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### **A FIELD KEY TO THE BATS OF COSTA RICA**

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**Illustrated by Errol D. Hooper, Jr.<sup>3</sup>**

Recent interest in tropical biology and in conserving tropical rain forests is triggering an unprecedented interest in tropical bats. In the Neotropics, bats are nocturnal arboreal predators, feeding as aerial insectivores, as gleaners of both larger invertebrates and smaller vertebrates from various substrates, and by gaffing both insects and small fish from streams and estuaries. Nectar-feeding bats are important pollinators of a wide array of plants, and frugivorous species serve as major seed dispersers. Vampires readily feed upon the blood of domestic animals (cattle, horses, pigs, dogs, chickens), causing significant blood loss as well as occasionally transmitting rabies.

Costa Rica has an extremely diverse bat fauna with 109 recorded species; undoubtedly, additional fieldwork will result in the addition of a few more species. The diversity of bats at a given locality can be remarkably high. For example, at the 730-ha La Selva Biological Reserve in the Caribbean lowlands 65 species were reported (Timm, 1994), and six more have been identified there recently, bringing the total number of species to 71. Our long-standing interest in Costa Rican bats has prompted us to examine most of the specimens in museum collections in an attempt to identify accurately species we work with and to understand better the systematics, ecology, and distributions of the Costa Rican fauna. This key represents a distillation of the characters that we use to identify bats, both in the field and as preserved specimens. Data presented herein in the form of keys have been gleaned from an array of sources, including extensive

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use of museum collections, the systematic literature, and living bats. Our goal is to produce the best possible key for recognition of a live bat in hand so that it may be released unharmed. We encourage the user to examine museum specimens whenever possible. We will be the first to admit that it is difficult to identify all of the 109 species of bats known from the country using only live, in-hand animals. Most notably, some species of *Sturnira*, *Myotis*, and *Eumops* often can only be identified reliably from cranial and dental characters that are visible only upon study of preserved specimens.

The key is dichotomous, and ideally, every couplet in this key would have only nonoverlapping, mutually exclusive choices. Unfortunately, that isn't possible using only external characters. We've tried to order the characters within each couplet as to their importance and ease in making the correct determination. The couplets use external characters whenever possible (Figs. 1, 2), but in many cases we also rely on dental characters. The size, number, and placement of teeth are usually visible to the naked eye, although a hand lens and adequate light will aid considerably. However, in several instances, we require the user to count cusps and examine cusp shape on minute teeth. Here a magnifying lens is mandatory. Specimens of these species were selected from as broad an area of Costa

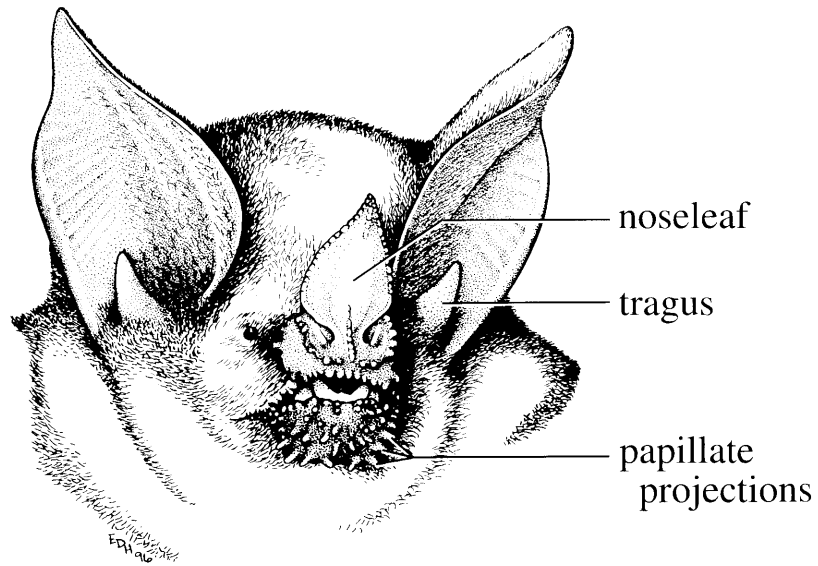


Fig. 1. Facial view of the fringe-lipped bat (sometimes called the frog-eating bat), *Trachops cirrhosus*, showing details of the nose leaf and warty, papillate projections on the lips and chin.

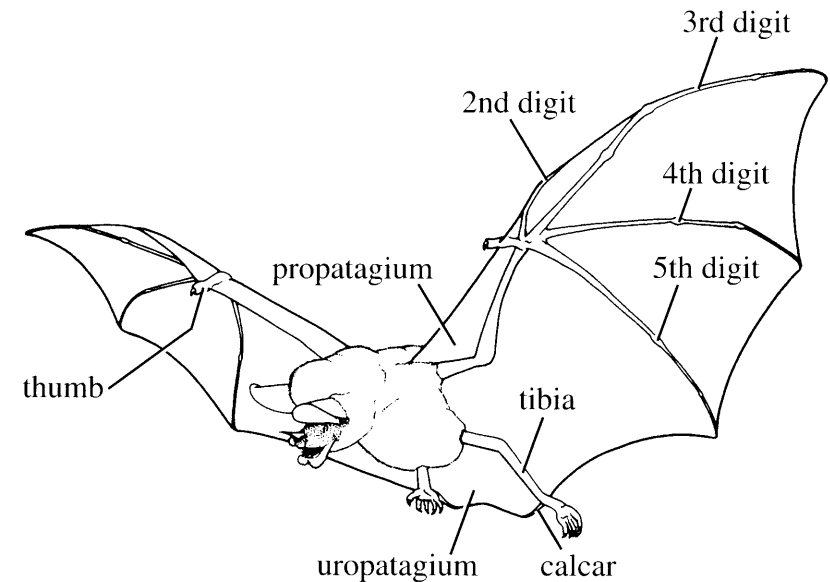


Fig. 2. The phyllostomine *Trachops cirrhosus* showing many of the external characters that are useful in identification of Neotropical bats.

Rica as possible, and occasionally from adjacent countries. Camera-lucida tracings illustrate states of the qualitative characters used in species identifications.

The colors used here describe the live bat in hand. Dark colors such as browns, grays, and black (melanins) usually remain unchanged on dried study skins or fluid-preserved specimens. However, bright colors, such as the orange-yellow trim on the noseleaf and ears of *Ectophylla alba* and the various species of *Artibeus* and *Vampyressa*, break down quickly and will not be apparent on preserved specimens. The snowy white pelage of *Diclidurus albus* and *E. alba* and the nearly white pelage of *Mesophylla macconnelli* fade, appearing as a light gray or brown on preserved specimens.

The key is specifically aimed at identification of Costa Rican bats. The measurements and illustrations we provide here are taken from Costa Rican specimens whenever possible. It is our hope that this key will be of use outside of Costa Rica, but the reader should be aware that geographic variation in size and other characters can be significant.

The scientific names of many species have been stable for decades. For other species, however, various names are found in the scientific literature. The truly confusing name choices reflect changing (and differing) opinions as to the systematic relationships of these bats. In order to assist the user, we list in parentheses alternative names frequently or historically used in

the literature for both genera and species. The arrangement of the families and subfamilies is taxonomic and follows Koopman (1993, 1994).

Other keys to Neotropical bats may prove especially useful both in Costa Rica and elsewhere in the Neotropics, including Hall (1981) for all North American bats, Álvarez et al. (1994) and Medellín et al. (1997) for all Mexican species, Pine (1980) for the species of the Caribbean islands, and Baker et al. (1984) for the species found on the Antillean islands. Emmons and Feer (1997) and Reid (1997) both provide extremely useful and well-illustrated guides to the genera of Neotropical bats, and Jones and Carter (1976) provide a valuable review of the taxonomy of the phyllostomid bats with an excellent key to the genera, based primarily upon cranial characters. Additional keys include Vizzoto and Taddei (1973), Hall (1981), Linares (1987, 1998), Buden (1987), Handley (1987), Fernández Badillo et al. (1988), and Muñoz (1995). Unfortunately, reliable identification of some bats requires study of preserved specimens. This is especially true for *Rhogeessa*, some species of *Artibeus*, *Myotis*, and *Eumops*, and for the high-elevation species of *Sturnira*.

Continued destruction of forests in Costa Rica and throughout the Neotropics poses an extremely serious threat to many species of bats. Human activities have altered the abundance and even distribution of many bat species in Costa Rica, as well as elsewhere. Some species have increased in abundance and distribution, but many others have decreased in abundance. Generalists tend to do fairly well in disturbed areas, and can occupy second growth and marginal habitats; some species even thrive in these habitats. However, specialists generally do poorly in disturbed habitats, and several truly endangered species deserve protection. This key is intended to assist users in the identification of live bats, which we hope will assist students in learning about these remarkable animals, assist researchers in identifying properly their study organisms, and promote conservation efforts. In many areas of the tropics, the habitats that bats and other wildlife need will only be saved if active efforts are made to preserve and protect these wild lands.

## FIELD KEY TO THE BATS OF COSTA RICA

### KEY TO FAMILIES OF BATS

1. Base of thumb and foot each with stalked adhesive disc (Figs. 3, 4) ..... Thyropteridae (p. 21)
- 1'. No discs on thumb or foot ..... 2
2. Incisors and canine teeth pointed, daggerlike (Fig. 5A); molars with crushing surface; thumb not exceptionally well developed ..... 3

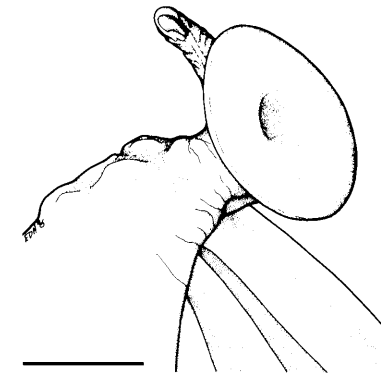


Fig. 3. Adhesive disc (suction cup) on the left wrist of *Thyroptera tricolor*. Scale bar = 2 mm.

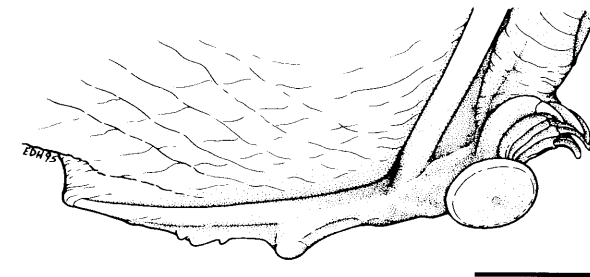


Fig. 4. Left hind foot of *Thyroptera tricolor* showing the adhesive disc and the membranous projections extending posteriorly from the calcar. Note that the outer projection has a cartilaginous continuation of the calcar. There is considerable variation in the appearance of these projections. Scale bar = 3 mm.

- 2'. Incisors and canine teeth laterally flattened and bladelike (Fig. 5B); molars much reduced, without crushing surface; thumb long and well developed ..... Subfamily Desmodontinae of Phyllostomidae (p. 20)
3. Nose with obvious, freely extending leaflike structure (Fig. 2), or face naked with folds and wrinkles ..... Phyllostomidae, excepting Desmodontinae (p. 9)
- 3'. Nose without obvious leaflike structure, face with fur ..... 4
4. Thumb and claw reduced, almost completely enclosed in propatagium; color of fur not white; size very small ..... Furipteridae (p. 20)
- 4'. Thumb normal, extending obviously beyond edge of propatagium (at least terminal joint and claw) except *Diclidurus* (Emballonuridae), which has white fur; size variable ..... 5

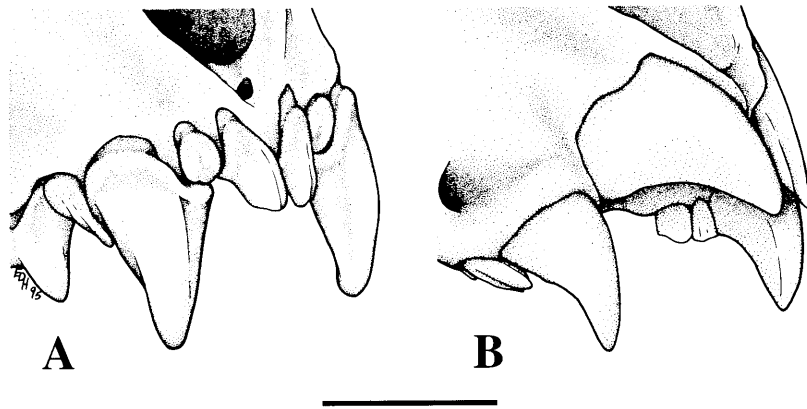


Fig. 5A. Upper daggerlike incisors and canines of *Tonatia saurophilia*. 5B. Upper bladelike incisors and canines of the common vampire bat, *Desmodus rotundus*. Scale bar = 3 mm.

5. Tail entirely contained in uropatagium, reaching to edge (terminal vertebra sometimes projecting slightly beyond posterior edge) ... 6
6. Hind legs, tail, and uropatagium extremely long (tail longer than head and body); ears funnel-shaped; 3rd digit with two phalanges ..... Natalidae (p. 20)
- 6'. Hind legs, tail, and uropatagium variable, but not exceptionally long; ears variable in size, but not funnel-shaped; 3rd digit with three phalanges ..... Vespertilionidae (p. 21)
- 5'. Tail projecting above or beyond uropatagium ..... 7
7. Tail extending well beyond posterior edge of uropatagium ..... Molossidae (p. 23)
- 7'. Tail projecting above the surface of the uropatagium ..... 8
8. Lips and chin without extra grooves, wrinkles, or flaps; propatagium with sac in many species (Fig. 6); 2nd digit without phalanges ..... Emballonuridae (p. 7)
- 8'. Lips and chin with grooves, wrinkles, and/or flaps; no sac in propatagium; 2nd digit with one or two phalanges ..... 9
9. Two lower incisors; 2nd digit with two phalanges; lips with unadorned grooves and folds; fur very short, appearing sparse with bare patches over hind legs; usually a narrow white or yellowish line down middle of back ..... Noctilionidae (p. 9)
- 9'. Four lower incisors; 2nd digit with one phalanx; lips with horizontal flaps and folds, often adorned with small papillae; fur long, soft, silky, more completely covering body, although showing bare areas over hind legs in some species; skin of wings in some species

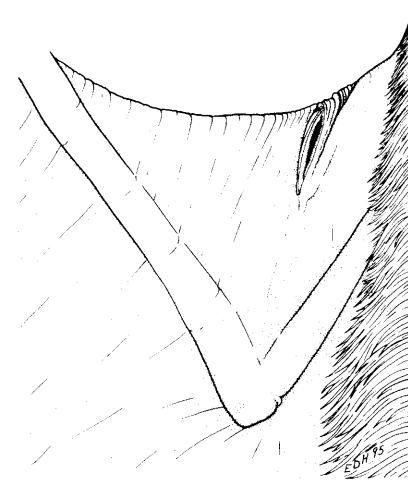


Fig. 6. The anterior portion of the wing membrane or propatagium of the sac-winged bat *Peropteryx kappleri* showing the glandular sac, which opens away from the body and begins near the leading edge of the wing membrane.

meeting at middorsal line giving naked-backed appearance; no light line down back ..... Mormoopidae (p. 8)

#### KEY TO SPECIES OF EMBALLONURIDAE (SHEATH-TAILED OR SAC-WINGED BATS)

1. Color of fur white; forearm 65–66 mm; males often with keratinized dark brown or black V-shaped structure near center of dorsal side of uropatagium ..... *Diclidurus albus* (=virgo)
- 1'. Color of fur dark; forearm less than 55 mm; no unusual structures on uropatagium ..... 2
2. No sac in propatagium ..... 3
3. Back with two wavy longitudinal white lines; fur grizzled, brownish or grayish; forearm with tufts of white hair along outer side on upper surface of membrane; upper lip and nose extending noticeably beyond lower lip; ears long and pointed; forearm 35–41 mm ..... *Rhynchonycteris naso*
- 3'. Back without white lines; fur not grizzled; forearm without tufts of hair; upper lip and nose not overhanging lower lip to a great extent; ears variable; forearm 43–47.5 mm ..... 4
4. Ears moderately long, pointed; fur pale reddish brown, hair on uropatagium reddish; forearm 42.5–45.5 mm ..... *Centronycteris centralis* (=maximiliani)

- 4'. Ears short, rounded; fur dark gray brown, same color on uropatagium; forearm 45.5–47.5 mm ..... *Cyttarops alecto*
- 2'. Propatagium with glandular sac opening on dorsal surface (Fig. 6) (less obvious, sometimes inconspicuous in females) ..... 5
5. Back with two wavy light lines; large glandular sac near forearm or slitlike opening through the dorsal surface of the wing membrane opening toward body ..... (*Saccopteryx*) 6
6. Fur black or brownish black; light lines white or buffy; forearm 41–47 mm (males) or 44–49 mm (females) .....  
..... *Saccopteryx bilineata*
- 6'. Fur uniform brown, light lines indistinct; forearm 37–40 mm (males) or 39–43 mm (females) ..... *Saccopteryx leptura*
- 5'. Back without light lines; sac with opening at anterior edge or in middle of propatagium and with general appearance of fold or pocket rather than sac; size of sac variable, opening facing toward or away from body ..... 7
7. Sac small, in center of propatagium, with opening toward body; restricted to Guanacaste and adjacent Puntarenas; forearm 38–46.5 mm ..... *Balantiopteryx plicata*
- 7'. Sac small to large, with opening facing away from body; probably widespread in Costa Rica; forearm 38–54 mm ..... 8
8. Sac of small to moderate size, extending from anterior edge of propatagium posteriorly, but not to near elbow (Fig. 6) .....  
..... (*Peropteryx*) 9
9. Forearm 45–51 mm (males) or 47–54 mm (females) .....  
..... *Peropteryx kappleri*
- 9'. Forearm 38–44.5 mm (males) or 43–44.5 mm (females) .....  
..... *Peropteryx macrotis*
- 8'. Sac large, in middle of membrane, extending almost (but not) from edge of propatagium to near elbow; forearm 46–48 mm .....  
..... *Cormura brevirostris*

#### KEY TO SPECIES OF MORMOOPIDAE (MUSTACHED BATS)

1. Wings attached to sides of body ..... 2
2. Large; forearm 50–65 mm ..... *Pteronotus parnellii*
- 2'. Small; forearm 41–47 mm ..... *Pteronotus personatus*
- 1'. Wings attached (fused) to back at middorsal line, giving back appearance of being naked ..... 3
3. Larger; forearm 50–56 mm; plagiopatagium covered with many short hairs ..... *Pteronotus gymnotus*

- 3'. Smaller; forearm 41–50 mm; plagiopatagium sparsely covered by long irregularly spaced hairs ..... *Pteronotus davyi*

#### KEY TO SPECIES OF NOCTILIONIDAE (BULLDOG OR FISHING BATS)

1. Forearm 75 mm or more; hind feet exceptionally large, more than 25 mm long; more than 50 g ..... *Noctilio leporinus*
- 1'. Forearm less than 70 mm (56–59 mm); hind feet 20 mm long, or less; less than 50 g ..... *Noctilio albiventris*

#### KEY TO SUBFAMILIES OF PHYLLOSTOMIDAE (LEAF-NOSED BATS, EXCEPTING DESMODONTINAE)

1. Snout narrow and elongate; ears relatively small and widely separated; noseleaf small and equilaterally triangular; lower lip with deep trough extending onto chin from mouth; tongue long with hairlike projections directed back into the mouth .....  
..... Glossophaginae (p. 12)
- 1'. Snout variable but not long and narrow; ears variable but often large; noseleaf variable but usually well developed; lower lip sometimes with groove but not deep trough; tongue usually without hairlike projections ..... 2
2. Tail absent; uropatagium reduced and narrow; head rounded; snout short and blunt (rounded); ears not exceptionally enlarged, never joined across top of head; noseleaf well developed but not exceptionally enlarged, often with accessory fleshy pad behind it (or, noseleaf reduced; face naked with wrinkles and folds); many species with light lines on back or face .....  
..... Stenodermatinae (p. 15)
- 2'. Tail variable but usually obvious; uropatagium variable but usually fairly well developed; snout somewhat squared, not rounded; ears well developed, often very large, sometimes joined across top of head; noseleaf well developed, often exceptionally large but usually without accessory pad; color often quite dark ..... 3
3. Ears and noseleaf well developed but not exceptionally large; noseleaf pointed, taller than broad; tail extending about halfway out into moderately well-developed uropatagium, usually projecting slightly above surface, sometimes inconspicuous; forearm 34–45 mm (from members of the subfamily Phyllostominae having the same range of forearm measurements, Carollinae can readily be

distinguished by one or more of the following characters: fur on back appearing banded; ears not greatly enlarged nor connected across top of head; noseleaf not greatly elongate or broadened; membranes rather heavy, not papery; tail not extending to the edge of uropatagium) ..... Carolliinae (p. 14)

- 3'. Ears and noseleaf well developed and often very large; tail variable, but usually extending well into uropatagium, sometimes all the way to the edge (two genera); forearm 31–116 mm; ears sometimes connected across top of head by low ridge ..... Phyllostominae (p. 10)

### KEY TO SPECIES OF PHYLLOSTOMINAE (GLEANNING BATS)

- 1 . Size large; forearm greater than 75 mm ..... 2  
 1'. Size small to medium; forearm less than 70 mm ..... 5  
 2 . Tail absent or barely visible; ears large, rounded ..... 3  
 3 . Forearm 100–116 mm; tail absent; four lower incisors .....  
 ..... *Vampyrum spectrum*  
 3'. Forearm 78–84 mm; tail barely visible; two lower incisors .....  
 ..... *Chrotopterus auritus*  
 2'. Tail extending part way out in uropatagium; ears moderately large, more or less pointed ..... 4  
 4 . Forearm 88–93 mm; all lower incisors of equal width; wingtips dark ..... *Phyllostomus hastatus*  
 4'. Forearm about 76–83 mm; outer lower incisors one-half width of inner; wingtips white ..... *Phylloderma (Phyllostomus) stenops*  
 5 . Tail extending to posterior edge of uropatagium ..... 6  
 6 . Small size; forearm 35–38 mm; noseleaf long, fairly broad .....  
 ..... *Macrophyllum macrophyllum*  
 6'. Medium size; forearm 45–54 mm; noseleaf very long, narrow, about as long as ears ..... *Lonchorhina aurita*  
 5'. Tail extending to middle of uropatagium or less ..... 7  
 7 . Lips and chin with numerous papillate projections (Fig. 1); forearm 56–62 mm ..... *Trachops cirrhosus*  
 7'. Lips without papillate projections; chin sometimes with low papillae or wartlike bumps; forearm 31–67 mm ..... 8  
 8 . Small size; forearm 31–44 mm; chin tip with smooth pads angled to form a V or with low wartlike bumps ..... 9  
 8'. Medium size; forearm 40–67 mm; chin tip as above in *Micronycteris hirsuta*, variable in others ..... 15

- 9 . Ears connected by interauricular band across forehead; two or four lower incisors ..... 10  
 9'. Ears not connected; four lower incisors ..... (*Micronycteris*) 13  
 The interauricular band is not always obvious and may best be located by blowing into the hair between the ears.  
 10 . Chin with low wartlike bumps; interauricular band low, not notched; noseleaf not beginning below level of nostrils; two lower incisors; forearm 32–40 mm .....  
 ..... *Tonatia brasiliensis* (= *minuta* and *nicaraguae*)  
 10'. Chin with simple a naked V; interauricular band notched in center; noseleaf beginning below level of nostrils; four lower incisors ..... (*Micronycteris*) 11  
 11 . Ventral fur approximately the same color as dorsal fur, and hairs brown or white to base; forearm 31–38 mm; interauricular band with slight notch ..... *Micronycteris microtis*  
 11'. Ventral fur much paler than dorsal fur, and hairs white to base; forearm 33–36 mm; interauricular band with deep notch ..... 12  
 12 . Calcar longer than foot ( $\pm 10$  mm); height of first and second upper premolars approximately equal; thumb longer than 9.2 mm .....  
 ..... *Micronycteris schmidtorum*  
 12'. Calcar shorter than foot (7–8 mm); height of first upper premolar significantly less than that of second; thumb shorter than 9.2 mm .....  
 ..... *Micronycteris minuta*  
 13 . Ventral fur golden yellow or orange to base of hairs, especially bright yellow on the chin; forearm 38–43 mm; calcar longer than foot; outer upper incisors bicuspidate, easily visible (one-half the height of inner upper incisors); last upper premolars straight ...  
 ..... *Micronycteris brachyotis*  
 13'. Ventral fur color brown, gray, silver, or dull yellow, but with dark roots; calcar shorter than foot; outer upper incisors minute; last upper premolars reduced or recurved; 4th metacarpal shortest, 3rd or 5th longest ..... 14  
 14 . Forearm 37–43 mm; fur on back clearly banded, with dark (usually black) basal band; 1st lower premolar about same size as 2nd or only slightly larger; no middorsal gray line; 5th metacarpal longest ..... *Micronycteris sylvestris*  
 14'. Forearm 35–39 mm; fur on back only faintly banded; 1st lower premolar considerably larger than others; some individuals with middorsal gray line; 3rd metacarpal longest .....  
 ..... *Micronycteris nicefori*

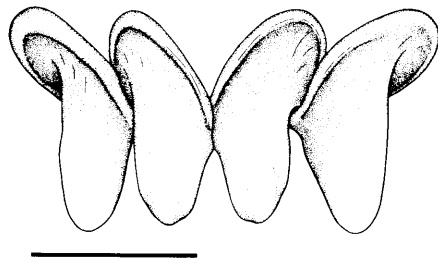


Fig. 7. Upper incisors and canines of *Micronycteris daviesi*, which are nearly equal in size. This character separates *M. daviesi* from all other species of *Micronycteris*, as well as from all species of *Mimon* and *Tonatia*. Scale bar = 2 mm.

15. Ears medium sized, set wide apart; tail short, less than one third length of femur; forearm 55–67 mm ..... *Phyllostomus discolor*
- 15'. Ears large and set close together, sometimes connected; tail longer, about equal to length of femur ..... 16
16. Two upper incisors, equal to upper canines in size (Fig. 7); forearm 53–58 mm ..... *Micronycteris (Barticonycteris) daviesi*
- 16'. Four upper incisors, much smaller than upper canines ..... 17
17. Noseleaf relatively long and narrow, obviously longer than broad; two or four lower incisors ..... 18
- 17'. Noseleaf relatively short and broad, near shape of equilateral triangle; two lower incisors ..... (*Tonatia*) 20
18. Ears connected by low interauricular band; four lower incisors; forearm 40–46 mm ..... *Micronycteris hirsuta*
- 18'. Ears not connected; two lower incisors; forearm 45–61 mm ..... (*Mimon*) 19
19. Forearm 45–52 mm; median white line on back ..... *Mimon crenulatum*
- 19'. Forearm 53–59 mm; no white middorsal line ..... *Mimon bennettii (=cozumelae)*
20. Ears large (range 33–40 mm), with bands that nearly meet near middle of forehead; little hair on forearms, legs, rostrum, and ears; no middorsal stripe on head; venter often white; tragus long, with three small toothlike projections near base of outer border; forearm 47–60 mm ..... *Tonatia silvicola*
- 20'. Ears smaller (range 28–32 mm), no bands connecting ears; forearms, legs, rostrum, and ears well haired; often with short, middorsal white stripe on head; venter dark; tragus small and simple; forearm 53–61 mm ..... *Tonatia saurophila (=bidens)*

**KEY TO SPECIES OF GLOSSOPHAGINAE  
(NECTAR-FEEDING BATS)**

1. Lower incisors present (not always obvious) ..... 2
- 1'. Lower incisors absent ..... 6
2. Large; forearm 40–45 mm; inner upper incisors much larger than outer ..... *Lonchophylla robusta*
- 2'. Small; forearm 30–38 mm; inner and outer upper incisors differ relatively little in size ..... 3
- Note in *Lonchophylla mordax* that the inner upper incisors are much larger than the outer.
3. Tongue with deep groove along each side underneath; lower incisors tricuspidate; upper outer incisors pointed, reduced, and not in contact with inner incisors and canines; forearm 31–36 mm ..... *Lonchophylla mordax*
- 3'. Tongue without lateral grooves; lower incisors unicuspid, peglike; upper outer incisors like, and more or less in contact with, inner incisors; forearm 32–39 mm ..... (*Glossophaga*) 4
4. Inner upper incisors somewhat longer than outer; lower incisors in contact with each other; forearm 32–37 mm ..... *Glossophaga soricina*
- 4'. Inner and outer upper incisors approximately equal in size; lower incisors uncrowded, usually with conspicuous spaces between them ..... 5
5. Forearm 32–36 mm; lower incisors usually evenly spaced ..... *Glossophaga commissarisi*
- 5'. Forearm 34–39 mm; lower incisors with larger space between inner incisors than between inner and outer incisors ..... *Glossophaga leachii (=alticola)*
6. Forearm 38–47 mm ..... (*Anoura*) 7
7. Tail absent; calcar and uropatagium very much reduced, inconspicuous; 1st lower premolar approximately same size and shape as other premolars; forearm 39–47 mm; weight 12–16 g ..... *Anoura geoffroyi*
- 7'. Tail small, but present; calcar and membrane present but reduced, not usually obvious; 1st lower premolar greatly enlarged and bladelikey; forearm 38–44 mm; weight 18–22 g *Anoura cultrata*

Other than the differences in the uropatagium, tail, and calcar, the *Anoura* of Central America are difficult to distinguish in the field. *Anoura cultrata* and *A. geoffroyi* both have two minute upper incisors; in *A. cultrata* the outer incisor is considerably larger than the inner, and in *A. geoffroyi* the

two incisors are similar in size. If comparative material is available, both the upper and lower canines are considerably larger in *A. geoffroyi* than they are in *A. cultrata*; this difference is striking given that the two species are nearly identical in size. The three upper premolars and three lower premolars are reduced in size in *A. cultrata* and large in *A. geoffroyi*.

- 6'. Forearm 30–38 mm ..... 8  
 8. Four upper cheekteeth (two molars); wing attached to base of outer toe; forearm 30–36 mm ..... *Lichonycteris obscura*  
 8'. Five upper cheekteeth (three molars); wing attached to base of ankle; forearm 31–36 mm ..... 9  
 9. Lower premolars with three cusps nearly equal; upper incisors separated into pairs by wide median gap; fur of back bicolored; forearm 32–36 mm ..... *Choeroniscus godmani*  
 9'. Lower premolars with middle cusp much larger than others; upper incisors more or less evenly spaced; fur of back tricolored; forearm 31–36 mm ..... *Hylonycteris underwoodi*

#### KEY TO SPECIES OF CAROLLINAE (SHORT-TAILED FRUIT BATS)

1. Forearm and feet quite hairy; fur on back three or four banded, with broad, dark (usually black) basal band contrasting sharply with middle whitish band; medium size; forearm 38–41 mm; tibia 16–18 mm ..... *Carollia brevicauda*  
*Carollia brevicauda* in South America can be larger with a forearm up to 43 mm.  
 1'. Forearm and feet not particularly hairy; fur on back three banded (or appearing two banded) with relatively little contrast between bands ..... 2  
 2. Larger; forearm 40–45 mm; tibia 19–21 mm; fur clearly three banded ..... *Carollia perspicillata*  
 2'. Smaller; forearm 35–42 mm; tibia 13–17 mm; fur indistinctly three banded or two banded ..... 3  
 3. Larger; forearm 37–42 mm; tibia 15–17 mm; fur appearing short, sparse, and coarse ..... *Carollia subrufa*  
 3'. Smaller; forearm 35–39 mm; tibia 13–17 mm; fur indistinctly three banded ..... *Carollia castanea*

In Central America, the lower incisors are useful for identifying the species of *Carollia*. In *C. brevicauda*, *C. castanea*, and *C. subrufa* the inner and outer lower incisors are similar in height and shape, although the outer

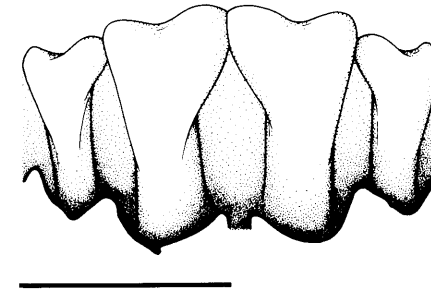


Fig. 8. Lower incisors of *Carollia perspicillata*. The outer incisors are shorter and one-half the width of the inner incisors. Scale bar = 1 mm.

incisors are slightly smaller. However, in *C. perspicillata* the outer lower incisors are noticeably shorter than the inner incisors and about one-half their width (Fig. 8). In Guanacaste, where *C. perspicillata* and *C. subrufa* are rather similar in appearance and overlap in size, examination of the lower incisors may enable the field worker to separate these two difficult species. See Pine (1972) for more details on identifying these species.

#### KEY TO SPECIES OF STENODERMATINAE (FRUIT-EATING BATS)

1. Face typically with one or two pairs of light stripes ..... 2  
 1'. No light stripes on face ..... 21  
 2. White line down middle of back ..... 3  
 2'. No white line on back ..... 11  
 3. Small size; forearm 35–52 mm ..... 4  
 3'. Medium size; forearm 52–64 mm ..... 10  
 4. Dorsal stripes sharp and distinct ..... 5  
 4'. Dorsal stripes indistinct ..... 9  
 5. Facial stripes distinct; ears rimmed with yellow or white ..... 6  
 5'. Facial stripes indistinct; ears not rimmed with yellow or white; forearm 36–46 mm ..... *Uroderma magnirostrum*  
 6. Edge of uropatagium well furred; uropatagium very narrow; middorsal line from between ears; forearm 37–40 mm .....  
 ..... *Platyrrhinus (Vampyrops) helleri*  
 6'. Edge of uropatagium bare or sparsely furred; middorsal line from upper back ..... 7  
 7. Usually grayish brown; upper middle incisors evenly bilobed (Fig. 9A), only slightly larger than outer incisors; five teeth posterior to both upper and lower canines; forearm 39–46 mm .....  
 ..... *Uroderma bilobatum*



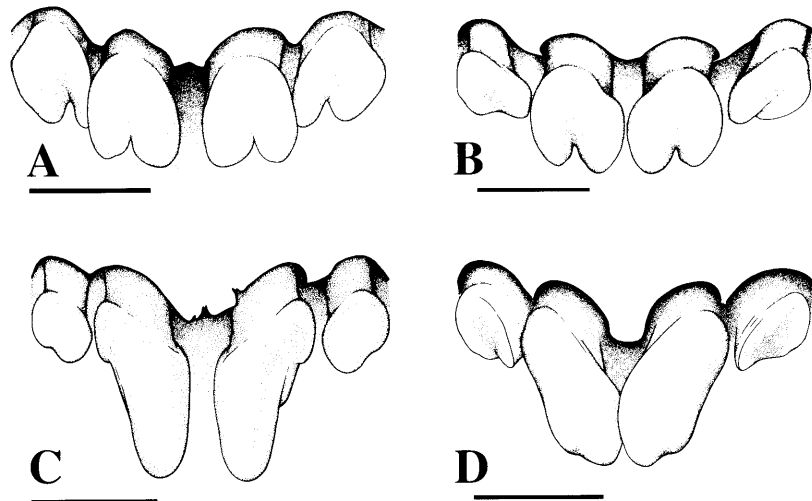


Fig. 9A. Upper incisors of *Uroderma bilobatum*. The inner incisors are nearly equally bilobed. 9B. Upper incisors of *Artibeus watsoni*. The outer lobe of the inner incisors is smaller than the inner lobe. 9C. Upper incisors of *Chiroderma* showing the simple, long, narrow caninelike inner incisors. 9D. Upper incisors of *Vampyressa nymphaea*. The inner incisors are unevenly bilobed. Scale bars = 1 mm.

- 7'. Dark brown to yellowish brown; upper middle incisors simple and long, more than twice the length of outer incisors (Fig. 9C); four teeth posterior to both upper and lower canines .... (*Chiroderma*) 8
8. Dark brown; forearm 44–52 mm ..... *Chiroderma salvini*
- 8'. Brown or yellowish brown; forearm 37–42 mm .....  
..... *Chiroderma trinitatum*
- Chiroderma trinitatum* is known from adjacent Panama, but there are no specimens from Costa Rica. LaVal captured and released an adult male *Chiroderma* (forearm = 38 mm) at Tortuguero on 31 March 1997 that he believed was *C. trinitatum*. This is the only observation for Costa Rica.
9. Facial stripes indistinct; long guard hairs scattered through fur; upper middle incisors long, narrow, caninelike (Fig. 9C); forearm 43–50 mm ..... *Chiroderma villosum*
- 9'. Facial stripes distinct; fur of uniform length; upper middle incisors unevenly bilobed (Fig. 9D); forearm 35–39 mm .....  
..... *Vampyressa nymphaea*
10. Five teeth posterior to upper canine; color dark blackish brown; lower part of facial stripes reduced, indistinct, or absent; forearm 59–64 mm ..... *Platyrrhinus (Vampyrops) vittatus*

- 10'. Four teeth posterior to upper canine; color pale brown; both pairs of facial stripes distinct; forearm 52–55 mm .....  
..... *Vampyroides caraccioli* (=major)
11. Large; forearm more than 50 mm; facial stripes distinct or indistinct ..... (large *Artibeus*) 12
12. Basal one-half of uropatagium without fur dorsally; venter variably colored, always frosted; facial stripes sometimes indistinct; forearm 52–67 mm ..... *Artibeus jamaicensis*
- 12'. Basal one-half of uropatagium furred dorsally; venter dark brown, no frosting; facial stripes distinct; forearm 61–76 mm ..... 13
13. Forearm 63–76 mm; two pairs of bright white facial stripes .....  
..... *Artibeus lituratus*
- 13'. Forearm 61–68 mm; usually only one pair of facial stripes (over eye), stripes beneath eye may be present, but indistinct .....  
..... *Artibeus intermedius*
- 11'. Size small to medium; forearm less than 50 mm; facial stripes variable ..... 14
14. Size small; forearm 30–32 mm; color pale brown; facial stripes usually indistinct; uropatagium with fur extending to edge to form a fringe ..... *Vampyressa pusilla*
- 14'. Size medium; forearm 35–50 mm; color variable; facial stripes variable ..... 15
15. Upper middle incisors not lobed ..... 16
- 15'. Upper middle incisors bilobed (Figs. 9B, 9D) ..... 17
16. Forearm 43–50 mm; color light brown (various shades); facial stripes indistinct; upper inner incisors long, narrow, caninelike (Fig. 9C); long guard hairs scattered through fur .....  
..... *Chiroderma villosum*
- 16'. Forearm 37–43 mm; color blackish brown; facial stripes distinct, buffy; upper inner incisors short, broad, flat .....  
..... *Artibeus (Dermanura or Enchisthenes) hartii*
17. Upper inner incisors unevenly bilobed (Fig. 9D), outer lobe much smaller, and differing considerably in size and shape from outer incisors; facial stripes distinct; ears yellow, noseleaf light; forearm 35–40 mm ..... *Vampyressa nymphaea*
- 17'. Upper inner incisors bilobed (Fig. 9B), outer lobe slightly smaller (about one-half as large as inner lobe); outer incisor approximates the shape of the inner incisor; facial stripes often indistinct, occasionally absent; forearm 35–48 mm .....  
..... (small *Artibeus* or *Dermanura*) 18

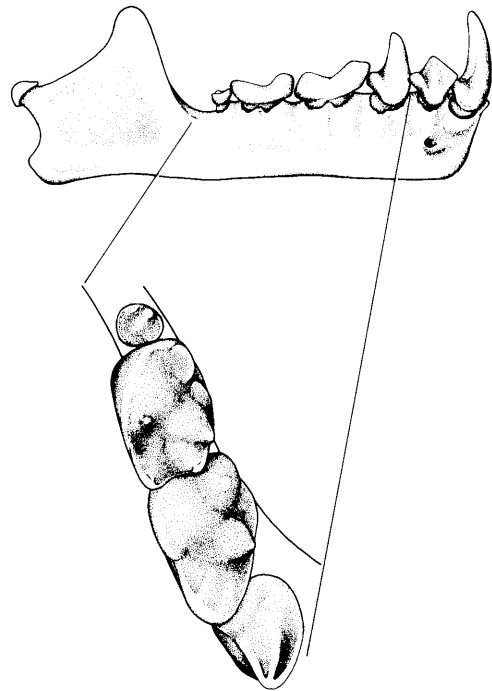


Fig. 10. Lateral view of the mandible (and enlarged dorsal view) of *Artibeus watsoni* showing the minute 3rd molar, which is present in about 85% of the individuals.

- 18. Color shades of brown or gray; facial stripes conspicuous; uropatagium wide, not conspicuously haired on surface, without obvious fringe of hairs along edge ..... 19
- 19. Two lower molars; wide talonid on M1; forearm 35–42 mm; ears trimmed in yellow; sea level to 1,000 m .....  
.....*Artibeus (Dermanura) phaeotis*
- 19'. Three lower molars, last one extremely minute, but usually visible (Fig. 10); narrow talonid on M1; forearm 35–41 mm; ears trimmed in white; sea level to 1,500 m .....  
.....*Artibeus (Dermanura) watsoni*
- 18'. Color dark brown or black; facial stripes indistinct or lacking; uropatagium narrow, conspicuously haired, with obvious fringe along edge ..... 20
- 20. Forearm 43–48 mm; usually above 900 m .....  
.....*Artibeus (Dermanura) aztecus*
- 20'. Forearm 37–40 mm; usually between 300 and 1,500 m .....  
.....*Artibeus (Dermanura) toltecus*

- 21. Large; forearm 52–67 mm; venter variable but always frosted; basal one-half of uropatagium without fur; facial stripes sometimes indistinct ..... *Artibeus jamaicensis*
- 21'. Small to medium size; forearm less than 50 mm ..... 22
- 22. Size small; forearm 25–33 mm; color white or whitish brown; membranes with yellow trim; uropatagium without fur ..... 23
- 23. Forearm 25–30 mm; color white or gray white, membranes black; ears and noseleaf trimmed with orange; noseleaf simple .....  
.....*Ectophylla alba*
- 23'. Forearm 29–33 mm; color whitish brown; membranes dark brown; a second tiny noseleaf present directly behind outer noseleaf ...  
.....*Mesophylla (Vampyressa) macconnelli*
- 22'. Medium size; forearm 37–48 mm; color variable, not white or whitish brown; membranes without yellow trim; uropatagium with fur extending to edge to form a fringe ..... 24
- 24. No obvious noseleaf; face naked with folds and wrinkles; white spot on shoulder at base of propatagium; uropatagium obvious; forearm 41–46 mm .....  
.....*Centurio senex*
- 24'. Noseleaf present; face furred, without folds and wrinkles; no white spot on shoulder; uropatagium very narrow and densely furred or absent .....  
..... (*Sturnira*) 25
- 25. Lower incisors trilobed (Fig. 11A); forearm 37–45 mm; lowlands (to 1,000 m) ..... 26
- 26. Forearm seldom as long as 41 mm; dorsally pale in color; maxillary tooththrows arched outward (not parallel) .....  
.....*Sturnira lilium*
- 26'. Forearm 41–45 mm; dorsally dark; maxillary tooththrows nearly parallel to each other .....  
.....*Sturnira luisi*

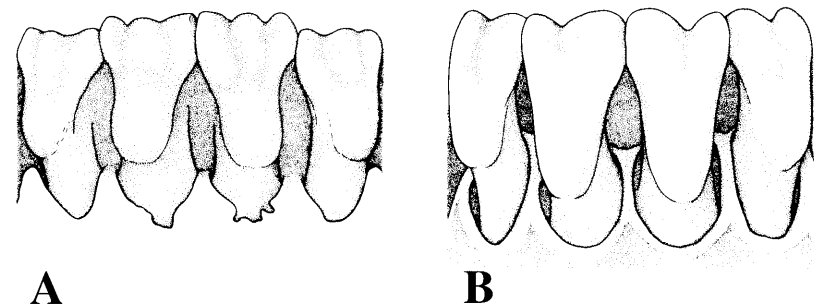


Fig. 11A. Lower trilobed incisors of *Sturnira lilium*. 11B. Lower bilobed incisors of *Sturnira ludovici*. Scale bar = 1 mm.

- 25'. Lower incisors bilobed (Fig. 11B); forearm 42–48 mm; mostly highlands ..... 27
27. Forearm 42–47 mm; upper middle incisors generally unicuspid with diverging pointed tips in contact near middle of crown; brown or gray in color; legs and hind feet heavily furred; hairy uropatagium ..... *Sturnira ludovici*
- 27'. Forearm 46–48 mm; upper middle incisors bicuspid with converging flattened tips in contact near the tips; dark brown in color; legs and hind feet sparsely furred; uropatagium with little hair; highlands only ..... *Sturnira mordax*

The species of *Sturnira*, especially the higher elevation forms, are very difficult to distinguish. *Sturnia lilium* generally is the smallest, with the dental arcade rounded and the upper incisors relatively small; *S. ludovici* is larger and has a less rounded dental arcade; *S. mordax* has the largest skull and an oval dental arcade (Davis, 1980), is significantly darker brown than *S. ludovici*, and in the hand is obviously a larger, heavier bat.

#### KEY TO SPECIES OF DESMODONTINAE (VAMPIRE BATS)

1. Legs thickly furred; calcar present as short distinct rod; eyes large; ridge over nostrils without middorsal cleft; lower incisors four lobed (inner) and seven lobed (outer), forming continuous row between canines; uropatagium extremely reduced at midpoint between hind legs; forearm 54–56 mm ..... *Diphylla ecaudata*
- 1'. Legs sparsely furred; calcar absent or inconspicuous; eyes small; ridge over nostrils with V-shaped cleft middorsally; lower incisors two- or three-lobed or entire, narrow, conspicuously separated into pairs by a median gap ..... 2
2. Wing tips normally pigmented; thumb conspicuously long with obvious accessory pad at base of each phalanx; no calcar; uropatagium obviously continuous between hind legs; small but obvious tuberclelike pad on medial side of heel; lower incisors bilobed; forearm usually more than 57 mm (55–63 mm) ..... *Desmodus rotundus*
- 2'. Wing tips white; thumb long but without obvious pads; calcar vestigial; uropatagium highly reduced, connecting between hind legs as narrow fold; no projecting pad on heel; lower incisors trilobed (inner) and bilobed (outer) or entire; forearm 50–56 mm ..... *Diaemus* (or *Desmodus*) *youngi*

#### FAMILY NATALIDAE (FUNNEL-EARED BATS)

Only one species is found in Central America; forearm 35–37 mm ..... *Natalus stramineus*

#### FAMILY FURIPTERIDAE (SMOKY BATS)

Only one species is known to occur in Central America; forearm 35–36 mm ..... *Furipterus horrens*

#### KEY TO SPECIES OF THYROPTERIDAE (DISK-WINGED BATS)

1. Underparts white or pale yellow; forearm 35–38 mm; tail extending 5–8 mm beyond tail membrane; uropatagium nearly naked; calcar usually with two membranous projections extending into posterolateral border of membrane (Fig. 4) ..... *Thyroptera tricolor*
- 1'. Underparts brown or orange-brown; forearm 31–35 mm; tail extending 2–4 mm beyond tail membrane; uropatagium with sparsely distributed long (4 mm), thin hairs; calcar with one membranous projection extending into posterolateral border of membrane ..... *Thyroptera discifera*
- Thyroptera tricolor* is widespread throughout low and mid elevations of Costa Rica. Marco Tschapka recently obtained *T. discifera* at La Salva, and it is to be expected elsewhere in the Caribbean lowlands.

#### KEY TO SPECIES OF VESPERTILIONIDAE (EVENING BATS)

1. Ears long, extending well past end of snout when laid forward; muzzle abruptly truncated, with nostrils opening forward on horseshoe-shaped ridge; forearm 47–58 mm ..... *Antrozous (Baurus) dubiaquercus*
- 1'. Ears relatively short, not reaching or barely reaching end of snout when laid forward; nostrils simple, lacking horseshoe-shaped ridge ..... 2
2. Ears short and rounded; upper surface of uropatagium furred for at least one-half its extent; tragus roughly triangular or noticeably rounded ..... (*Lasiurus*) 3
3. Large, forearm 43–55 mm; back buffy, yellowish brown, or mahogany brown ..... 4

- 3'. Smaller, forearm 37–45 mm; back reddish to reddish brown or deep chestnut; white shoulder patch; legs and uropatagium entirely or mostly furred dorsally ..... 5
4. Color variable from dark brownish (rarely) to buffy or clay-white (pale colors predominate); hind legs and posterior one-half of uropatagium naked on dorsum; forearm 43–52 mm .....  
..... *Lasiurus ega*
- 4'. Forearm 46–55 mm; back yellowish brown to mahogany brown, heavily frosted with silver (not as yet known from Costa Rica, but may occur at higher elevations) ..... *Lasiurus cinereus*
5. Color reddish to reddish brown, including face; legs and uropatagium entirely furred; forearm 37–44 mm .....  
..... *Lasiurus blossevillii* (= *borealis*)
- 5'. Color deep chestnut; face black; distal one-fourth of uropatagium naked; forearm 44–45 mm (extremely rare) .....  
..... *Lasiurus castaneus*
- 2'. Ears of moderate length, more or less pointed; surface of uropatagium naked, sparsely haired, or furred only at the base; tragus long and narrow, usually rather straight ..... 6
6. Color yellow brown (long hairs showing mostly yellow basally with brown ends) dorsally, more yellow ventrally; two upper incisors; forearm 26–32 mm ..... (*Rhogeessa*) 7
- 6'. Color not yellowish dorsally, but varying from reddish to brown to almost black; dorsal and ventral coloration similar; four upper incisors; forearm 33–52 mm ..... 8
7. Forearm 26–30 mm; color paler; 2N = 34; Pacific lowlands and slopes ..... *Rhogeessa tumida*
- 7'. Forearm 30–32 mm; color darker; 2N = 30; Caribbean lowlands and slopes ..... *Rhogeessa io*
8. Nostrils open laterally; upper canine and single premolar in close contact; one large conspicuous upper premolar that is obviously longer than molars; tragus relatively blunt; color rather uniform brown or dark brown; inner upper incisors bilobed, relatively broad, much longer than the inconspicuous outer incisors; forearm 37–54 mm ..... (*Eptesicus*) 9
9. Small; forearm 37–43 mm; fur short ..... *Eptesicus furinalis*
- 9'. Medium to large; forearm 42.5–52 mm; fur long ..... 10
10. Forearm 42–47; blackish ..... *Eptesicus brasiliensis* (= *andinus*)
- 10'. Forearm 46–54; rich dark brown ..... *Eptesicus fuscus*
- 8'. Nostrils open anteriorly; upper canine and 1st premolar (3rd) with obvious gap between teeth, gap  $\geq$  length of premolar; 1st two upper

- premolars minute, obviously shorter than 3rd premolar; tragus narrow and sharply pointed; color varying through range indicated in 6'; inner upper incisors with single sharp point (in anterior view), appearing conical; outer incisors about equal in length; forearm 31–44 mm ..... (*Myotis*) 11
11. Fur on uropatagium extends from body to at least halfway between knee and foot along tibia, usually reaches foot; often orange-brown; forearm 31–41 mm (found only in the highlands, 1,000 m and above) ..... *Myotis keaysi*
- 11'. Fur on uropatagium rarely extends posteriorly as far as knee; variable in color, but often grayish or blackish ..... 12
12. Dorsal fur dark, often black, with short white tips on hairs, giving frosted appearance; forearm 33–38 mm ..... *Myotis albescens*
- 12'. Dorsal fur variable in color, but lacking white-tipped hairs .. 13
13. Size large; forearm 38–44 mm; fur long and woolly, with little contrast between tips and bases; occurs only above 900 m .....  
..... *Myotis oxyotus*
- 13'. Size small; forearm 31–39 mm; fur variable, but rarely woolly; mostly below 900 m ..... 14
14. Usually blackish; 1st and 2nd small upper premolars not crowded in toothrow, 2nd premolar about one-half to two-thirds height of 1st; length of lower incisor 2  $\leq$  incisor 1 and incisor 1 narrow; fur silky; a few specimens from as high as 2,700 m .....  
..... *Myotis nigricans*
- 14'. Grayish, brownish, or reddish brown; 1st and 2nd small upper premolars crowded in toothrow, 2nd premolar much smaller than 1st premolar; incisor 1 wide ..... 15
15. Pale brown or reddish brown; small upper premolars crowded, but all aligned in toothrow; length of lower incisor 2  $\leq$  incisor 1; bicolored more or less silky fur; forearm 32–35 mm; lowlands only ..... *Myotis elegans*
- 15'. Dark gray (commonly) to cinnamon; 2nd upper premolar crowded to inside of toothrow and not visible from side; length of incisor 2  $\geq$  incisor 1; fur near monocolored, woolly; forearm 32–39 mm; a few from as high as 1,300 m ..... *Myotis riparius*

All species of Neotropical *Myotis* have three upper premolars. When viewed from the side, one of these is substantially larger than the other two (this often requires a hand lens to see). Usually two of these are one quarter to two-thirds the height of the largest of the three. "Two upper premolars crowded in toothrow" refers to the fact that in *M. riparius* and *M. elegans* the premolars are smaller and more crowded than in other Neotropical species, and in *M. riparius* the smallest of the three premolars is relatively smaller than in *M. elegans*. In *M. riparius* this minute tooth is crowded to

the inside of the toothrow and is rarely visible in the field. In *M. elegans* it is barely crowded into the toothrow. The species of *Myotis* are very difficult to distinguish; see additional characters in LaVal (1973a).

### KEY TO SPECIES OF MOLOSSIDAE (FREE-TAILED BATS)

1. Upper lip with deep vertical grooves or wrinkles; ears with row of tubercular projections along upper front edge; antetragus not well developed ..... 2
2. Ears short, not joined at base; 2nd phalanx of 4th digit more than 5 mm; forearm 37–46 mm ..... *Tadarida brasiliensis*
- 2'. Ears large, joined at base; 2nd phalanx of 4th digit less than 5 mm; forearm 41–45 mm ..... *Nyctinomops laticaudatus*
- 1'. Upper lip without grooves or wrinkles; ears without row of tubercles; antetragus variable, well developed ..... 3
3. Ears large, extending beyond nostril when laid forward, usually joined at base; antetragus large but not in form of circular disc ....  
..... (*Eumops*) 4
4. Forearm less than 52 mm ..... 5
  5. Forearm 39–49 mm ..... *Eumops bonariensis* (=nanus)
  - 5'. Forearm 36.5–42 mm ..... *Eumops hansae*

*Eumops bonariensis* and *E. hansae* can be reliably distinguished only by study of preserved specimens.
- 4'. Forearm greater than 52 mm ..... 6
6. Tragus small, pointed, 3.5 mm from posterior notch; forearm 56–63 mm ..... *Eumops auripendulus*
- 6'. Tragus medium size, 4–5 mm from posterior notch, square or rounded across top; forearm 58–71 mm ..... 7
7. Forearm 58–66 mm; tragus broad and square across top .....  
..... *Eumops glaucinus*
- 7'. Forearm 65–77 mm; ears short and heavily keeled .....  
..... *Eumops underwoodi*

*Eumops underwoodi* has only recently been reported from the Guanacaste lowlands of northwestern Costa Rica (Foster and Aguilar, 1993). It has also been observed by LaVal at the Río Congo, near the provincial border with Puntarenas in southern Guanacaste, and is to be expected anywhere in the country, especially at lower elevations.

- 3'. Ears short, rounded, not or just barely reaching end of snout, often arising from same point on head but not joined; antetragus prominent, circular disc ..... 8
8. Four lower incisors ..... 9

9. Head appears small, flattened; ears not connected in middle; forearm 33–38 mm ..... *Molossops greenhalli*
- 9'. Head large, domed; ears connected in middle; forearm 49–56 mm ..... *Promops centralis*
- 8'. Two lower incisors ..... 10
10. Ears not connected in middle; head flattened; forearm 33–38 mm  
..... *Molossops greenhalli*

*Molossops greenhalli* may have either one or two pairs of lower incisors, if two pairs are present, the outer pair is minute and difficult to see; all lower incisors are deeply bicuspidate.

- 10'. Ears connected in middle; head not especially flattened; forearm 37.8 mm or greater ..... (*Molossus*) 11
11. Forearm greater than 47 mm (males) or 46.5 mm (females) ....  
..... 12
12. Dorsal hairs with contrasting white or gray bases; forearm 46–52 mm ..... *Molossus sinaloae*
- 12'. Dorsal hairs with little contrast between tips and bases; forearm 47–51 mm ..... *Molossus ater* (=rufus)
- 11'. Forearm less than 46.5 mm (males) or 45.5 mm (females) .... 13
13. Fur ca. 3 mm long in center of back; pale basal band on dorsal hairs; forearm usually 38–41 mm ..... *Molossus molossus*
- 13'. Fur ca. 2 mm long in center of back; little or no contrast between tips and bases of dorsal hairs ..... 14
14. Forearm more than 43 mm (males) or 41 mm (females) .....  
..... *Molossus pretiosus*
- 14'. Forearm less than 43 mm (males) or 41.5 mm (females) .....  
..... *Molossus bondae*

We include *Promops centralis* and *Nyctinomops laticaudatus* in the above key as we are confident that they do occur in Costa Rica even though no records to date document their occurrence in the country. Two other species of molossids, *Nyctinomops aurispinosus* and *N. macrotis*, may eventually be discovered in Costa Rica also.

### TAXONOMIC NOTES

**Phyllostomidae.**—The leaf-nosed bats are the most common bats netted in Costa Rica. Most species are quite easy to distinguish; however, there are several very difficult groups. The species referred to as *Micronycteris megalotis* in the literature is a composite of two valid

species—*Miconycteris microtis*, which occurs from Mexico through Central America to northern South America and *M. megalotis*, which occurs throughout much of the northern one-half of South America (Simmons, 1996, and others). All previous literature references to *M. megalotis* in Costa Rica should be attributed to *M. microtis*. Additional characters useful in identifying species of *Miconycteris* are provided by Simmons (1996). Baker et al. (1988a) regarded *Phylloderma* as congeneric with *Phyllostomus*, thus treating *P. stenops* as a species of *Phyllostomus*. However, we continue to recognize *Phylloderma* as a valid genus until the relationships of these species are better understood. Griffiths (1982) accorded the nectar-feeding bats of the genera *Lionycteris*, *Lonchophylla*, and *Platalina* subfamilial rank as the subfamily Lonchophyllinae, rather than as members of the subfamily Glossophaginae. Although Koopman (1993, 1994) concurred, recent research suggests that treating the Lonchophyllini as a tribe within the subfamily Glossophaginae best reflects the true relationships. Herein, we continue to treat *Lonchophylla* as a glossophagine. Mares and Wilson (1971) earlier reported *Choeronycteris mexicana* from Costa Rica, we however discount this identification as we now know the species is distributed from the southwestern United States to Honduras, and no voucher specimen exists for confirmation. Taxonomy of the fruit-eating bats of the genus *Artibeus* is currently under debate and both the larger (*Artibeus* proper) and smaller (*Dermanura*) species are in need of revision. Owen (1987) regarded the smaller members of the genus *Artibeus* as a separate genus, *Dermanura*; however, herein we follow Koopman (1993) in using *Artibeus* for the Costa Rican members of the *Dermanura* group. We accept *A. watsoni* as a species distinct from *A. glaucus* (Handley, 1987), rather than following Koopman (1993, 1994). We treat *Mesophylla macconnelli* as the only member of the genus *Mesophylla* rather than following Owen (1987) in recognizing it as a species of *Vampyressa*. It has also, and we believe inappropriately, been placed in the genus *Ectophylla* by some authors. We follow Hall (1981) and Gardner and Ferrell (1990) in recognizing *Platyrrhinus* as the senior synonym of *Vampyrops*, although Koopman (1994) continued to use *Vampyrops* as the name for the white-lined bats. The species currently known as *Sturnira ludovici* almost certainly represents a composite of species. If that is definitely shown, then *S. hondurensis* sensu Goodwin (1940) will be the name applicable to the Central American populations.

**Thyropteridae.**—*Thyroptera discifera* was first reported from Costa Rica at Tortuguero (Rodríguez, 1993); however, Timm examined this specimen and considers it a juvenile *T. tricolor*. We studied the recent specimen from La Selva, which is also deposited in the Universidad de Costa Rica collection and concur with Tschapka that it represents *T. discifera*.

**Vespertilionidae.**—Red bats of the genus *Lasiurus* historically have been regarded as a single widely distributed species, *L. borealis*. However, Baker et al. (1988b) recently demonstrated that the red bats of the western United States, Mexico, Central America, and South America should be considered the species *L. blossevillii*. The relationships of the red bats of Mexico and Central and South America are in need of study, and it is quite likely that more than one biological species is represented throughout this broad geographic range. The systematics and species distributions of yellow bats of the genus *Rhogeessa* are not well understood. Traditionally, all Costa Rican *Rhogeessa* were treated as belonging to the single widespread species *R. tumida* (LaVal, 1973b). Recent cytogenetic studies show that the genus is more speciose than previously believed. Genoways and Baker (1996) suggested that 10 species should be recognized, with two (*R. tumida* and *R. io*) occurring in Costa Rica and Nicaragua. In Costa Rica, the species in Guanacaste and on the Nicoya Peninsula was considered to be *R. tumida*. Genoways and Baker (1996) believed *R. io* to be the species found elsewhere in the country, as well as throughout Panama and much of northern South America. These two species were recognized as distinct, on the basis of only karyotypic differences. Based on 49 Costa Rican specimens known to us, *R. io*, as compared to *R. tumida*, is larger in size (five wing measurements differed significantly) and darker in color. We suspect that *R. tumida* will be found throughout the tropical dry forest region of Guanacaste and adjoining Puntarenas, with *R. io* being found throughout the remainder of the country. For reviews of characters useful in the genus *Rhogeessa*, see LaVal (1973b) and Ruedas and Bickham (1992). Identification of *Rhogeessa* in the field should be considered tentative until morphologic and cytogenetic studies are undertaken to better understand the species and to verify their distributions.

Although earlier versions of this key have been field tested for many years in Costa Rica by the authors, by students, and by other biologists, it contains couplets that may not always work in the field. We need your input on corrections and changes, so that a future second edition, when published, will be more reliable and easier to use.

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