimon Kohls, Clifford, and Jones
Mimom crumata, Bolivia

Ornithodoros peruvianus Kohls, Clifford, and Jones
Desmodus rotundus, Perú
Glossiphana sp., Perú

Ornithodoros rossi Kohls, Sosenshine, and Clifford
Glossiphana longirostris, Venezuela
Leptonycteris rutilis, Arizona
Lonchophylax ariminensis, Venezuela
Macrolophus californicus, México

Ornithodoros videog Cooley and Kohls
Brachyphylla nova, Cuba
Erophylla hondurensis, Puerto Rico
Phyllonycteris pocyi, Cuba and Haiti**

Ornithodoros yumatensis Cooley and Kohls
Artibeus aztecus, México
Artibeus lituratus, México
Carollia perspicillata, Venezuela
Desmodus rotundus, México

Paradytchirus parvuloides Wenzel (Streblidae)
Anura geoffroyi
Glossiphana soroquina

Paraeuteneodes longipes Pessôa and Guimarães (Streblidae)
Anura geoffroyi
Anura geoffroyi
Phyllonotus hastatus, Brazil

Parahosma maxima McDaniel (Labidocarpidae)
Enchisthenes hartii, Venezuela
Glossiphana longirostris, Venezuela

Parahosma tadarida McDaniel and Lawrence
Carollia breviceps, Venezuela
Glossiphana longirostris, Venezuela
Stenolaema lutea, Venezuela

Paralabidocarpus artibe McPhee and Pinchponse (Labidocarpidae)
Artibeus lituratus, Trinidad
Stenoderma rufum, Puerto Rico
Stenolaema lutea, Nicaragua

Paralabidocarpus carolliae Fain
Carollia perspicillata, Surinam

Paralabidocarpus desmodus Fain
Desmodus rotundus, Surinam

Paralabidocarpus foxi de la Cruz, Tamsitt, and Valdivieso
Artibeus jamaicensis, Puerto Rico
Stenoderma rufum, Puerto Rico
Paralabidocarpus macrophyllum Fain
  Macrophyllum macrophyllum, Surinam
Paralabidocarpus stenodermi de la Cruz, Tamsitt, and Valdivieso
  Stenodermus rufum, Puerto Rico
Paralabidocarpus tonatiae Fain
  Tonatia venezuelae, Venezuela
Paralabidocarpus trachops Fain
  Trachops cirrhosus, Surinam
Parascoschoengastia aemulata (Brennan and Jones) (TROMBICULIDAE)
  Anura cuadros, Venezuela
  Sturnina leucopsis, México*
Parascoschoengastia megastyrax (Brennan and Jones)
  Carolia perspicillata, Panamá
Parascoschoengastia longicalcar (Brennan and Jones) (TROMBICULIDAE)
  Desmodus rotundus, Trinidad
  Vampyrus spectrum, Panamá
Parasceia manueli (Brennan and Yunker)
  Uroderma bilobatum, Costa Rica*
Parasceia soucouyant (Brennan and Yunker)
  Sturnina ludovici, Panamá
Parascreba handleyi Wenzel (STREBILIDAE)
  Micronyx eis nichcusi, Panamá
Paratrichobius sp. (STREBILIDAE)
  Artibeus azteca, Panamá
  Artibeus lituratus. Colombia and Panamá
  Artibeus toltecus, Panamá
  Chiroderma villosum, Panamá
  Vampyrus helleri, Panamá
  Vampyrus vittatus, Panamá
Paratrichobius americanus Peterson and Ross
  Choeronycteris mexicana, Arizona
Paratrichobius dunnii (Curran)
  Artibeus jamaicensis
  Uroderma bilobatum, Panamá
Paratrichobius longicrus (M. Ribeiro)
  Artibeus jamaicensis, Brazil, Colombia, and Panamá
  Artibeus lituratus, El Salvador and Trinidad
  Carolia perspicillata
  Uroderma bilobatum
  Vampyrus lineatus
Paratrichobius lowei Wenzel
  Artibeus watsoni, Panamá
Paratrichobius salvini Wenzel
  Chiroderma salvini, Panamá
Paratrichobius sanchezii Wenzel
  Enchisthenes harrii, Panamá and Venezuela
Parichoronyssus sp. (MACRONYSSIDAE)
  Artibeus azteca, Panamá
  Artibeus toltecus, Panamá
  Vampyrodes catacciloai, Panamá
Parichoronyssus crassipes Radovsky
  Carolia perspicillata, Panamá
Parichoronyssus eusthenum Radovsky
  Sturnina ludovici, Panamá
Parichoronyssus selerus Radovsky
Glossophaga soricina, Panamá
Phylllostomus sp., Costa Rica

Perates anophthalma (Hoffmann) (Trombiculidae)
Ariteus aztecs, México*
Caroliella perspicillata, Trinidad
Desmodus rotundus, México and Panamá
Eryophylla szekorii, Bahamas
Micronycteris megalotis, Colombia and Perú

Periglischirus sp. (Spinurmicidae)
Caroliella perspicillata, Panamá
Lonchothere robusta, Panamá
Macrophyllum macrophyllum, Panamá

Periglischirus acurisernus Machado-Allison
Ariteus concolor, Venezuela
Phylllostomus discolor, Trinidad and Venezuela
Phylllostomus elongatus, Trinidad and Venezuela
Phylllostomus hastatus, Colombia, Panamá, Trinidad, and Venezuela

Periglischirus caligus Kolenati
Anoura cardivera, Venezuela
Anoura cultrata, Venezuela
Glossophaga sp., México and Panamá
Glossophaga longirostris, Venezuela
Glossophaga soricina, Brazil, Panamá, Surinam, Trinidad, and Venezuela

Periglischirus cubanus Dusbabek
Brachyphylla nana, Cuba
Eryophylla szekorii, Cuba
Phyllioncyritis poeyi, Cuba

Periglischirus delfinadoae Dusbabek
Mycerus waterhousei, Cuba

Periglischirus dusbabeki Machado-Allison and Antequera
Mimon crenulatum, Venezuela

Periglischirus gameroi Machado-Allison and Antequera
Lonchorhina aurita, Venezuela

Periglischirus hererrai Machado-Allison
Desmodus rotundus, Panamá, Trinidad, and Venezuela

Periglischirus hopkinsi Machado-Allison
Lioncyritis sparreri, Venezuela
Rhinotheilla pumilio, Brazil and Venezuela

Periglischirus iheringi Oudemans
Ariteus sp., Panamá
Ariteus aztecs, México, Panamá, and Venezuela
Ariteus cincturus, Panamá, Paraguay, and Venezuela
Ariteus tolteca, Panamá and Venezuela
Ariteus concolor, Venezuela
Ariteus jamaicense, Cuba, México, Panamá, Puerto Rico, Venezuela, and Virgin Islands
Ariteus lituratus, Brazil, Colombia, Guatemala, Honduras, Panamá, Paraguay, Surinam, Trinidad, and Venezuela

Chirolodermus sp., Venezuela
Chirolodermus salvini, Panamá and Venezuela
Desmodus rotundus, México and Panamá
Enchisthenes hartii, Panama and Venezuela
Silenodermus rufum, Puerto Rico
BIOLOGY OF THE PHYLLOSTOMATIDAE

Sturnira lilium, México
Sturnira ludovici, Colombia and Venezuela
Uroderma bilobatum, Guatemala, Panamá, Paraguay, and Venezuela
Vampyressa pusilla, Panamá
Vampyrophes canaccioloi, Panamá
Vampyrops sp., Paraguay
Vampyrops dorsalis, Venezuela
Vampyrops helleri, México and Panamá
Vampyrops lineatus, Brazil
Vampyrops vittatus, Panamá, Paraguay, and Venezuela

Periglischrus micronycteridis Forman
  Microchironycteris megalotis, Panamá and Trinidad
  Microchironycteris minutus, Panamá

Periglischrus djasti Machado-Allison
  Archeus tolteces, México**
  Sturnira lilium, Panamá, Trinidad, and Venezuela
  Sturnira ludovici, Panamá

Periglischrus paracutiferus Machado-Allison
  Anoura geoffroyi, Venezuela
  Trachops cirrhosus, Venezuela

Periglischrus parvus Machado-Allison
  Microchironycteris sp., Venezuela
  Microchironycteris megalotis, Panamá and Trinidad
  Microchironycteris minutus, Panamá

Periglischrus ramirezi Machado-Allison and Antequera
  Rhinolophus pamphilius, Brazil and Venezuela

Periglischrus torrealbai Machado-Allison
  Phylostomus discolor, Venezuela
  Phylostomus hastatus, Panamá, Trinidad, and Venezuela

Periglischrus vargasii Hoffmann
  Anoura sp., Guatemala
  Anoura cadifer, Venezuela
  Anoura coelicauda, Panamá and Venezuela
  Anoura geoffroyi, Colombia, Guatemala, México, Panamá, and Venezuela
  Archeus jamacensis, Cuba and Puerto Rico
  Leptonycteris nivalis, México and Texas
  Leptonycteris sanborni, México
  Macrotus californicus, México
  Macrotus waterhousii, México
  Monophyllus cubanus, Cuba
  Sturnira lilium, México
  Trachops cirrhosus, Panamá

Perissodonta bartoniana (Brennan) (TROMBICULIDAE)
  Carollia perspicillata, Surinam
  Microchironycteris daviesi, Brazil

Perissodonta bellinsi (Hoffmann)
  Archeus aztecus, México*
  Archeus hirsutus, México*
  Glossophaga soricina, México*
  Macrotus californicus, Arizona*, California*, and México*

Perissodonta deceptus (Brennan)
  Microchironycteris megalotis, Perú

Perissodonta eximia (Brennan)
  Carollia perspicillata, Perú and Trinidad
Desmodus rotundus, Trinidad
Diaemus youngii, Trinidad
Glossophaga soricina, Trinidad
Micronycteris megalotis, Perú

Perissopalla iepani Brennan
Carollia perspicillata, Brazil and Surinam

Perissopalla precaria (Brennan and Dalmat)
Desmodus rotundus, Trinidad
Glossophaga soricina, México
Micronycteris megalotis, Panamá

Phyllostomomylossus conradiyunkeri Fain (Gastronyssidae)
Artibeus jamaicensis, Venezuela
Artibeus lituratus, Surinam and Venezuela
Uroderma bilobatum, Surinam
Vampyrops kelleri, Surinam

Pseudalabidocarpus seccus McDaniel (Labidocarpidae)
Phyllostomus discolor, Venezuela
Phyllostomus elongatus, Venezuela

Pseudoschoengastia bulihibera Brennan (Trombiculidae)
Sturisira luevcicci, Panamá

Pseudostrebla greenwelli Wenzel (Streblidae)
Tonatia nicaraguae, Panamá

Pseudostrebla riebeiroi Costa Lima
Tonatia sylvicola, Brazil and Panamá

Psorergatozoides artibeii Lukoschus, Rosmalen, and Fain (Psorergatidae)
Artibeus lituratus, Surinam

Psorergatozoides glossophagae Lukoschus, Rosmalen, and Fain
Glossophaga soricina, Surinam
Psorergatozoides longchirinae Fain
Lonchichirus auri, Venezuela

Radfordiella anourae Radovsky, Jones, and Phillips (Macronyssidae)
Anoura geooffroyi, México

Radfordiella carolliae Radovsky
Carollia castanea, Panamá
Carollia perspicillata, Panamá (Canal Zone)

Radfordiella desmodi Radovsky
Carollia perspicillata, Trinidad
Desmodus rotundus, Panamá and Trinidad

Radfordiella monophylli Radovsky, Jones, and Phillips
Monophyllus redmanni, Cuba

Radfordiella oricola Radovsky, Jones, and Phillips
Anoura geooffroyi, México
Leptonycteris nivalis, México

Radfordiella ouedemansi Forseca
Brachyphylla cavernarum, Puerto Rico
Desmodus rotundus, Brazil
Diaemus youngii, Trinidad

Speiseria ambigua Kessel (Streblidae)
Anoura geooffroyi, Trinidad
Carollia castanea, Panamá
Carollia perspicillata, Colombia, Panamá, and Trinidad
Carollia subrugosa, Panamá
Desmodus rotundus, Panamá
Glossophaga soricina, Trinidad
Lonchophylla robusta, Panamá
Lonchorhina aurita, Panamá
Micronycteris brachyotis, Trinidad
Phyllostomus hastatus, Panamá
Tonatia bidens
Trachops cirrhosus, Panamá
Vampyrops vittatus, Panamá

Spelaeorhynchus sp. (Spelaeorhynchidae)
Carollia perspicillata, Brazil

Spelaeorhynchus monophyllus Fain, Anastos, Camin, and Johnston
Monophyllus redmani, Puerto Rico

Spelaeorhynchus praecursor Neumann
Aritbeus sp., México
Aritbeus jamaicensis, Cuba, Dominican Republic, Mexico*+, and Puerto Rico
Carollia castanea, México
Carollia perspicillata, Brazil, Colombia, México, and Venezuela
Glossophaga soricina, Amazon(?)

Speloechir aitkeni Fain (Ereynetidae)
Anoura geoffroyi, Trinidad

Speloechir barbulata Fain and Aitken
Mimon crenulatum, Brazil

Speloechir brasiliensis Fain and Aitken
Aritbeus jamaicensis, Brazil
Vampyrodus caraccioi, Brazil

Speloechir carollae Fain and Lukoschus
Carollia perspicillata, Surinam

Speloechir phyllostomi (Clark)
Phyllostomus hastatus, Colombia

Speloeclota davisii Webb and Loomis (Trombiculidae)
Desmodus rotundus, México
Glossophaga soricina, México
Leptonycteris sunbornii, México

Speloeclota secunda Brennan and Jones
Carollia castanea, Nicaragua*
Carollia perspicillata, Surinam
Carollia subrubra, Nicaragua*
Desmodus rotundus, Trinidad
Glossophaga commissarissi, Nicaragua*
Glossophaga soricina, Nicaragua
Micronycteris hirsuta, Trinidad
Micronycteris megalotis, Trinidad

Stenotyus sotoqui (Fonsca) (Mackronyssidae)
Glossophaga soricina, Brazil

Stizostrebla longirostris Jobling (Striblidae)
Tonatia sp., Brazil and Colombia

Strebla sp. (Striblidae)
Dianthus youngi, Trinidad

Strebla almaní Wenzel
Carollia perspicillata, Panamá
Lonchorhina aurita, Panamá and Venezuela
Macrophlyllum macrophyllum, Panamá
Trachops cirrhosus, Panamá

Strebla alvarezi Wenzel
Micronycteris megalotis, Panamá
Micronycteris nicefori, Panamá
Micronycteris sylvestris, Panamá
Strebla carolliae Wenzel
Artibeus jamaicensis, Panamá
Carollia sp., Surinam
Carollia castanea, Panamá
Carollia perspicillata, Brazil, Colombia, Panamá, Trinidad, and Venezuela
Carollia subrugosa, Panamá
Desmodus rotundus, Panamá
Glossophaga soricina, El Salvador, Panamá, and Venezuela
Lonchophylla robusta, Panamá
Lonchorkhinia aurita, Panamá
Macrophylla macrophylla, Panamá
Phyllostomus hastatus, Panamá
Trachops cirrhosus, Panamá

Strebla christinae Wenzel
Phylloderma stenops, Panamá

Strebla consocia Wenzel
Carollia perspicillata, Trinidad
Phyllostomus sp., Perú and Surinam
Phyllostomus discolor, Colombia
Phyllostomus hastatus, Surinam, Trinidad, and Venezuela
Trachops sp., Perú

Strebla diaemi Wenzel
Diaemus youngii, Colombia and Panamá

Strebla diphyllae Wenzel
Desmodus rotundus, Guatemala
Diphylla ecaudata, Guatemala and México
Trachops cirrhosus, Guatemala

Strebla galindoii Wenzel
Tonatia sp., Trinidad
Tonatia bidens, Panamá

Strebla hertigi Wenzel
Artibeus jamaicensis, Panamá
Desmodus rotundus, El Salvador and Panamá
Phyllostomus discolor, Colombia, Costa Rica, El Salvador, México, Nicaragua, Panamá, Surinam, Trinidad, and Venezuela
Phyllostomus hastatus, Costa Rica, Nicaragua, and Panamá

Strebla hoogstraali Wenzel
Tonatia nicaraguensis, Panamá

Strebla kohlsi Wenzel
Tonatia sylvicola, Colombia and Panamá

Strebla machadoi Wenzel
Micronycteris minuta, Venezuela

Strebla mirabilis (Waterhouse)
Carollia perspicillata, Brazil, Panamá, and Trinidad
Desmodus rotundus, Perú and Trinidad
Diphylla ecaudata
Glossophaga soricina, Trinidad
Phyllostomus sp., Brazil, Panamá, and Perú
Phyllostomus discolor, Trinidad
Phyllostomus elongatus
Phyllostomus hastatus, Colombia, Panamá, Perú, and Trinidad
Tonatia sp., Colombia
Tonatia bidens

Strebla tonatiae (Kessel)
Tonatia bidens
Tonatia brasiliense, Ecuador and Panamá
Strebla wiedemanni Kolenati
Anoura caudifera, Brazil
Anoura geoffroyi
Artibeus jamaicensis, Panamá
Chrotopterus auritus, Brazil
Desmodus rotundus, Colombia, Ecuador, El Salvador, Guatemala,
Desmodus rotundus, Colombia, Ecuador, El Salvador, Guatemala, Honduras,
México, Panamá, Perú, Surinam, Trinidad, and Venezuela
Vanpyrops lineatus, Brazil
Tecomatitana sandovali Hoffmann (Trombiculidae)
Artibeus phaeoticus, México*
Desmodus rotundus, México*
Macrota californica, Arizona
Tecomatitana watkinsi Vercammen-Grandjean
Macrota californica, Arizona*, California, and México*
Trichobioides perspicillatus (Pessoa and Galvão) (Streblidae)
Carollia perspicillata, Brazil, México, and Perú
Desmodus rotundus, Panamá and Trinidad
Phyllostomus discolor, Colombia, Panamá, and Trinidad
Phyllostomus elongatus, Colombia
Phyllostomus hastatus, Surinam
Siurnira lilium, Panamá
Trichobius adamsi Augustson (Streblidae)
Macrota californica, Arizona, California, and México
Trichobius bequaerti Wenzel
Tonatia bidens, Panamá
Trichobius brevani Wenzel
Siurnira ludovici, Panamá
Trichobius cernyi Peterson and Hürka
Artibeus jamaicensis, Cuba
Monophyllus redmani, Cuba
Phyllostomus poeyi, Cuba
Trichobius costalmae Guimarães
Artibeus lituratus, Panamá
Carollia perspicillata, Panamá
Desmodus rotundus, Panamá
Phyllostomus discolor, Colombia, El Salvador, Guatemala, Panamá, Perú,
Puerto Rico, Trinidad, and Venezuela
Uroderma bilobatum, Panamá
Trichobius diphylla Wenzel
Diphylla ecaudata, Guatemala, México, and Venezuela
Trichobius dominicanus Peterson and Hürka
Monophyllus sp., Dominican Republic
Trichobius dugessii Townsend
Anoura geoffroyi, Trinidad
Artibeus jamaicensis, Cuba and Panamá
Carollia perspicillata, Costa Rica, Nicaragua, Panamá, and
Trinidad
Desmodus rotundus, Trinidad
Diaenous youngii, Trinidad
Enchisthenes harili, Trinidad
Glossophaga soricina, Colombia, El Salvador, Guatemala, México,
Panamá, Perú, and Trinidad
Micronycteris brachyotis, Trinidad
Phyllostomus hastatus, Trinidad
Trachops cirrhosus, Panamá
Trichobius dusesoides Wenzel
Carollia perspicillata, Panamá
Chrotomys auritus, Panamá
Lonchorhina aurita, Panamá
Trachops cirrhosus, Panamá

Trichobius dybasi Wenzel
Tomatia sylvicola, Panamá

Trichobius frequens Peterson and Hürka
Arizbeus jamaicensis, Cuba and Dominican Republic
Brachyphylla nana, Cuba
Brachyphylla paumila, Dominican Republic
Erophylla szekernyi, Cuba
Monophyllus redmani, Cuba
Phyllonycteris poeyi, Cuba and Dominican Republic

Trichobius furmani Wenzel
Desmodus rotundus, Peru
Diphylla ecaudata, Colombia
Glossophaga soricina, Paraguay

Trichobius intermedius Peterson and Hürka
Arizbeus sp., Guatemala and El Salvador
Arizbeus hirsutus, Mexico
Arizbeus jamaicensis, Bahamas, Cuba, Dominican Republic, Jamaica, Mexico, Puerto Rico, and Virgin Islands
Arizbeus lituarius, Mexico
Erophylla szekernyi, Cuba
Macrotus waterhousii, Jamaica
Monophyllus redmani, Dominican Republic
Phyllonycteris poeyi, Cuba and Dominican Republic

Trichobius joblingi Wenzel
Arizbeus jamaicensis, Panamá
Arizbeus litiarius, Panamá
Carollia castanea, Panamá
Carollia perspicillata, Brazil, Belize, Colombia, Costa Rica, El Salvador, Guatemala, Panamá, Peru, Surinam, Tobago, Trinidad, and Venezuela
Carollia subrufa, Panamá
Chirotoma villosa, Panamá
Desmodus rotundus, Panamá and Trinidad
Glossophaga soricina, Panamá and Trinidad
Lonchophylla robusta, Panamá
Lonchorhina aurita, Panamá
Macrophyllum macrophyllum, Panamá
Micronycteris brachyotis, Trinidad
Micronycteris nixefori, Panamá
Phyllonotus hastatus, Panamá and Trinidad
Tomatia sylvicola, Panamá
Trachops cirrhosus, Panamá
Uroderma bilobatum, Panamá

Trichobius johnsonae Wenzel
Carollia perspicillata, Panamá
Lonchophylla robusta, Panamá

Trichobius keenani Wenzel
Micronycteris megalotis, Panamá
Micronycteris nixefori, Panamá
Uroderma bilobatum, Panamá
Trichobius lionycteris Wenzel
  *Lionycteris spurrelli*, Panamá and Perú

Trichobius lynchophyllae Wenzel
  *Artibeus liuratus*, Panamá
  *Lonchophylla robusta*, Panamá

Trichobius longipes (Rudow)
  *Anoura geoffroyi*, Trinidad
  *Artibeus jamaicensis*, Cuba and Panamá
  *Cerollia perspicillata*, Panamá
  *Choeronycteris mexicana*, Arizona
  *Phyllostomus sp.*, Panamá
  *Phyllotomus discolor*, Trinidad
  *Phyllostomus hastatus*, Bolivia, Costa Rica, Colombia, Guatemala, Panamá, Perú, Surinam, Trinidad, and Venezuela

Trichobius macrophylli Wenzel
  *Cerollia perspicillata*, Panamá
  *Lonchonia aurita*, Panamá
  *Macrophyllum macrophyllum*, Panamá

Trichobius macroti Peterson and Hürka
  *Macrotus waterhousei*, Bahamas and Cuba

Trichobius mendezii Wenzel
  *Tonatia nicaraguensis*, Panamá

Trichobius neotropicus Peterson and Hürka
  *Macrotus waterhousei*, Dominican Republic

Trichobius parasiticus Gervais
  *Cerollia perspicillata*, Trinidad
  *Desmodus rotundus*, Brazil, Colombia, Costa Rica, El Salvador, Guatemala, México, Panamá, Perú, Surinam, Trinidad, and Venezuela
  *Diaemus youngii*, Panamá
  *Diphylla ecaudata*, Mexico
  *Glossophaga soricina*
  *Monophyllus redmani*, Jamaica
  *Phyllonycteris poeyl*
  *Phyllostomus hastatus*, Panamá
  *Tonatia sylvicola*, Brazil
  *Vampyrum spectrum*

Trichobius phyllostomae Kessel
  *Phyllostomus sp.*, Brazil
  *Phyllostomus hastatus*

Trichobius pseudotruncatus Jobling
  *Artibeus jamaicensis*

Trichobius robynae Peterson and Hürka
  *Artibeus jamaicensis*, Puerto Rico
  *Erophylla szekornii*, Puerto Rico
  *Monophyllus redmani*, Puerto Rico

Trichobius sparsus Kessel
  *Cerollia perspicillata*, Panamá

Trichobius sphaeronotus Jobling
  *Leptonycteris nivalis*, Texas
  *Leptonycteris sanborni*, Arizona, México, and New Mexico

Trichobius truncatus Kessel
  *Artibeus jamaicensis
  *Brachyphylla cavernarum*, Puerto Rico
  *Erophylla bombifrons*, Puerto Rico
Macrotus waterhousii, Cuba
Monophyllus redmani, Puerto Rico
Phyllomycteris poeyi

Trichobius uniformis Curran
  Artibeus jamaicensis, Panamá
  Desmodus rotundus, Panamá
  Glossophaga soricina, Costa Rica, Guatemala, Guyana, México,
  Panamá, Perú, and Venezuela
  Lonchopteryx robusta, Panamá

Trichobius urodendri Wenzel
  Uroderma bilobatum, Panamá and Venezuela

Trichobius vampyropis Wenzel
  Artibeus lituratus, Panamá
  Vampyrops vitatus, Panamá and Venezuela

Trichobius yunkeri Wenzel
  Artibeus lituratus, Panamá
  Carollia perspicillata, Panamá
  Lonchorhina aurita, Panamá
  Stenocrolade chipero, Panamá

Trombicula dunni Ewing (TROMBICULIDAE)
  Vampyressa pusilla, Panamá

Wagenaaria similis Brennan (TROMBICULIDAE)
  Glossophaga soricina, México*

Whartonia glieni californica Verammen-Grandjean, Watkins,
  and Beck (TROMBICULIDAE)
  Choeronycteris mexicanus, México*
  Macrothylactus californicus, Arizona*, California, and México*

Whartonia guerrerensis Hoffmann
  Erophylla seckelkorni, Bahamas

Whartonia nudosetosa (Warton)
  Artibeus jamaicensis, México
  Carollia sp., Costa Rica*
  Carollia perspicillata, Costa Rica*, Guatemala, México, Nicaragua*, and
  Trinidad
  Carollia subrufa, México*
  Desmodus rotundus, México and Trinidad
  Glossophaga soricina, México and Nicaragua*
  Macrothylactus sp., Jamaica
  Mimon coazumelae, México

Whartonia pachywhartonii Verammen-Grandjean
  Micronycteris megalotis, Brazil

Xenodontacarus serratus Loosli and Goff (TROMBICULIDAE)
  Artibeus lituratus, México

HOST-PARASITE LIST

Ectoparasites known from each host species are listed alphabetically. A single
asterisk indicates an unpublished record from the Chigger Laboratory, California
State University, Long Beach; two asterisks indicate an unpublished record from
The Museum, Texas Tech University, Lubbock. Geographic origin of records is
given if known. Since this list was prepared, four publications (Brennan and
Bronswijk, 1975; Brennan and Reed, 1975; Herrin and Yunker, 1975; Reed and
Brennan, 1975) have appeared that should be consulted for additional records.
Anoura sp.

*Anastroblea matudeni* (Streblidae), Venezuela (reported by Wenzel et al., 1966, as from *A. aculeata*, possibly a manuscript name, but in any event unknown to us)

*Exastinon clovisi* (Streblidae), Venezuela (same as above)

*Nycterinastes primus* (Trombiculidae), Venezuela

*Periglischrus vargasii* (Spinturnicidae), Guatemala

**Anoura culturata** Handley

*Anastroblea matudeni* (Streblidae), Panamá

*Exastinon clovisi* (Streblidae), Panamá

*Periglischrus caligus* (Streblidae), Venezuela

*Periglischrus vargasii* (Spinturnicidae), Panamá and Venezuela

**Anoura caudifer** (E. Geoffroy St.-Hilaire)

*Alabidocaptor furmani* (Labidocarpidae), Venezuela

*Anastroblea matudeni* (Streblidae), Colombia

*Praeuctenodes longipes* (Streblidae), Brazil

*Parascobengastia aemulata* (Trombiculidae), Venezuela

*Periglischrus caligus* (Spinturnicidae), Venezuela

*Periglischrus vargasii* (Spinturnicidae), Venezuela

*Streblia wiedemanni* (Streblidae), Brazil

**Anoura geoffroyi** Gray

*Alabidocaptor furmani* (Labidocarpidae), Nicaragua and Trinidad

*Anastroblea matudeni* (Streblidae), Panamá and Venezuela

*Anastroblea modestini* (Streblidae), Guatemala, México, Panamá, and Trinidad

*Aspidoptera phyllostomatidis* (Streblidae), Trinidad (?)

*Basilac speiseri* (Nycteribiidae)

*Exastinon clovisi* (Streblidae), Brazil, Colombia, Panamá, Trinidad, and Venezuela

*Chiorrhynchobius masoni* (Chiorrhynchobiidae), Venezuela

*Exodes downsii* (Ixodidae), Trinidad

*Locustia desmodus* (Trombiculidae), Venezuela

*Nycterinastes primus* (Trombiculidae), Venezuela

*Nycterinastes secundus* (Trombiculidae), Costa Rica* and Venezuela

*Paradysschiria parvaloides* (Streblidae)

*Praeuctenodes longipes* (Streblidae)

*Periglischrus paracutieranus* (Spinturnicidae), Venezuela

*Periglischrus vargasi* (Spinturnicidae), Colombia, Guatemala, México, Panamá, and Venezuela

*Radfordiella anourae* (Macronyssidae), México

*Radfordiella oricola* (Macronyssidae), México

*Speiseria ambigua* (Streblidae), Trinidad

*Speleocbir aikenii* (Ereynetidae), Trinidad

*Streblia wiedemanni* (Streblidae)

*Trichobius dugesi* (Streblidae), Trinidad

*Trichobius longipes* (Streblidae), Trinidad

**Artibeus sp.**

*Aspidoptera knucki* (Streblidae), Puerto Rico

*Aspidoptera phyllostomatis* (Streblidae)

*Periglischrus iheringi* (Spinturnicidae), Panamá

*Speleocbirius praecursor* (Spelaeorhynchidae), México

*Trichobius intermedius* (Streblidae), Guatemala and El Salvador

**Artibeus aztecs** Anderson

*Eutrombicula alfredi* (Trombiculidae), México*

*Macronyssoides kochi* (Macronyssidae), Panamá
Ornithodoros yumatensis (Argasidae), México
Paratrichobius sp. (Strebloidae), Panamá
Parichoronysius sp. (Macronyssidae), Panamá
Perates anophthalma (Trombiculidae), México*
Periglieschirius iberinig (Spiinturnicidae), México, Panamá, and Venezuela
Perissopalla beltrani (Trombiculidae), México*

Artibeus cinereus (Gervais)
Alabidocarpus guayanensis (Labidoceridae), Surinam
Chirnysoides capturi (Sarcopota), Panamá
Eutrombicula geoldi (Trombiculidae), Trinidad
Megistopoda sp. (Strebloidae), Trinidad
Neotrichobius delicatus (Strebloidae), Panamá and Trinidad
Periglieschirius iberinig (Spiinturnicidae), Panamá, Paraguay, and Venezuela

Artibeus concolor Peters
Periglieschirius acutisterni (Spiinturnicidae), Venezuela
Periglieschirius iberinig (Spiinturnicidae), Venezuela

Artibeus hirsutus Andersen
Perissopalla beltrani (Trombiculidae), México*
Trichobius intermedius (Strebloidae), México

Artibeus jamaicensis Leach
Amblyomma sp. (Ixodidae), Venezuela
Aspidoptera huací (Strebloidae), Colombia, Cuba, Guatemala, México, and Panamá
Basilia bellardi (Necteribiidae), Brazil
Basilia rondani (Necteribiidae)
Basilia wenzeli (Necteribiidae), Panamá
Chirnysoides capturi (Sarcoptidae), México** and Panamá
Chirpaxella myops (Trombiculidae), México
Eutrombicula vigueri (Myobiidae), Cuba (Isla de Pinos) and México**
Eutrombicula alfreddegei (Trombiculidae), Costa Rica*
Eutrombicula webbi (Trombiculidae), Venezuela
Hooperaella succopteryx (Trombiculidae), Costa Rica*
Hooperaella vesperruginis (Trombiculidae), México, Nicaragua*, and Trinidad
Ixodes sp. (Ixodidae), Venezuela
Leptotrombidium hamaxialum (Trombiculidae), Costa Rica* and Panamá
Macronyssoides kochi (Macronyssidae), Cuba, Panamá, and Trinidad
Megistopoda aranea (Strebloidae), Brazil, Costa Rica, Colombia, El Salvador, Guatemala, México, Panamá, Puerto Rico, Surinam, Trinidad, and Venezuela
Metelasmus pseudopterus (Strebloidae), Panamá
Microtrombicula carmenae (Trombiculidae), Panamá
Neotrichobius delicatus (Strebloidae), Panamá
Nycterophilus coxata (Strebloidae)
Ornithodoros azteci (Argasidae), Cuba, México, and Venezuela
Ornithodoros brazi (Argasidae), México
Ornithodoros dusabeki (Argasidae), Cuba (Isla de Pinos)
Ornithodoros hasei (Argasidae), Venezuela
Paralabidocarpus foxi (Labidoceridae), Puerto Rico
Paratrichobius dunni (Strebloidae)
Paratrichobius longicornis (Strebloidae), Brazil, Colombia, and Panamá
Periglieschirius iberinig (Spiinturnicidae), Cuba, México, Panamá, Puerto Rico, Venezuela, and Virgin Islands
Periglieschirius vurgasi (Spiinturnicidae), Cuba and Puerto Rico
Phyllostomomyssus conradjunkerii (Gastromyssidae), Venezuela
Speloaorhynchus praecursor (Speloaorhynchidae), Cuba, Dominican Republic, 
México**, and Puerto Rico
Speleoehir brasiliensis (Ereynetidae), Brazil
Strebla carollae (Streblidae), Panamá
Strebla hertigi (Streblidae), Panamá
Strebla wiedemanni (Streblidae), Panamá
Trichobius cernyi (Streblidae), Cuba
Trichobius duvesci (Streblidae), Cuba and Panamá
Trichobius frequens (Streblidae), Cuba and Dominican Republic
Trichobius intermedius (Streblidae), Bahamas, Cuba, Dominican
Republic, Jamaica, México, Puerto Rico, and Virgin Islands
Trichobius jubilis (Streblidae), Panamá
Trichobius longipes (Streblidae), Cuba and Panamá
Trichobius pseudotruncatus (Streblidae)
Trichobius robyniae (Streblidae), Puerto Rico
Trichobius truncatus (Streblidae)
Trichobius uniformis (Streblidae), Panamá
Whattonia nudosa (Trombiculidae), México

Artibeus littatus (Offer)
Amblyomma sp. (Ixodidae), Venezuela
Amblyomma longirostre (Ixodidae), Venezuela
Aspidoptera buschi (Streblidae), Panamá
Aspidoptera phyllostomatis (Streblidae)
Hooperella vesperginis (Trombiculidae), México
Macronyssoides kochii (Macronyssidae), Brazil, Colombia, and
Trinidad
Megastrongylus aranea (Streblidae), Colombia, Panamá, and Trinidad
Metelasmus pseudoapterus (Streblidae), Panama and Paraguay
Ornithodoros hoesl (Argasidae), Costa Rica
Ornithodoros yumaensis (Argasidae), México
Parabiasphycus artibei (Labidocarpidae), Trinidad
Paratrichobius sp. (Streblidae), Colombia and Panamá
Paratrichobius longiceps (Streblidae), El Salvador and Trinidad
Periglischrus heringi (Spinichriidae), Brazil, Colombia, 
Guatemala, Honduras, Panamá, Paraguay, Surinam, Trinidad, and
Venezuela
Phyllostomomyssus conradjunkerii (Gastromyssidae), Surinam and
Venezuela
Pseorergatoides artibei (Pseorergatidae), Surinam
Trichobius costalimai (Streblidae), Panamá
Trichobius intermedius (Streblidae), México
Trichobius jubilis (Streblidae), Panamá
Trichobius lanceolatus (Streblidae), Panamá
Trichobius vangiro (Streblidae), Panamá
Xenodonta carus serratus (Trombiculidae), México

Artibeus phaeotis (Miller)
Tecomatilus sandsvaldi (Trombiculidae), México*

Artibeus toltecus (Sauvage)
Chirinyssoides caparit (Sarcopodidae), México** and Panamá
Leptotrombidium hamoxiata (Trombiculidae), Panamá
Loomisia desmodus (Trombiculidae), Costa Rica* and Nicaragua*
Macronyssoides kochii (Macronyssidae), Panamá
Microtrombicula honesti (Trombiculidae), México
Paratrichobius sp. (Streblidae), Panamá
Parichoronyssus sp. (Macronyssidae), Panamá
Periglychus iheringi (Spinturnicidae), Panamá and Venezuela
Periglychus oajasti (Spinturnicidae), México

Artibeus watsoni Thomas
Paratrichobius lowei (Streblidae), Panamá

Brachypylla cavernarum Gray
Lawrenceocarpus micropilus (Labidocarpidae), Puerto Rico
Lawrenceocarpus puertoricensis (Labidocarpidae), Puerto Rico
Nectrophiella coxata (Streblidae), British West Indies
Ornthodoros hawaii (Argasidae), Guadeloupe** and Martinique
Rufodornella aedeomans (Macronyssidae), Puerto Rico
Trichobius truncatus (Streblidae), Puerto Rico

Brachypylla namai Miller
Endosabulekia cernyi (Myobothriidae), Cuba
Macronyssoides kochii (Macronyssidae), Cuba
Ornthodoros azteci (Argasidae), Cuba
Ornthodoros viguieri (Argasidae), Cuba
Periglychus cubanus (Spinturnicidae), Cuba
Trichobius frequens (Streblidae), Cuba

Brachypylla pumila Miller
Trichobius frequens (Streblidae), Dominican Republic

Carollia sp.
Beamerella acutascuta (Trombiculidae), Costa Rica*
Chitinophyes carolliae (Sarcoptidae), Panamá
Hooperella vesperginis (Trombiculidae), Panamá
Loomisia alcithone (Trombiculidae), Venezuela
Loomisia desmodus (Trombiculidae), Venezuela
Loomisia yankerti (Trombiculidae), Venezuela
Orinthodoros azteci (Argasidae), Venezuela
Orinthodoros bromeli (Argasidae), Venezuela
Orinthodoros hawaii (Argasidae), Venezuela
Streblia carolliae (Streblidae), Surinam
Whartonia nudoxota (Trombiculidae), Costa Rica*

Carollia brevicauda (Schinz)
Labidocarpus furmani (Labidocarpidae), Venezuela
Amblyomma sp. (Ixodidae), Venezuela
Eutrombicula ochoi (Trombiculidae), Venezuela
Eutrombicula pacae (Trombiculidae), Venezuela
Parakoxoa tadariva (Labidocarpidae), Venezuela

Carollia castanea H. Allen
Hooperella vesperginis (Trombiculidae), Nicaragua*
Loomisia desmodus (Trombiculidae), Costa Rica*
Loomisia sprucei (Trombiculidae), Nicaragua*
Rufodornella corolliae (Macronyssidae), Panamá
Speiseria ambigu (Streblidae), Panamá
Speleocola secunda (Trombiculidae), Nicaragua*
Spelaeorhynchus praecursor (Spelaeorhynchidae), México
Streblia corolliae (Streblidae), Panamá
Trichobius loblingii (Streblidae), Panamá

Carollia perspicillata (Linnaeus)
Labidocarpus furmani (Labidocarpidae), Venezuela
Alexfainia chilonycteris (Trombiculidae), Panamá
Amblyomma sp. (Ixodidae), Venezuela
Aspidoptera buscki (Streblidae), Panamá
Aspidoptera delatorrei (Streblidae), Panamá
Basilia speiseri (Nycteribiidae), Brazil
Beamerella acuticuta (Trombiculidae), Nicaragua*, Panamá, and Trinidad
Chirnysoides sp. (Sarcoptidae), Brazil
Chirnysoides amazonae (Sarcoptidae), Brazil
Chirnysoides carolliae (Sarcoptidae), Panamá and Surinam
Chirnysoides surinamense (Sarcoptidae), Surinam
Chirnysoides zandervorti (Sarcoptidae), Surinam
Demodex carolliae (Demodicidae), Surinam
Demodex longissimus (Demodicidae), Surinam
Hooperella vespertina (Trombiculidae), Nicaragua*, Surinam, and Trinidad
Lawrenceocarpsus lobus (Labidocarpidae), Nicaragua
Loomisia desmodus (Trombiculidae), Colombia, Nicaragua*, Trinidad, and Venezuela
Mastoptera guamaracai (Streblidae), Panamá
Megistopoda aranea (Streblidae), Panamá
Metelasmus pseudopterus (Streblidae), Panamá
Nycteramastes primus (Trombiculidae), Venezuela
Nycterophyllum parvissimum (Streblidae), Panamá
Ornthodoros aztec (Argasidae), Panamá (Canal Zone)
Ornthodoros brodyi (Argasidae), Panamá and Venezuela
Ornthodoros hasei (Argasidae), Venezuela
Ornthodoros yumanensis (Argasidae), Venezuela
Paralabidocarpsus carolliae (Labidocarpidae), Surinam
Parasarcophogeton dedicatus (Trombiculidae), Panamá
Paratrichobius longicornis (Streblidae)
Perichoronyssus crassipes (Macronyssidae), Panamá
Perinephrotis anophtalmica (Trombiculidae), Trinidad
Periglischrus sp. (Spinturnicolidae), Panamá
Perissopalpa barbiconyx (Trombiculidae), Surinam
Perissopalpa eximunus (Trombiculidae), Perú and Trinidad
Perissopalpa ipar (Trombiculidae), Brazil and Surinam
Rodfordiella carolliae (Macronyssidae), Panamá (Canal Zone)
Rodfordiella desmodi (Macronyssidae), Trinidad
Speiseria ambigua (Streblidae), Colombia, Panamá, and Trinidad
Spelaehorhynchus sp. (Spelaehorhynchidae), Brazil
Spelaehorhynchus praecursor (Spelaehorhynchidae), Brazil, Colombia, México, and Venezuela
Speleochir carolliae (Erynetidae), Surinam
Speleocelis secunda (Trombiculidae), Surinam
Strebla almarai (Streblidae), Panamá
Strebla carolliae (Streblidae), Brazil, Colombia, Panamá, Trinidad, and Venezuela
Strebla conocia (Streblidae), Trinidad
Strebla mirabilis (Streblidae), Brazil, Panamá, and Trinidad
Trichobius perspicuus (Streblidae), Brazil, México, and Perú
Trichobius costalimai (Streblidae), Panamá
Trichobius degesi (Streblidae), Costa Rica, Nicaragua, Panamá, and Trinidad
Trichobius dugsioides (Streblidae), Panamá
*Trichobius joblingi* (Streblidae), Brazil, Belize, Colombia, Costa Rica, El Salvador, Guatemala, Panamá, Perú, Surinam, Tobago, Trinidad, and Venezuela

*Trichobius johnsoni* (Streblidae), Panamá

*Trichobius longipes* (Streblidae), Panamá

*Trichobius macrophylli* (Streblidae), Panamá

*Trichobius parashicus* (Streblidae), Trinidad

*Trichobius sparsus* (Streblidae), Panamá

*Trichobius zunkeri* (Streblidae), Panamá

*Whatortica nudosetosa* (Trombiculidae), Costa Rica*, Guatemala, México, Nicaragua, and Trinidad

**Carolla subrufa** (Hahn)

*Chirynysoides carollae* (Sarcoptidae), Panamá

*Hooperella vespereginius* (Trombiculidae), México* and Nicaragua*

*Loemisia desmodus* (Trombiculidae), Nicaragua*, Panamá, and Venezuela

*Speiseria ambigua* (Streblidae), Panamá

*Speleoscolex secunda* (Trombiculidae), Nicaragua*

*Strebula carollae* (Streblidae), Panamá

*Trichobius joblingi* (Streblidae), Panamá

*Whatortica nudosetosa* (Trombiculidae), México*

**Centurio senex** Gray

*Basilia* sp. (Nycteribiidae)

**Chirodera** sp.

*Periglischiras iheringi* (Spinturnicidae), Venezuela

**Chirodera salvini** Dobson

*Chirynysoides caparti* (Sarcoptidae), Panamá

*Ornithodoros hasel* (Argasidae), Venezuela

*Paratrichobius salvini* (Streblidae), Panamá

*Periglischiras iheringi* (Spinturnicidae), Panamá and Venezuela

**Chiroderma villosum** Peters

*Amblyomma* sp. (Ixodidae), Venezuela

*Aspidoptera buscki* (Streblidae), Panamá

*Paratrichobius* sp. (Streblidae), Panamá

*Trichobius joblingi* (Streblidae), Panamá

**Choeronicus minor** (Peters)

*Amblyomma* sp. (Ixodidae), Venezuela

**Choeronycteris mexicana** Tschudi

*Paratrichobius americanus* (Streblidae), Arizona

*Trichobius longipes* (Streblidae), Arizona

*Whatortica glemni californicus* (Trombiculidae), México*

**Chrotophorus auritus** Peters

*Basilia hughsotti* (Nycteribiidae), Brazil

*Hooperella vespereginius* (Trombiculidae), Nicaragua*

*Ornithodoros brodzi* (Argasidae), México

*Strebula wiedemanni* (Streblidae), Brazil

*Trichobius dagesioides* (Streblidae), Panamá

**Desmodus rotundus** E. Geoffroy St.-Hilaire

*Basilia ferrisi* (Nycteribiidae), Venezuela

*Chirynysoides caparti* (Sarcoptidae), Panamá

*Eodubabekia argani* (Myobiidae), México

*Hooperella saccoperxy* (Trombiculidae), Trinidad

*Hooperella vespereginius* (Trombiculidae), Nicaragua* and Trinidad

*Loemisia desmodus* (Trombiculidae), Guatemala, Nicaragua*, and Venezuela

*Macronyssoides kochii* (Macronyssidae), Brazil and Trinidad
Megistopoda aranea (Streblidae), Panamá
Microtrombicula boneti (Trombiculidae), México*
Nycterinastes primus (Trombiculidae), Venezuela
Onthodoros azteci (Argasidae), México, Panamá, and Trinidad
Onthodoros peruvianus (Argasidae), Perú
Onthodoros yumatensis (Argasidae), México
Paralabidocarpus desmodi (Labidocarpiidae), Surinam
Paraschoschoungastia megasipyrrax (Trombiculidae), Trinidad
Paraschoungastia longicarina (Trombiculidae), Trinidad
Perates anophthalmus (Trombiculidae), México and Panamá
Perigaliscus herrei (Spinturnicidae), Panamá, Trinidad, and Venezuela
Perigaliscus heringi (Spinturnicidae), México and Panamá
Perissopalla exhuma (Trombiculidae), Trinidad
Perissopalla precaria (Trombiculidae), Trinidad
Rudfordiella desmodi (Macronyssidae), Panamá and Trinidad
Rudfordiella oudenansi (Macronyssidae), Brazil
Speiseria ambigua (Streblidae), Panamá
Speleocola davisi (Trombiculidae), México
Speleocola secunda (Trombiculidae), Trinidad
Strebla carolliae (Streblidae), Panamá
Strebla diphyliae (Streblidae), Guatemala
Strebla hertigi (Streblidae), El Salvador and Panamá
Strebla mirabilis (Streblidae), Perú and Trinidad
Strebla wiedenne (Streblidae), Colombia, Ecuador, El Salvador,
Guatemala, Honduras, México, Panamá, Perú, Surinam, Trinidad,
and Venezuela.
Teconatana sandovali (Trombiculidae), México*
Trichobiodes perspicillatus (Streblidae), Panamá and Trinidad
Trichobius costalimai (Streblidae), Panamá
Trichobius dugesii (Streblidae), Trinidad
Trichobius favonii (Streblidae), Perú
Trichobius joblingi (Streblidae), Panamá and Trinidad
Trichobius parasiticus (Streblidae), Brazil, Colombia, Costa Rica,
El Salvador, Guatemala, México, Panamá, Perú, Surinam,
Trinidad, and Venezuela.
Trichobius uniformis (Streblidae), Panamá
Whartonidia radosetzoi (Trombiculidae), México and Trinidad
Diamesus youngii (Jentink)
Nycteronyssus desmodus (Macronyssidae), Venezuela
Perissopalla exhuma (Trombiculidae), Trinidad
Rudfordiella oudenansi (Macronyssidae), Trinidad
Strebla sp. (Streblidae), Trinidad
Strebla dorea (Streblidae), Colombia and Panamá
Trichobius dugesii (Streblidae), Trinidad
Trichobius parasiticus (Streblidae), Panamá
Diphylla caudata (Spix)
Strebla diphyliae (Streblidae), Guatemala and México
Strebla mirabilis (Streblidae)
Trichobius diphyliae (Streblidae), Guatemala, México, and
Venezuela
Trichobius favonii (Streblidae), Colombia
Trichobius parasiticus, México
Enchisthenes hartii (Thomas)
Macronyssoides sp. (Macronyssidae), Panamá
Parakosa maxima (Labidocarpidae), Venezuela
Paratriebius sanchezii (Streblidae), Panamá and Venezuela
Periglischrus theringi (Spinturnicidae), Panamá and Venezuela
Trichobius dagesii (Streblidae), Trinidad

Erophylla bombifrons (Miller)
Ornithodoros viguerasi (Argasidae), Puerto Rico
Trichobius truncatus (Streblidae), Puerto Rico

Erophylla schlemani Gundlach
Loomisia desmodius (Trombiculidae), Bahamas
Microtrombicula honesi (Trombiculidae), Bahamas
Peters anophthalmus (Trombiculidae), Bahamas
Periglischrus cubanus (Spinturnicidae), Cuba
Trichobius frequens (Streblidae), Cuba
Trichobius intermedius (Streblidae), Cuba
Trichobius rohynae (Streblidae), Puerto Rico
Whartonia guerrerensis (Trombiculidae), Bahamas

Glossophaga sp.
Ornithodoros peruianus (Argasidae), Perú
Periglischrus caligus (Spinturnicidae), México and Panamá

Glossophaga alticola Davis
Hooperella vesperuginis (Trombiculidae), México and Nicaragua

Glossophaga commissarisi Gardner
Hooperella saccopteryx (Trombiculidae), México*
Hooperella vesperuginis (Trombiculidae), Nicaragua*
Speciocola secunda (Trombiculidae), Nicaragua*

Glossophaga longirostris Miller
Labidocarpus furcatus (Labidocarpidae), Venezuela
Amblyomma sp. (Ixodidae), Venezuela
Entrombicula goeldii (Trombiculidae), Venezuela
Loomisia desmodius (Trombiculidae), Venezuela
Ornithodoros azteci (Argasidae), Venezuela
Ornithodoros hasei (Argasidae), Venezuela
Ornithodoros rossi (Argasidae), Venezuela
Parakosa maxima (Labidocarpidae), Venezuela
Porakosa tadarida (Labidocarpidae), Venezuela
Periglischrus caligus (Spinturnicidae), Venezuela

Glossophaga soricina (Pallas)
Labidocarpus furcatus (Labidocarpidae), Nicaragua
Amblyomma sp. (Ixodidae), Venezuela
Beamerella acutaesula (Trombiculidae), México
Chrysosomoides cuparii (Sarcoptidae), Surinam
Hooperella saccopteryx (Trombiculidae), Costa Rica*
Hooperella vesperuginis (Trombiculidae), México*, Nicaragua*, Panamá, and Surinam
Loomisia desmodius (Trombiculidae), México, Nicaragua*, Panamá, Surinam, and Venezuela
Loomisia sproksi (Trombiculidae), México*
Loomisia univari (Trombiculidae), México*
Macrocnemoides kochi (Macrocnemoidae), Trinidad
Microtrombicula boneti (Trombiculidae), México*
Nycterimus primus (Trombiculidae), Venezuela
Ornithodoros azteci (Argasidae), Venezuela
Paradyschiria parvaloides (Streblidae)
Paricharonystus setifer (Macrocnemoidae), Panamá
Periglischrus caligus (Spinturnicidae), Brazil, Panamá, Surinam, Trinidad, and Venezuela
Perissopelia beltranii (Trombiculidae), México
Perissopella eximia (Trombiculidae), Trinidad
Perissopella precaria (Trombiculidae), México
Psorergatoides glossofagae (Psorergatidae), Surinam
Speiserinae ambigu (Streblidae), Trinidad
Spelaeorhynchus praeceptor (Spelaeorhynchidae), Amazon
Spleocola davisi (Trombiculidae), México
Spleocola secunda (Trombiculidae), Nicaragua
Stenonyssus joaquinii (Macronyssidae), Brazil
Strebla carolliae (Streblidae), El Salvador, Panamá, and Venezuela
Strebla minuta (Streblidae), Trinidad
Trichobius digesii (Streblidae), Colombia, El Salvador, Guatemala, México, Panamá, Perú, and Trinidad
Trichobius furmani (Streblidae), Paraguay
Trichobius joblingi (Streblidae), Panamá and Trinidad
Trichobius longipes (Streblidae)
Trichobius uniformis (Streblidae), Costa Rica, Guatemala, Guyana, México, Panamá, Perú, and Venezuela
Wagenastia similis (Trombiculidae), México
Whartonia nolosetosa (Trombiculidae), México and Nicaragua

Hylonycteris underwoodi Thomas
Basilia rondani (Nycteribiidae)

Leptonycteris curasoae Miller
Antricola sp. (Argasidae), Venezuela
Ornithodoros sp. (Argasidae), Venezuela

Leptonycteris nivalis Saussure
Basilia corynorkini (Nycteribiidae), Texas
Macronyssus undens (Macronyssidae), Arizona
Ornithodoros rossi (Argasidae), Arizona
Periglischrus vurgasi (Spinturnicidae), México and Texas
Radfordella oricola (Macronyssidae), México
Trichobius spheronotus (Streblidae), México and Texas

Leptonycteris sanborni Hoffmeister
Basilia antrozoi (Nycteribiidae)
Periglischrus vurgasi (Spinturnicidae), México
Spleocola davisi (Trombiculidae), México
Trichobius spheronotus (Streblidae), Arizona and New Mexico

Lionycteris spurrelli Thomas
Nycterinastes primus (Trombiculidae), Venezuela
Periglischrus napkinsi (Spinturnicidae), Venezuela
Trichobius ionycyteris (Streblidae), Panamá and Perú

Lonchophyilla concava Goldman
Beamerealla angustata (Trombiculidae), Costa Rica
Loomisia sp. (Trombiculidae), Costa Rica

Lonchophyilla robusta Miller
Anastrebla nyceridis (Streblidae), Panamá
Antistrichobius scorzaí (Streblidae), Panamá
Chirozetes lonchophylla (Macronyssidae), Venezuela
Eldanina breviceps (Streblidae), Panamá
Loomisia desmodus (Trombiculidae), Costa Rica and Venezuela
Nycterinastes secundus (Trombiculidae), Costa Rica
Periglischrus sp. (Spinturnicidae), Panamá
Speiseria ambigu (Streblidae), Panamá
Strebla carolliae (Streblidae), Panamá
Trichobius joblinsi (Streblidae), Panamá
Trichobius johnsonae (Streblidae), Panamá
Trichobius lonicophylle (Streblidae), Panamá
Trichobius uniformis (Streblidae), Panamá

Lonchorhina aurita Tomes
Basilia wenzeli (Nycteribiidae), Venezuela
Nycterinastes primus (Trombiculidae), Venezuela
Ornithodoros azteci (Argasidae), Cuba, Jamaica, Trinidad, and Venezuela
Ornithodoros brodyi (Argasidae), Venezuela
Ornithodoros hasei (Argasidae), Venezuela
Periglischirus gameroi (Spinturnicidae), Venezuela
Psorergatoidea jonchorhinica (Psorergatidae), Venezuela
Speiseria ambigu (Streblidae), Panamá
Strebla altmani (Streblidae), Panamá and Venezuela
Strebla carolliae (Streblidae), Panamá
Trichobius duxsioi (Streblidae), Panamá
Trichobius joblingi (Streblidae), Panamá
Trichobius macrophylli (Streblidae), Panamá
Trichobius yunker (Streblidae), Panamá

Lonchorhina orinocensis Linares and Ojasti
Ornithodoros sp. (Argasidae), Venezuela
Ornithodoros hasei (Argasidae), Venezuela
Ornithodoros rossi (Argasidae), Venezuela

Macrophylmm macrophyllm (Schinz)
Basilia consticta (Nycteribiidae)
Entrombica variabilis (Trombiculidae), Venezuela
Ornithodoros azteci (Argasidae), Venezuela
Paralabidocarpus macrophyllm (Labidocarpidae), Suriname
Periglischirus sp. (Spinturnicidae), Panamá
Strebla altmani (Streblidae), Panamá
Strebla carolliae (Streblidae), Panamá
Trichobius joblingi (Streblidae), Panamá
Trichobius macrophylli (Streblidae), Panamá

Macrotus sp.
Whartonia nudovesa (Trombiculidae), Jamaica

Macrotus californicus Baird
Loomisia prossini (Trombiculidae), California
Nycterophiliocomis cosuta (Streblidae), Arizona and California
Ornithodoros sp. (Argasidae), Arizona
Ornithodoros rossi (Argasidae), México
Periglischirus vargasi (Spinturnicidae), México
Psorergata beltrani (Trombiculidae), Arizona*, California*, and México*

Teconalana watkinsi (Trombiculidae), Arizona*, California, and México

Trichobius adamsi (Streblidae), Arizona, California, and México
Whartonia gleni californica (Trombiculidae), Arizona*, California, and México*

Macrotus waterhousii Gray
Eidusabakia suminaki (Myobiidae), Cuba (Isla de Pinos)
Nycterophiliocomis sp. (Streblidae), México*
Nycterophila coxata (Streblidae), México
Nycterophila parnellii (Streblidae), Cuba
Ornithodoros azteci (Argasidae), Cuba
Ornithodoros hasei (Argasidae), Jamaica**
Periglieschria delfinadoae (Spinthiriocidae), Cuba
Periglieschria vargasii (Spinthiriocidae), México
Trichobius intermedius (Streblidae), Jamaica
Trichobius macroti (Streblidae), Bahamas and Cuba
Trichobius neotropicus (Streblidae), Dominican Republic
Trichobius truncatus (Streblidae), Cuba

Micronycteris sp.
Periglieschria parvus (Spinthiriocidae), Venezuela

Micronycteris brachyotis (Dobson)
Speiseria arbigna (Streblidae), Trinidad
Trichobius dugesii (Streblidae), Trinidad
Trichobius joblingi (Streblidae), Trinidad

Micronycteris daviesi (Hill)
Perissopalla barticoyctaris (Trombiculidae), Brazíl

Micronycteris hisuta (Peters)
Beamerella acutacuta (Trombiculidae), Panamá and Trinidad
Beamerella subacutacuta (Trombiculidae), Trinidad
Hooperella vespertinigis (Trombiculidae), Trinidad
Lawrencecorpus phyllostomus (Labidocarpidae), Venezuela
Speleoscolex secundo (Trombiculidae), Trinidad

Micronycteris megalotis (Gray)
Basilis bequaerti (Nycteribiidae)
Beamerella acutacuta (Trombiculidae), Panamá
Chrysosoma carupta (Sarcoptidae), Surinam
Eutrombicula batatae (Trombiculidae), Venezuela
Hooperella spinistrostra (Trombiculidae), Brazil
Hooperella vespertinigis (Trombiculidae), Trinidad
Labidocarpus lachosi (Labidocarpidae), Surinam
Loomisia desmodus (Trombiculidae), Panamá and Trinidad
Microtrombicula boneti (Trombiculidae), Curaçao
Perates anophthala (Trombiculidae), Colombia and Perú
Periglieschria micronycteridis (Spinthiriocidae), Panamá and Trinidad
Periglieschria parvus (Spinthiriocidae), Panamá and Trinidad
Perissopalla deopteras (Trombiculidae), Perú
Perissopalla exhumata (Trombiculidae), Perú
Perissopalla precaria (Trombiculidae), Panamá
Speleoscolex secundo (Trombiculidae), Trinidad
Srebla alvarezi (Streblidae), Panamá
Trichobius keenani (Streblidae), Panamá
Whartonoa pachyphantoni (Trombiculidae), Brazil

Micronycteris minutula (Gervais)
Periglieschria micronycteridis (Spinthiriocidae), Panamá
Periglieschria parvus (Spinthiriocidae), Panamá
Srebla machadoi (Streblidae), Venezuela

Micronycteris niefoi Sanborn
Parastrebla hadleyi (Streblidae), Panamá
Srebla alvarezi (Streblidae), Panamá
Trichobius joblingi (Streblidae), Panamá
Trichobius keenani (Streblidae), Panamá
**Micronycteris sylvestris** (Thomas)  
*Strebla davarezi* (Streblidae), Panamá

**Minion cozmamale** Goldman  
*Loonias desmodus* (Trombiculidae), México  
*Whartonia nudojota* (Trombiculidae), Mexico

**Minion crenulatum** (É. Geoffroy St.-Hilaire)  
*Basilia tioption* (Nycteribiidae), Panamá and Venezuela  
*Iopanella mariae* (Myobiidae), Venezuela  
*Ornithodoros sp.* (Argasidae), Venezuela  
*Ornithodoros dieci* (Argasidae), Venezuela  
*Ornithodoros mimon* (Argasidae), Bolivia  
*Periglischrus dasubek* (Spinturnicidae), Venezuela  
*Sperlichthor barbulata* (Trombiculidae), Brazil

**Monophyllus** sp.  
*Trichobius dominicanus* (Streblidae), Dominican Republic

**Monophyllus cubanus** Miller  
*Eudababekia rosickyi* (Myobiidae), Cuba  
*Periglischrus vargas* (Spinturnicidae), Cuba

**Monophyllus redmani** Leach  
*Rudofordia monophylli* (Macronyssidae), Cuba  
*Spleaorhynchus monophylli* (Spleaorhynchidae), Puerto Rico  
*Trichobius cernyi* (Streblidae), Cuba  
*Trichobius frequent* (Streblidae), Cuba  
*Trichobius intermedius* (Streblidae), Dominican Republic  
*Trichobius parasiticus* (Streblidae), Jamaica  
*Trichobius rohynae* (Streblidae), Puerto Rico  
*Trichobius truncatus* (Streblidae), Puerto Rico

**Phylloderma stenops** Peters  
*Strebla christinae* (Streblidae), Panamá

**Phyllonycteris aphylia** (Miller)  
*Ornithodoros hauseri* (Argasidae), Jamaica**

**Phyllonycteris poeyi** Gundlach  
*Anricola margarita* (Argasidae), Cuba  
*Anricola silvai* (Argasidae), Cuba  
*Eudababekia danieli* (Myobiidae), Cuba  
*Macronyssides kochi* (Macronyssidae), Cuba  
*Ornithodoros viguerasi* (Argasidae), Cuba and Haiti**  
*Periglischrus cubanus* (Spinturnicidae), Cuba  
*Trichobius cernyi* (Streblidae), Cuba  
*Trichobius frequent* (Streblidae), Cuba and Dominican Republic  
*Trichobius intermedius* (Streblidae), Cuba and Dominican Republic  
*Trichobius parasiticus* (Streblidae)  
*Trichobius truncatus* (Streblidae)

**Phyllostomus** sp.  
*Aspidopetera phyllostomatis* (Streblidae), Brazil  
*Basilia bellardii* (Nycteribiidae), Brazil  
*Basilia speiseri* (Nycteribiidae)  
*Mastoptera guiananasi* (Streblidae), Panamá  
*Megistopoda aranea* (Streblidae), Brazil and Cuba  
*Parichoronyssus christinae* (Macronyssidae), Costa Rica  
*Strebla consocius* (Streblidae), Perú and Surinam  
*Strebla mirabilis* (Streblidae), Brazil, Panamá, and Perú  
*Trichobius longipes* (Streblidae), Panamá  
*Trichobius phyllostomatis* (Streblidae), Brazil
Phyllostomus discolor (Wagner)
Aspidoptera buscki (Streblidae), Panamá
Beamerella acutangula (Trombiculidae), Nicaragua*
Euchistochilus phyllostomus (Myobiidae), Nicaragua
Eutrombicula goeldii (Trombiculidae), Venezuela
Hooperella venerinensis (Trombiculidae), Nicaragua*
Megistopoda aranea (Streblidae), Panamá
Microtrombicula carmenae (Trombiculidae), Costa Rica, Nicaragua, and Trinidad
Periglischrus acutiventer (Spinuracidae), Trinidad and Venezuela
Periglischrus torrealba (Spinuracidae), Venezuela
Pseudoalbidocarpus secus (Labidocarpidae), Venezuela
Streblia consort (Streblidae), Colombia
Streblia herigi (Streblidae), Colombia, Panamá, Perú, Surinam, Trinidad, and Venezuela
Streblia mirabilis (Streblidae), Brazil, Panamá, and Trinidad
Trichobioidea perspicillata (Streblidae), Colombia, Panamá, and Trinidad
Trichobius costatimani (Streblidae), Colombia, El Salvador, Guatemala, Panamá, Perú, Puerto Rico, Trinidad, and Venezuela
Trichobius longipes (Streblidae), Trinidad
Phyllostomus elongatus (E. Geoffroy St.-Hilaire)
Lawrenceocarpos phyllostomus (Labidocarpidae), Venezuela
Periglischrus acutiventer (Spinuracidae), Trinidad and Venezuela
Pseudoalbidocarpus secus (Labidocarpidae), Venezuela
Streblia mirabilis (Streblidae)
Trichobioidea perspicillata (Streblidae), Colombia
Phyllostomus hastatus (Pallas)
Alabidocarpus phyllostomus (Labidocarpidae), Surinam
Blankaria binamarii (Trombiculidae), Panamá
Demodes phyllostomatis (Demodicidae), Surinam
Eutrombicula goeldii (Trombiculidae), Venezuela
Mastoptera guinaraesi (Streblidae), Colombia and Panamá
Mastoptera minota (Streblidae), Colombia
Microtrombicula honeti (Trombiculidae), Panamá
Microtrombicula carmenae (Trombiculidae), Panamá
Nasicola annectuaxi (Trombiculidae), Venezuela
Neotrichobius delicatus (Streblidae), Surinam
Omnithodoros actessi (Argasidae), Venezuela
Omnithodoros haesi (Argasidae), Venezuela
Pahaenodes longipes (Streblidae), Brazil
Periglischrus acutiventer (Spinuracidae), Colombia, Panamá, Trinidad, and Venezuela
Periglischrus torrealba (Spinuracidae), Panamá, Trinidad, and Venezuela
Spæseria ambiguë (Streblidae), Panamá
Spæleochir phyllostomus (Erythraetidae), Colombia
Streblia carolliae (Streblidae), Panamá
Streblia connivus (Streblidae), Surinam, Trinidad, and Venezuela
Streblia herigi (Streblidae), Costa Rica, Nicaragua, and Panamá
Streblia mirabilis (Streblidae), Colombia, Panamá, Perú, and Trinidad
Trichobioidea perspicillata (Streblidae), Surinam
Trichobius dugesii (Streblidae), Trinidad
Trichobius joblingi (Streblidae), Panamá and Trinidad
Trichobius longipes (Streblidae), Bolivia, Costa Rica, Colombia, Guatemala, Panamá, Perú, Surinam, Trinidad, and Venezuela
Trichobius parasiticus (Streblidae), Panamá
Trichobius phyllostomae (Streblidae)

Rhynophyllus pumilio Peters
Periglischrus hopkinsi (Spinturnicidae), Brazil and Venezuela
Periglischrus ramirezii (Spinturnicidae), Brazil and Venezuela

Stenodema rufum Desmarest
Parablidocarpus articulatus (Labidocarpidae), Puerto Rico
Parablidocarpus foetidus (Labidocarpidae), Puerto Rico
Parablidocarpus stenoderma (Labidocarpidae), Puerto Rico
Periglischrus iheringi (Spinturnicidae), Puerto Rico

Sturnira lilium (E. Geoffroy St.-Hilaire)
Aspidoptera delatorrei (Streblidae), Guatemala and Panamá
Aspidoptera phyllostoma (Streblidae), Paraguay
Chironyssidodes brasiliensis (Sarcopitidae), Brazil
Eudubebeka lepidose (Macronyssididae), Nicaragua
Entomobrya goeldii (Trombiculidae), Venezuela
Exostinon clovisi (Streblidae)
Hooperella vespertina (Trombiculidae), Nicaragua*
Ixodes sp. (Ixodidae), Venezuela
Loomisia desmodus (Trombiculidae), Venezuela
Megistopoda proxima (Streblidae), Colombia and Panamá
Microtrombicula sturnata (Trombiculidae), México and Nicaragua
Nycteriglyphus sturnatae (Rosensteinidae), Brazil
Ornithodoros sp. (Argasidae), Venezuela
Ornithodoros hessei (Argasidae), Venezuela
Parakosa talarida (Labidocarpidae), Venezuela
Parablidocarpus articulatus (Labidocarpidae), Nicaragua
Periglischrus iheringi (Spinturnicidae), México
Periglischrus ojasti (Spinturnicidae), Panamá, Trinidad, and Venezuela
Periglischrus vargasii (Spinturnicidae), México
Trichobiusides perspicillatus (Streblidae), Panamá

Sturnira ludoviciana Anthony
Ixodes sp. (Ixodidae), Venezuela
Megistopoda proxima (Streblidae), Costa Rica
Megistopoda theodori (Streblidae), Panamá
Microtrombicula carmenae (Trombiculidae), Costa Rica and Panamá
Microtrombicula sturnatae (Trombiculidae), Costa Rica and Panamá
Ornithodoros hessei (Argasidae), Venezuela
Parasceles soncouyanii (Trombiculidae), Panamá
Patrichoronyssus euthysternum (Macronyssididae), Panamá
Periglischrus iheringi (Spinturnicidae), Colombia and Venezuela
Periglischrus ojasti (Spinturnicidae), Panamá
Pseudochengastia bathófo (Trombiculidae), Panamá
Trichobius brennani (Streblidae), Panamá
Trichobius yankerti (Streblidae), Panamá

Sturnira morrisi (Goodwin)
Microtrombicula carmenae (Trombiculidae), Costa Rica
Microtrombicula sturnatae (Trombiculidae), Costa Rica

Sturnira tildae de la Torre
Amblonyx sp. (Ixodidae), Venezuela

Tonatia sp.
Mastopiera minuta (Streblidae), Bolivia, Colombia, Ecuador, Perú,
and Surinam
Sizostrebia longirostris (Streblidae), Brazil and Colombia
Strebla galindoi (Streblidae), Trinidad
Strebla mirabilis (Streblidae), Colombia

**Tonatia bidens** (Spix)
- Speiseria ambigu (Streblidae)
- Strebla galindoi (Streblidae), Panamá
- Strebla mirabilis (Streblidae)
- Strebla tonatiae (Streblidae)
- Trichobius bequaerti (Streblidae), Panamá

**Tonatia brasiliensis** (Peters)
- Strebla tonatiae (Streblidae), Ecuador and Panamá

**Tonatia nicaraguane** Goodwin
- Mastoptera minuta (Streblidae), Panamá
- Pseudostrebla greenwelli (Streblidae), Panamá
- Strebla hoogstraali (Streblidae), Panamá
- Trichobius mendez (Streblidae), Panamá

**Tonatia sylvicola** (D'Orbigny)
- Basilia constricta (Nectaribiidae)
- Mastoptera minuta (Streblidae), Brazil and Panamá
- Ornithodoros hasel (Argasidae), Panamá
- Pseudostrebla ribeiroi (Streblidae), Brazil and Panamá
- Strebla kohls (Streblidae), Colombia and Panamá
- Trichobius dysis (Streblidae), Panamá
- Trichobius jolbini (Streblidae), Panamá
- Trichobius parasiticus (Streblidae), Brazil

**Tonatia venezuelae** (Robinson and Lyon)
- Chironyssoides venezuelae (Sarcoptidae), Venezuela
- Paralabidocarpus tonatiae (Labidocarpidae), Venezuela

**Trachops sp.**
- Strebla consocius (Streblidae), Perú

**Trachops cirrhatus** (Spix)
- Loomisia desmodus (Trombiculidae), México*
- Ornithodoros sp. (Argasidae), Venezuela
- Ornithodoros azicci (Argasidae), Venezuela
- Ornithodoros bradyi (Argasidae), Panamá
- Paralabidocarpus trachops (Labidocarpidae), Surinam
- Periglychris paracuticeros (Spinturnicidae), Venezuela
- Periglychris vargas (Spinturnicidae), Panamá
- Speiseria ambigu (Streblidae), Panamá
- Strebla almani (Streblidae), Panamá
- Strebla carolliae (Streblidae), Panamá
- Strebla diphylla (Streblidae), Guatemala
- Trichobius dugesii (Streblidae), Panamá
- Trichobius ldesiodes (Streblidae), Panamá
- Trichobius joblingi (Streblidae), Panamá

**Uroderma bilobatum** Peters
- Alabidocarpus nicaraguane (Labidocarpidae), Nicaragua
- Amblyomma sp. (Ixodidae), Venezuela
- Basilia constricta (Nectaribiidae)
- Basilia myxois (Nectaribiidae)
- Chitohyphobia unorner (Chitohyphobidae), Panamá
- Eutrombicula bartasi (Trombiculidae), Trinidad
- Macronyssoides sp. (Macronyssidae), Panamá
- Neotrichobius delicatus (Streblidae), Panamá
Ornithodoros hasei (Argasidae), Panamá
Paraseelia manueli (Trombiculidae), Costa Rica
Pararichobius dunnii (Strebloidae), Panamá
Pararichobius longicrus (Strebloidae)
Periglischrus iberini (Spintruncicidae), Guatemala, Panamá, Paraguay, and Venezuela
Phyllostomonyssus conradyunkeri (Gastroxyssidae), Surinam
Trichobius costalmani (Strebloidae), Panamá
Trichobius joblingi (Strebloidae), Panamá
Trichobius keni (Strebloidae), Panamá
Trichobius trodermae (Strebloidae), Panamá and Venezuela
Uroderma magnirostrum Davis
Alabidocarpus nicaraguae (Labidocarpidae), Venezuela
Esinus babkae urodermae (Myobiidae), Brazil
Oritodorus hasei (Argasidae), Venezuela
Vampyressa nympheana Thomas
Aspidopera baschi (Strebloidae), Panamá
Meteosimus pseudopterus (Strebloidae), Panamá
Vampyressa pusilla (Wagner)
Chirynnoides caparitii (Sarcopidae), Panamá
Macronyssoides sp. (Macronyssidae), Panamá
Neoarichobius delicatus (Strebloidae), Panamá and Venezuela
Periglischrus iberini (Spintruncicidae), Panamá
Trombicula dunnii (Trombiculidae), Panamá
Vampyrodes caraccioloi Thomas
Chirynnoides caparitii (Sarcopidae), Panamá
Parichoronyssus sp. (Macronyssidae), Panamá
Periglischrus iberini (Spintruncicidae), Panamá
Speleochir brasilensis (Erynetidae), Brazil
Vampyrops sp.
Periglischrus iberini (Spintruncicidae), Paraguay
Vampyrops dorsalis Thomas
Periglischrus iberini (Spintruncicidae), Venezuela
Vampyrops helleri Peters
Alabidocarpus fumarii (Labidocarpidae), Venezuela
Alabidocarpus jonesii (Labidocarpidae), Nicaragua and Venezuela
Amblyomma sp. (Ixodidae), Venezuela
Basilia aostchii (Nycteribiidae), Colombia
Eutrombicula nachatrani (Trombiculidae), Venezuela
Oritodorus hasei (Argasidae), Panamá
Pararichobius sp. (Strebloidae), Panamá
Periglischrus iberini (Spintruncicidae), México and Panamá
Phyllostomonyssus conradyunkeri (Gastroxyssidae), Surinam
Vampyrops lineatus É. Geoffroy St.-Hilaire
Megistopoda plutei (Strebloidae), Brazil, Cuba, México, and U.S.A.
Pararichobius longicrus (Strebloidae)
Periglischrus iberini (Spintruncicidae), Brazil
Strebla wiedemannii (Strebloidae), Brazil
Vampyrops vittatus Peters
Chirynnoides caparitii (Sarcoptidae), Panamá
Loxomistis desmodus (Trombiculidae), Costa Rica
Macronyssoides consilensis (Macronyssidae), Panamá
Pararichobius sp. (Strebloidae), Panamá
Speiseria ambiguus (Strebloidae), Panamá
Trichobius vamppropii (Strebloidae), Panamá and Venezuela
Vampyrus spectrum (Linnaeus)
Hooperella vesperuginis (Trombiculidae), Panamá and Trinidad
Parasecia longiculce (Trombiculidae), Panamá
Trichobius parasticus (Streblidae)

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