HHS Public Access

Author manuscript

Occas Pap Tex Tech Univ Mus. Author manuscript; available in PMC 2019 May 28.

Published in final edited form as:

Occas Pap Tex Tech Univ Mus. 2019 ; 360: .

Field Identification Key and Guide for Bats of the United States of America

Clint N. Morgan,
Poxvirus and Rabies Branch, Div of High-Consequence Pathogens and Pathology, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, GA 30333, USA

Loren K. Ammerman,
Department of Biology, Angelo State University, San Angelo, TX 76909, USA

Krysta D. Demere,
Texas A&M Natural Resources Institute, Texas A&M University, College Station, TX 77843, USA

Jeffrey B. Doty,
Poxvirus and Rabies Branch, Div. of High-Consequence Pathogens and Pathology, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, GA 30333, USA

Yoshinori J. Nakazawa, and
Poxvirus and Rabies Branch, Div. of High-Consequence Pathogens and Pathology, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, GA 30333, USA

Matthew R. Mauldin
Poxvirus and Rabies Branch, Div of High-Consequence Pathogens and Pathology, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, GA 30333, USA

Abstract

Bats are the second most speciose lineage of mammals with more than 1,300 recognized species. Overall, bats are extremely ecologically and morphologically diverse, making them of interest to a wide variety of biologists. Bats are also known reservoirs for an assortment of zoonotic diseases, including rabies, for which they are commonly tested if identified as sick, behaving abnormally, or in instances where there has been a significant human exposure. In these cases, proper identification of bat species is important to public health experts as it will inform future testing procedures and management practices, as well as broaden our understanding of rabies virus bat variant distributions and disease ecology. Despite the multiple disciplines interested in bats, no key has been developed which includes all species found within the United States. For this reason, a dichotomous key and bat identification guide, designed to differentiate bats to species level, has been developed. This document can be used by people with a variety of backgrounds to

morphologically identify bats quickly and accurately using only a scale, a ruler, and attention to detail.

Keywords

bat guide; bat key; bats; Chiroptera; identification key; public health; rabies virus

Introduction

There are 51 species of bats currently documented in the United States (Reid 2006; Baird et al. 2017). Some of these species are widespread in their distribution and are recorded from the east to the west coast, while other species are restricted in their range and are recorded from only one or a handful of states. Four species have been recorded as “accidental” (occurring rarely, with few records, suggesting no permanent or seasonal populations) in the southern Florida Keys. This document contains species descriptions, physical measurements, range maps, and additional information that can be utilized when identifying bats in the United States to species level. Researchers from multiple universities, state agencies and organizations have compiled excellent field guides for specific regions and states, many of which were utilized for the creation of this document (Menzel et al. 2002; Gannon et al. 2005; Reid 2006; Harvey et al. 2011; Ammerman et al. 2012; Schmidly and Bradley 2016). However, an updated, inclusive key to the bats of the entire U. S. has not been created nor made available to the public. The primary objective of this project was to create an easily accessible bat identification key that could serve as a resource for public health laboratories and could also be utilized by wildlife rescuers, bat rehabilitation organizations, biological contractors, and wildlife biologists. Herein, we provide a diagnostic key to the bat species within the U.S. and emphasize the bat species most commonly submitted to health labs for rabies diagnostics (shown in bold within the Bat Identification Guide section). We recommended that the “Key to the Bats of the United States” should be utilized first to identify the species, and then the “Bat Identification Guide” should be used to corroborate the resulting species’ geographic distribution, distinguishing characteristics, and measurements to further validate the identification.

This bat key and guide are intended to be used as a reference to aid accurate and efficient identification of bat species within the U.S., and therefore, does not attempt to provide any additional information regarding species-specific ecological information or natural history. Additional resources should be consulted for more detailed figures, range maps, and both ecological and natural history information that can be valuable when identifying bats (see the additional resources section at the end of the document).

Bats (order Chiroptera) are a very diverse group of mammals both ecologically and morphologically. Although there exists a great deal of morphological variation within this order, the basic anatomy of bats is relatively similar. For this reason, it is important to understand the general anatomy of a bat and the corresponding terms (Fig. 1) before attempting to identify the species to which a specimen could belong. It is worth noting that a single anatomical feature may have multiple corresponding names. For example, the

interfemoral membrane shown in Fig. 1 is also referred to as the tail membrane or the uropatagimn, as it will be referred to herein.

Variations in specific anatomical features, such as the shape of the uropatagimn, full length of tail, or the length of tail that extends past the uropatagium, can be used to distinguish between certain groups of bats. Being able to identify the major differences between families of bats will quickly help to narrow the list of potential species. Another necessary piece of information is the geographic location where the bat was collected. In addition to those provided in this document, distribution maps for many bat species are available through a variety of publications and online resources (see Appendix for additional resources). It is important to note that these distribution maps are not geographically immutable boundaries, but can be very helpful in determining if a species is likely to occur in a given locality. Generally, the more closely related two species of bats are, the more likely they are to be similar in their morphology. In these instances, small details, such as the place where the plagiopatagimn connects to the hind limb, or whether the calcar is keeled or un-keeled, could be the only morphological means of distinguishing between the two species (when using external characteristics). This scenario is common between some species of *Myotis* (Fig. 2).

Measuring a specimen is recommended to support the putative species identification, and occasionally such measurements are the only way to morphologically support a species level identification. Commonly reported measurements include total body length, tail length, ear length, hindfoot length, and forearm length (Fig. 3). These measurements are best taken by using calipers or metric rulers. If using a ruler, measurements should be taken from the “0” mark and not the end of the ruler. This will allow for more accurate measurements. Cutting the tip of the ruler so that the “0” mark is the edge is very helpful, especially when measuring ear length. When measuring mass (weight), attempt to dry the bat off before weighing if the specimen is wet, and be sure to measure mass prior to any sample collection.

Measurements provided herein were compiled from Jacobs (1996), Reid (2006), Ammerman et al. (2012), and Ceballos (2014) for adult specimens. Juveniles of a given species may not be easily identified by measurements alone; however, young of the year are often considered subadults by the time they begin taking flight, and could reach adult size by September or October of the same year. If an ‘X’ is given for a measurement, that measurement was not provided in the reference. If a ‘O’ is given in the place of the tail measurement, the bat has no tail. Measurements from Jacobs (1996), Reid (2006), or Ceballos (2014) are given as ranges and measurements from Ammerman et al. (2012) are provided as averages (≈). Measurements are taken in millimeters (mm) and indicated as follows: HB = head and body length (excluding tail); T = tail length (base to tip of tail); HF = hindfoot length (ankle to tip of claw); E = ear length (intertragic notch to tip of out-stretched ear); M = mass in grams (g); FA = forearm length (from outer edge of elbow to wrist).

Species distribution maps were created from spatial data provided by the International Union for Conservation of Nature (IUCN) Red List (IUCN 2010). The distributions provided are rough estimates, as incidental occurrences of bat species are relatively common in areas outside of their normal range (particularly migratory species). For this reason, as well as the

ability of climate change to modify animal distributions, it is suggested that researchers consult additional resources to determine more precise geographic distributions of species in question, especially if the collection locality is near the edge of a provided distribution.

Key to Bats of the United States

This key includes the bat species that are commonly distributed within the borders of the United States of America including Alaska and Hawaii, but excluding U.S. territories. Geographical information appears in italicized text. For identification help with bats in Puerto Rico, see Gannon et al. (2005). This key does not include non-native bat species or accidental migrants, with the exception of *Diphylla ecuadata* (Hairy-legged Vampire Bat) and *Desmodus rotundus* (Common Vampire Bat), which were included due to their epizootiological importance. Although the accidental species in the Florida Keys were not included in the key, they were included in the guide (next section).

1. Nose leaf (a distinct, upward and freely projecting, triangular-shaped flap of skin) present at end of snout (Fig. 4a); some additional species with this nose leaf (not listed in this key) are known to be accidental species in the Florida Keys; if the bat was collected near this location, see the “Non-native phyllostomids” section in the following bat guide 2

Nose leaf absent (Fig. 4b), snout normal, or with deep groove around nostrils and nose pad (Fig. 4c).....5

2. Tail present (including tail within interfemoral membrane).....3

Tail not evident, only a narrow band of uropatagimn along the hind legs.....4

3. Tail evident: *Macrotus californicus* (California Leaf-nosed Bat). *Occurs only in AZ, southern NV, and southern CA.*

Tail very small, projecting about 10 mm from dorsal side of uropatagimn; distance from eye to nose about twice distance from eye to ear; forearm less than 48 mm: *Choeronycteris mexicana* (Mexican Long-tongued Bat). *Occurs in extreme southern TX and southwestern NM, AZ, and CA along U.S.-Mexico border.*

4. Dorsal fur sooty brown, silver hair tips; eye about midway between nose and ear; forearm more than 56 mm; base of forearms haired; 3rd phalanx of the 3rd digit is greater than 15 mm: *Leptonycteris nivalis* (Mexican Long-nosed Bat). *Occurs only in far western TX and southern NM.*

Reddish dorsal fur with brownish ventral fur, with no silver hair tips; forearm less than 56 mm; base of forearms naked; 3rd phalanx of the 3rd digit is less than 15 mm: *Leptonycteris yerbabuenae* (Lesser Long-nosed Bat). *Occurs only in southern NM and AZ.*

5. Tail absent, narrow U-shaped band of membrane around the legs; thumb length more than 10 mm; presence of deep groove around nostrils and nose pad (Fig. 4c).....6

Tail present; absence of deep groove around nostrils and nose pad.....7

6. One pad under base of thumb; rounded ears; hind-legs well furred: *Diphylla ecaudata* (Hairy-legged Vampire Bat). *Known from one record in southern TX.*

Two pads under base of thumb; triangular ears; hind-legs only slightly haired: *Desmodus rotundus* (Common Vampire Bat). *This species occurs in northern Mexico with a distribution near the U.S.-Mexico border; however it has not yet been recorded in the U.S.*

7. Prominent flaps on chin; tail protruding from dorsal surface of uropatagimn (Fig. 5 a): *Mormoops megalophylla (Ghost-faced Bat).* Occurs in southern TX, NM, and AZ.

No notable flaps on chin; tail extending to or beyond the edge of the uropatagimn.....8

8. Tail extends conspicuously beyond edge of uropatagimn (Fig. 5b).....9

Tail does not extend beyond the edge of the uropatagimn (Fig. 5c).....12

9. Forearm more than 64 mm.....10

Forearm less than 64 mm.....11

10. Ears reach just to the tip of nose when laid forward; thick bristle-like hairs on rump: *Eumops underwoodi* (Underwood's Bonneted Bat). *Occurs in extreme south-central AZ.*

Ears reach beyond the nose when laid forward; no bristle-like hairs on rump: If in Florida, *Eumops floridanus* (Florida Bonneted Bat); if in the southwestern U.S., *Eumops perotis* (Western Bonneted Bat).

11. Ears joined at base (Fig. 6a): If FA is less than 52 mm, *Nyctinomops femorosaccus* (Pocketed Free-tailed Bat); if FA is more than 52 mm, *Nyctinomops macrotis* (Big Free-tailed Bat). *Both species occur in southwestern U.S.*

Ears not united at base (Fig. 6b): *Tadarida brasiliensis* (Brazilian Free-tailed Bat). *Occurs across the southern half of the contiguous U.S.*

12. Ears proportionally large relative to body, more than 25 mm from notch to tip.....13

Ears not proportionally large relative to body, less than 25 mm from notch to tip.....17

13. Color black with three large white spots on back, one just behind each shoulder, the other at the base of the tail (Fig. 7): *Euderma maculatum* (Spotted Bat). *Occurs M'est of the Rockv Mountains and in Big Bend region of TX.*

Color variable, but not black; no white spots on back.....14

14. No distinctive glands (large bumps) evident on each side of the nose; tawny or yellow dorsal color.....15

Glands (large bumps) evident on each side of nose (Fig. 8); dorsal color light brown to gray.....16

15. Flaps (lappets) projecting forward from base of ears (Fig. 9); hairs are yellow-gray at tips and dark brown at base: *Idionycteris phyllotis* (Allen's Big-eared Bat). *Occurs only in NM and AZ.*

No flaps projecting forward from base of ears; dorsal color pale yellow: *Antrozous pallidns* (Pallid Bat). *Occurs across the western half of the contiguous U.S.*

16. Hairs on venter have white tips; strong contrast in color between the basal portions and tips of hairs on both dorsum and venter; presence of long hairs projecting beyond the toes: *Corvnorhinus rafinesquii* (Rafinesque's Big-eared Bat). *Occurs in southeastern U.S.*

Hairs on venter have pinkish buff tips; little contrast in color between basal portions and tips of hairs on both dorsum and venter; absence of long hairs projecting beyond the toes: *Corvnorhinus townsendii* (Townsend's Big-eared Bat). *Typically occurs in western U.S. but some populations exist in the Appalachian (C. t. virginianus) and Ozark Mountains (C. t. ingens)* and are recognized as distinct subspecies.

17. At least the anterior half of the dorsal uropatagium well furred (Fig. 10).....18

Dorsal surface of uropatagium naked, scantily haired, or at most lightly furred on the anterior third.....24

18. Color of hair black, with many of the hairs distinctly silver-tipped: *Lasionycieris noctivagans* (Silver-haired Bat). *Occurs across the contiguous U.S. and southeastern AK.*

Color various, but never uniformly black.....19

19. Color yellow or yellow-gray.....20

Color red, brown, or grayish (not yellow).....21

20. Total length more than 120 mm: *Dasypterus intermedius* (Northern Yellow Bat). *Occurs across the south-eastern U.S., however some populations exist along the coast of NC, VA, and NJ.*

Total length less than 120 mm: *Dasypterus xanthinus* (Western Yellow Bat). *Occurs in the extreme south-western U.S. from CA to far western TX.* Most likely the cryptic species *Dasypterus ega* (Southern Yellow bat) *if found in the southern tip of Texas.*

21. Forearm more than 45 mm; ear rimmed with dark brown or black, color is a mixed brown-gray, heavily frosted with white. If collected in the contiguous U.S. or collected in HI with mass greater than 21g: *Aeorestes cinereus* (Hoary Bat), *occurs across the contiguous U.S. and in HI.* If collected in HI with mass less than 21g: *Aeorestes semotus* (Hawaiian Hoary Bat), *occurs only in HI.*

Forearm less than 45 mm; ear color buff or brown; upper dorsal fur reddish or reddish-brown.....22

22. Dorsal fur brown or mahogany, and frosted with white: *Lasiurus seminolus* (Seminole Bat). *Occurs in the southeastern U.S. and east-central TX.*

Dorsal fur brick red to rusty red, frequently washed with white.....23

23. Color reddish with frosted appearance resulting from white-tipped hairs; uropatagium fully furred: *Lasiurus borealis* (Eastern Red Bat). *Occurs east of the Rocky Mountains across the eastern U.S.*

Color rusty-red to brownish without frosted appearance; posterior one-third of uropatagium bare or only scantily furred: *Lasiurus blossevillii* (Western Red Bat). *Occurs across the western U.S.*

24. Tragus (projection within ear) short, blunt/rounded, and curved (Fig. 11a)..... 25

Tragus long, pointed, and straight (Fig. 11b).....29

25. Forearm at least 42 mm, calcar with keel (Fig. 12a): *Eptesicus fuscus* (Big Brown Bat). *Occurs across the contiguous U.S.*

Forearm less than 42 mm, calcar without keel (Fig. 12b).....26

26. Dorsal fur tricolored when parted (black at base, yellow/brown at middle, darker color at tip) (Fig. 13); brownish ears: *Perimyotis subflavus* (Tricolored Bat). *Occurs from the Great Plains across the eastern U.S., excluding the lower peninsula of MI.*

Dorsal fur unicolored or bicolored; black or very dark brown ears and facemask.....27

27. Forearm less than 33 mm; color golden brown to smoke gray: *Parastrellus hesperus* (Canyon Bat). *Occurs from across the southwestern U.S. to northern OR.*

Forearm more than 33 mm; color brown.....28

28. Hair on hind foot extends beyond tips of claws; tragus long and blunt; underwing lightly furred to elbow: *Myotis lucifugus* (Little Brown Bat). *Occurs across most of the contiguous U.S. and AK.*

No long hair on foot; tragus is short, blunt and curved; underwing, muzzle, and uropatagium are hairless: Nycticeius humeralis *(Evening Bat).* Occurs east of the Rocky Mountains across the eastern U.S., excluding the northeastern and northern border-states.

29. Calcar with well-marked keel (Fig. 12a).....30

Calcar without well-marked keel (Fig. 12b).....34

30. Forearm at least 35 mm.....31

Forearm less than 35 mm.....32

31. Collected east of the 98th Meridian (Fig. 14); no fur on ventral side of wing: *Myotis sodalis* (Indiana Bat). *Occurs in the eastern U.S.*

Collected west of the 98th Meridian; lightly furred ventral side of wing from the body to a line connecting the elbow and the knee: *Myotis volans* (Long-legged Myotis). *Occurs across the western U.S., and southeastern AK.*

32. Collected east of the 98th Meridian: *Myotis leibii* (Eastern Small-footed Bat). *Occurs in the eastern U.S.*

Collected west of the 98th Meridian.....33

33. Hairs on back have dull reddish-brown tips; black facemask not noticeable; thumb less than 4 mm long; naked part of snout about as long as the width of the nostrils when viewed from above: *Myotis californicus* (California Myotis). *Occurs in the western U.S., and southeastern AK.*

Fur on back long and glossy with brownish tips; black facemask usually noticeable; thumb more than 4 mm in length; naked part of snout approximately 1.5 times the width of the nostrils: *Myotis ciliolabrum* (Western Small-footed Myotis). *May include *Myotis melanorhinus* (Dark-nosed Small-footed Myotis), as not all authorities recognize *M. melanorhinus* as a distinct species (Ammerman et al. 2016). *Occurs across the western U.S.*

34. Conspicuous bare patch on back between the scapulae; FA=37–47; dorsal fur same color from base to tip: *Myotis velifer* (Cave Myotis). *Occurs in TX, NM, AZ, and central OK and KS.*

No bare patch on back between scapulae.....35

35. Conspicuous thick fringe of stiff hairs on free edge of uropatagimn; base of dorsal hair is black and tips are shiny: *Myotis thysanodes* (Fringed Myotis). *Occurs across the western U.S.*

No conspicuous thick fringe on edge of uropatagimn.....36

36. When laid forward ears extend at least 3 mm beyond tip of nose.....37

When laid forward ears extend less than 3 mm or not at all.....40

37. Black or blackish facemask, ears, and membranes.....38

Brown or brownish facemask, ears, and membranes.....39

38. Ears very long and extend 5 mm or more past muzzle; fur on mid-back is 9–11 mm long: *Myotis evotis* (Long-eared Myotis). *Occurs west of the 98th Meridian.*

Ears long and extend less than 5 mm past muzzle; fur on mid-back is 6–9 mm long: *Myotis keenii* (Keen's Myotis). *Occurs in northwestern WA and southeastern AK.*

39. Dorsal fur dark brown or yellow-brown; collected east of the 98th Meridian: *Myotis septentrionalis* (Northern Long-eared Myotis). *Occurs primarily east of the 98th Meridian, as well as parts of ND, and eastern SD.*

Dorsal fur buff to orange-brown; collected west of the 98th Meridian; *Myotis auriculus* (Southwestern Myotis). *Occurs only in AZ and NM.*

40. Collected east of the 98th Meridian (Fig. 14).....41

Collected west of the 98th Meridian (Fig. 14).....42

41. Dark gray fur; plagiopatagium attaches to foot at ankle (Fig. 15a); FA = 40–46 mm; toe hairs do not extend beyond tip of claws: *Myotis grisescens* (Gray Myotis). *Occurs in the east-central U.S.*

Brownish-gray fur on dorsal side, tan-whitish on ventral side; plagiopatagium attaches to foot at base of toes (Fig. 15b); FA = 33–41 mm; toe hairs extend beyond tip of claws: *Myotis austroriparius* (Southeastern Myotis). *Occurs in the southeastern U.S.*

42. FA typically more than 36 mm; mass is typically more than 7 grams: *Myotis occultus* (Arizona Myotis). *Occurs in the southwestern U.S., in and around AZ and NM.*

FA typically less than 36 mm; mass is typically less than 7 grams: *Myotis yumanensis* (Yuma Myotis). *Occurs across the western U.S., east to the Rocky Mountains and western TX.*

Bat Identification Guide

These brief species descriptions are best used to support the identification received from use of the dichotomous key. Entries are arranged in alphabetical order by family, and species are alphabetized within each family. In some instances, families are broken up into smaller categories (native vs. non-native phyllostomids, and tribes within Vespertilionidae). Species names in bold are among the most commonly submitted bat species to public health labs. All measurements are given in millimeters (mm) and mass is given in grams (g).

MOLOSSIDAE—Free-tailed Bats

Eumops floridanus (Florida Bonneted Bat)

- Only a few populations in south FL; large bat (larger than *T. brasiliensis)*
- Fur white at roots and gray-brown at tips; lips not wrinkled
- Broad ears that extend just to tip of nose when laid forward
- HB = 80–108; T = 46–57; HF = 12–15; E = 22–30; M = 34–47g; FA = 61–66

Eumops perotis (Western Mastiff Bat)

- Largest bat in United States
- Fur typically dark brown with hairs white at roots
- Ears meet, but do not join at base above forehead; ears extend beyond muzzle when laid down; upper lip not wrinkled
- HB = 105–125; T = 55–72; HF = 15–17; E = 36–47; M = 50–73g; FA = 73–83

Eumops underwoodi (Underwood's Bonneted Bat)

- Large bat with fur white at roots, tips gray-brown; face is pinkish
- Broad, short ears that do not reach tip of nose when laid forward

- Lips not wrinkled; some long fine hairs on rump extend beyond the length of fur
- HB = 95–112; T = 48–66; HF = 15–19; E = 26–33; M = 40–60g; FA = 66–74

Molossus molossus (Little Mastiff Bat)—non-native species, found only in the Florida Keys

- Medium sized bat with grayish-brown to dark brown fur, venter is pale brown
- Ears separate at base; lips not wrinkled
- HB = 99–101; T = 34–36; HF = 9–10; E = 12–13; M= 13–15g; FA = 38–39

Nyctinomops femorosaccus (Pocketed Free-tailed Bat)

- Medium sized bat with gray or dull brown fur, which is whitish at the roots; ears joined at base above forehead (Fig. 6a); when laid forward the ears extend to the muzzle or just beyond; wrinkled upper lip (Fig. 4b); some long hairs on rump extend beyond the length of fur
- Has a fold of skin stretching from the femur to the tibia that creates a shallow pocket on the ventral side of the wing surface
- HB = 58–74; T = 38–45; HF = 9–13; E = 18–23; M = 13–17g; FA = 44–50

Nyctinomops macrotis (Big Free-tailed Bat)

- Large bat; fur typically dark brown with hairs white at roots
- Ears extend beyond muzzle when laid down, and are joined at base above forehead (Fig. 6a); wrinkled upper lip (Fig. 4b); no long rump hairs extending past fur length
- HB = 75–84; T = 40–57; HF = 9–11; E = 25–32; M = 22–30g; FA = 58–63

Tadarida brasiliensis (Brazilian Free-tailed Bat)

- Medium sized bat with gray-brown hair, the same color root to tip

- Ears are broad and meet across the forehead, but do not join (Fig. 6b); when laid forward, ears extend to tip of nose
- Wrinkled/creased upper lip (Fig. 4b)
- HB = 55–65; T = 29–44; HF = 8–11; E = 14–19; M = 10–14g; FA = 41–45

MORMOOPIDAE—Ghost-faced or Leaf-chinned Bats

Mormoops megalophylla (Ghost-faced Bat)

- Medium sized, reddish or dark brown bat; has a distinguishing flap of skin along the chin; ears are short and rounded; eyes appear to be set inside of the ears
- Tail projects out of the dorsal side (not the distal edge) of the uropatagium (see Fig. 5a)
- HB = 57–70; T = 20–29; HF = 7–17; E = 10–18; M = 12–19g; FA = 51–58

PHYLLOSTOMIDAE—Leaf-nosed Bats

Native phyllostomids (includes vampire bats)

Choeronycteris mexicana (Mexican Long-tongued Bat)

- Medium to large bat, with grayish or gray/brown hair paler at roots
- Long snout, with small nose leaf; small round ears; visible short tail; U-shaped uropatagium
- HB = 65–80; T = 8–12; HF = 10–13; E = 3–7; M = 10–25g; FA = 43–48

Leptonycteris nivalis (Mexican Long-nosed Bat)

- Medium to large bat with gray brown to dull brown fur

- Long narrow snout with small nose leaf (Fig. 4a); short ears; very reduced V-shaped uropatagimn fringed with 2–3 mm hairs; no tail
- HB = 78–88; T = 0; HF ≈ 17; E ≈ 15; M = 18–30g; FA = 55–60

Leptonycteris yerbabuenae (Lesser Long-nosed Bat)

- Medium to large bat with orange-brown to grayish dorsum
- Long narrow snout with small nose leaf; short ears; short tail difficult to see (easier to feel it)
- V-shaped uropatagimn indistinctly fringed with 1 mm hairs
- HB = 70–82; T = 3; HF = 12–15; E = 14–17; M = 15–25g; FA = 51–56

Macrotus californicus (California Leaf-nosed Bat)

- Medium sized bat with gray to grayish-white dorsum, lighter venter
- Small nose leaf; large round ears; long tail (protrudes slightly from back edge of uropatagimn)
- HB = 55–65; T = 30–40; HF= 11–18; E = 30–35; M = 12–20g; FA = 47–55

Desmodas rotundas (Common Vampire Bat)—distribution includes portions of northern Mexico, but currently does not reach the southern border of TX

- Large bat with sturdy legs, and thick, short hair ranging from reddish to golden, with the venter lighter and tipped whitish
- No tail; sparsely haired uropatagimn, forearms, and legs; quadrupedal movement
- No distinct nose leaf, but has an ‘M’-shapcd pad with a fold of skin around tip of nose
- Very sharp upper incisors
- HB = 69–90; T = 0; HF = 13–20; E = 15–20; M = 25–40g; FA = 52–63

Diphylla ecaudata (Hairy-legged Vampire Bat)—TX only (known from a single record: Val Verde Co.)

- Medium to large bat with no tail and sturdy legs: uropatagimn is reduced
- Doesn’t have a true nose leaf, but has a thick square-shaped nose pad; long thumbs (Fig. 4c)
- HB = 70–82; T = 0; HF = 11–16; E = 12–21; M = 18–33g; FA = 49–56

Non-native phyllostomids (Accidental species in the Florida Keys)

Artibeus jamaicensis (Jamaican Fruit-eating Bat)

- Large bat with gray or gray/brown dorsum, paler venter
- Pale stripes on face above and below eyes; large triangular nose leaf
- No tail; large teeth and jaws
- HB = 70–85; T = 0; HF = 10–18; E = 20–24; M = 29–51g; FA = 55–67

Erophylla sezekorni (Buffy Flower Bat)

- Medium sized bat with dorsum pale yellow/brown; fur long and fluffy; long tapered rostrum
- Small well-developed nose leaf with fold of skin around tip of nose; small but distinct calcar which distinguishes them from similar species
- Short tail extends beyond uropatagium
- HB = 56–68; T = 7–14; HF = X; E = X; M = 10–19g; FA = 44–50

Phyllonycteris poeyi (Cuban Flower Bat)

- Medium sized bat; fur very short and pale gray to gray/brown on dorsum, venter white
- Short tail extends beyond uropatagium; no calcar
- Long tapered rostrum with a rudimentary nose leaf and a fold of skin around tip of nose
- HB = 66–73; T = 7–13; HF = X; E = X; M = 10–19g; FA = 44–50

Phyllops falcatus (Cuban Fig-eating Bat)

- Medium sized bat with gray-brown fur, including white patches of hair on shoulders
- No tail; short muzzle with well-developed nose leaf; no stripes on face, smaller than *A. jamaicensis*
- HB = 58–59; T = 0; HF = X; E = X; M = 14–16g; FA = 41–45

VESPERTILIONIDAE—Vesper / Evening Bats

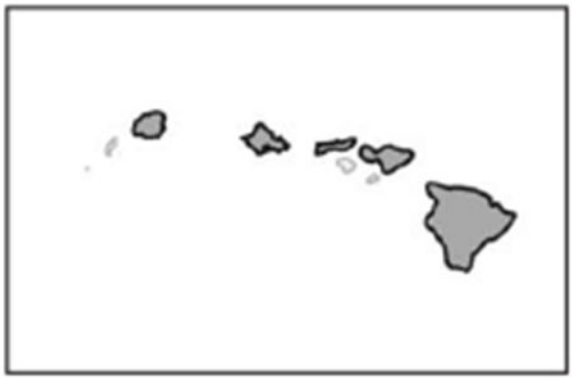
Tribe Lasiurini—At least a portion of the dorsal uropatagium has dense fur

Aeorestes cinereus (Hoary Bat; formerly *Lasiurus cinereus*)

- Large bat; densely furred uropatagium; ear rimmed with black or dark brown
- Base of hairs light brown, tips heavily frosted with gray, then white; membranes dark brown (except along forearms and digits where they’re more yellowish or light brown)
- HB = 72–84; T = 51–60; HF ≈ 8; E ≈ 13; M = 20–35g; FA = 45–57

Aeorestes semotus (Hawaiian Hoary Bat)—only in HI

- Medium sized bat; smaller than *A. cinereus*, but very similar in all other regards
- HB = 72–84; T = 51–60; HF ≈ 8; E ≈ 13; M = 13–20g; FA = 47–52



Dasypterus ega (Southern Yellow Bat; formerly *Lasiurus ega)*

- Medium sized yellow bat; ears are pinkish-brown; dark wing membranes
- The anterior half of the uropatagium is furred
- Nearly identical to *D. xanthinus,* range does not overlap
- HB = 62–75; T = 40–53; HF ≈ 9; E ≈ 13; M= 10–15g; FA = 42–48

Dasypterus intermedius (Northern Yellow Bat; formerly *Lasiurus intermedius*)

- Large bat (TL >120 mm); fur is dull yellow to yellow-brown; ears pinkish and pointed rather than rounded as in other *Dasypterus* species
- Anterior half of uropatagium furred
- HB = 60–89; T = 47–64; HF = 8–13; E = 15–19; M = 17–28g; FA = 45–63

Dasypterus xanthinus (Western Yellow Bat; formerly *Lasiurus xanthimis*)

- Medium sized (TL <120 mm) yellow bat, very similar to *D. ega*
- Species distribution does not overlap with that of *D. ega*
- Face not as black as *D. ega*

- HB = 61–76; T = 44–58; HF = 8–10; E = 15–19; M = 10–15g; FA = 45–48

Lasiurus blossevillii (Western Red Bat)

- Medium sized red bat; densely furred uropatagium
- Similar to *L. borealis*, but hairs are not white-tipped, and *L. blossevillii* is slightly smaller than *L. borealis*; distinct geographic ranges
- The distal ¹⁄₄ of the uropatagium is bare or sparsely furred
- HB = 51–62; T = 45–54; HF ≈ 10; E ≈ 13; M = 8–19g; FA = 38–42

Lasiurus borealis (Eastern Red Bat)

- Medium sized, distinctly reddish bat with short buff colored ears

- Densely furred uropatagium
- Membranes are dark brown with fur surrounding forearms on ventral side
- Tips of hairs white creating lightly frosted appearance
- HB = 50–60; T = 45–62; HF = 6–11; E = 8–13; M = 9–16g; FA = 36–43

Lasiurus seminolus (Seminole Bat)

- Medium sized bat, similar to *L. cinereus,* but more deep mahogany brown and slightly smaller on average; ears typically dark brown
- Densely furred uropatagium; tips of hairs may or may not be whitish/gray, resulting in little to no frosted appearance
- HB = 60–65; T = 43–52; HF ≈ 8; E ≈ 12; M = 9–15g; FA = 35–45

Tribe Eptesicini

Eptesicus fuscus (Big Brown Bat)

- Medium sized brown bat; ears relatively small, thick and leathery; membranes are blackish and lack hair
- Tragus blunt and slightly curved; keeled calcar
- A single upper incisor on each side
- HB = 64–75; T = 42–52; HF ≈ 11; E ≈ 17; M = 13–20g; FA = 42–52

Tribe Myotini—Mouse-eared bats. Many are very similar with only very subtle differences.

Myotis austroriparius (Southeastern Myotis)

- Small bat; dorsum yellow-gray to gray-brown with whitish belly; fur slightly wooly; hairs on toe extend beyond claws
- Calcar not keeled
- HB = 45–55; T = 33–44; HF = 10–12; E = 14–16; M = 6–12g; FA = 35–41

Myotis auricuius (Southwestern Myotis)

- Small bat with dull buff, gray or orange-brown fur; hairs on toes extend beyond tips of claws
- Calcar not keeled
- HB = 46–55; T = 40–49; HF = 9–11; E = 10–21; M = 6–8g; FA = 37–40

Myotis californicus (California Myotis)

- Very small bat with light brown to reddish-brown or dull buff fur
- Keel on calcar; narrow, pointed tragus; black facemask and ears
- Naked part of snout narrow and similar to nostril width
- HB = 38–48; T = 32–45; HF = 5–7; E = 12–15; M = 3–5g; FA = 31–35

Myotis ciliolabrum (Western Small-footed Myotis)

- Very small bat with buff brown fur
- Keel on calcar; narrow/pointed tragus; black facemask and ears
- Naked part of snout larger and 1.5× as wide as the nostril width

- HB = 40–50; T = 35–45; HF = 6–8; E = 13–16; M = 3–6g; FA = 31–36

Myotis evotis (Long-eared Myotis)

- Small bat with dark brown/yellowish fur; fur on mid-back 9–11 mm with pale tips of 4–5 mm
- Ears very long and extend 5 mm or more past nose when laid forward
- Calcar not keeled; black facemask and ears
- HB = 43–52; T = 36–45; HF = 8–10; E = 18–24; M = 4–9g; FA = 37–40

Myotis grisescens (Gray Myotis)

- Small, grayish bat, same color from root of hair to tip; fur short; orange spot of fur under chin/ears
- Calcar not keeled; tragus long and pointed; wing attaches to ankle
- HB = 47–52; T = 33–44; HF = 9–11; E = 13–16; M = 5–14g; FA = 40—46

Myotis keenii (Keen's Myotis; potential conspecific of *Myotis evotis*)

- Very small bat with dark brown to yellow-brown fur; fur on mid-back 6–9 mm with pale tips of 2–3 mm
- Ears are long and extend beyond nose when laid forward
- Indistinct keel on calcar; tragus is long, pointed and narrow
- HB = 40–50; T = 34–44; HF = 8–10; E = 16–20; M = 4–6g; FA = 34–38

Myotis leibii (Eastern Small-footed Bat)

- Very small bat with golden-brown and glossy fur
- Keel on calcar; narrow/pointed tragus
- HB = 40–50; T = 33–40; HF = 6–8; E = 12–15; M = 3–6g; FA = 30–34

Myotis lucifugus (Little Brown Bat)

- Small, yellow-brown bat; fur on back is glossy
- Tragus slightly curved and rounded/not sharply pointed
- Calcar not keeled; snout and ears dark brown to blackish
- Long hairs on toes that extend past the tip of claw

- HB = 46–58; T = 30–40; HF = 8–10; E = 14–16; M = 4–9g; FA = 34–41

Myotis occultus (Arizona Myotis)

- Small bat, which can have tawny, light brown, dark brown or golden-brown fur; similar in appearance to *M. lucifugus*
- Calcar not keeled
- HB ≈ 50, T ≈ 34, HF = 8–10; E = 11–15; M = 7–9g; FA = 34–41

Myotis septentrionalis (Northern Long-eared Myotis)

- Small bat with dark gray-brown or buff-brown fur, sometimes blonde
- Ears long and extend beyond nose when laid forward

- Indistinct keel on calcar; tragus is long, pointed and narrow
- HB = 40–46; T = 36–43; HF = 7–10; E = 16–19; M = 5–10g; FA = 35–39

Myotis sodalis (Indiana Bat)

- Small bat; fur on back dull, brown or gray-brown; belly buff colored
- Tragus narrow, not sharply pointed; calcar has slight keel
- HB = 42–48; T = 28–45; HF = 7–9; E = 10–15; M = 5–10g; FA = 35–40

Myotis thysanodes (Fringed Myotis)

- Small bat with buff brown/yellowish fur; fringe of short hairs along edge of uropatagimn distinguishes *M. thysanodes* from other *Myotis*

- Ears are long and extend beyond nose when laid forward
- Calcar not keeled
- HB = 45–57; T = 35–45; HF = 9–12; E = 16–20; M = 6–12g; FA = 40–45

Myotis velifer (Cave Myotis)

- Medium sized bat; grayish or gray-brown, dull fur; small, bare patch of skin on back between scapulae
- Calcar not keeled; slim/straight tragus
- HB = 46–59; T = 37–47; HF = 9–12; E = 14–17; M = 9–15g; FA = 40–47

Myotis volans (Long-legged Myotis)

- Small bat; fur on back usually dark brown or reddish brown; brown ears and snout
- Ears with rounded tips; calcar keeled; underside of wing lightly furred near body to a line from knee to elbow
- HB = 45–63; T = 40–50; HF = 8–11; E = 12–15; M = 5–10g; FA = 38–42

Myotis ynmanensis (Yuma Myotis)

- Small bat with dull light buff-brown or yellowish fur; hair on toes
- Calcar not keeled; can be difficult to distinguish from *M lucifugus* due to geographic variation across its range
- HB = 38–50; T = 30–40; HF = 8–10; E = 12–15; M = 5–7g; FA = 32–37

Tribe Nycticeiini

Lasionycteris noctivagans (Silver-haired Bat)

- Small bat, with sooty brown or black fur; tips of hairs are white that cause it to appear silver or frosted
- Proximal half (near rump) of uropatagimn is often (but not always) densely furred
- Wing membranes and ears also sooty brown to black
- HB = 53–63; T = 39–45; HF ≈ 9; E ≈ 14; M = 8–12g; FA = 38–45

Nycticeius humeralis (Evening Bat)

- Small bat; fur yellow-brown to dark brown and glossy on top
- Medium sized ears; tragus blunt, short and curved
- Calcar not keeled
- Only a single upper incisor on each side with a single large tooth behind canine
- HB = 54–58; T = 34–41; HF ≈ 8; E ≈ 12; M = 5–10g; FA = 34–37

Tribe Pipistrellini

Parastrellus hesperus (Canyon Bat; formerly *Pipistrellus hesperus*)

- Very small drab or smoke-gray bat
- Black leathery face, ears, and wing membranes
- Tragus is short, blunt, and slightly curved down
- Calcar not keeled
- HB = 37–47; T = 26–35; HF = 5–7; E = 10–14; M = 3–6g; FA = 26–32

Perimyotis subflavus (Tricolored Bat; formerly *Pipistrellus subflavus*)

- Very small bat with pale yellowish-brown pelage; membranes paler along leading edge of wings and edges of uropatagium
- Tragus long and slender; calcar not keeled
- Hairs are tricolored: dark root, grayish-yellow medially (majority of hair length), tip dusky brown (Fig. 13)
- HB = 40–48; T = 36–45; HF = 7–10; E = 13–15; M = 3–6g; FA = 31–35

Big Eared Bats (Tribes Antrozoini [*A. pallidus*] and Pecotini [all others])

Antrozous pallidus (Pallid Bat)

- Large, pale, yellowish-brown bat; pelage lighter on venter than dorsum
- Very large forward-pointing ears
- Snout is bare with a horseshoe shaped ridge over a blunted, pig-like nose
- HB = 62–79; T = 39–49; HF ≈ 11; E ≈ 28; M = 14–25g; FA = 50–57

Corynorhinus rafinesquii (Rafinesque's Big-eared Bat)

- Small bat; back is brown, belly whitish (fur dark at roots); long hairs on hind toes
- Very large ears
- Bumps (nose glands) on either side of muzzle (Fig. 8)
- HB = 42–56; T = 42–54; HF ≈ 11; E ≈ 32; M = 8–12g; FA = 39–44

Corynorhinus townsendii (Townsend's Big-eared Bat)

- Small bat; similar to *C. rafinesquii,* but belly is buffy brown
- Very large ears; no long hairs on hind toes
- Bumps (nose glands) on either side of muzzle (Fig. 8)
- HB = 47–59; T = 45–55; HF ≈ 11; E ≈ 34; M = 9–12g; FA = 40–47

Euderma maculatum (Spotted Bat)

- Medium sized bat with very large pink ears (42 mm); broad wings
- Black fur with three white spots - not easily confused with others (Fig. 7)
- HB = 60–75; T = 47–52; HF ≈ 11; E = 43; M = 16–20g; FA = 48–54

Idionycteris phyllotis (Allen's Big-eared Bat)

- Medium sized bat; very large ears, lobe of skin projects forward from base of ears (lappets) (Fig. 9); no bumps on side of muzzle
- Similar to both *C. rafinesquii* and *C. townsendii*
- HB = 103–118; T = 46–55; HF = 9–12; E = 34–43; M = 8–16g; FA = 45

Acknowledgments

We would like to thank Ginny L. Emerson, Robert D. Bradley, Audrey Matheny, Emily G. Pieracci, Andres Velasco-Villa, and Ryan M. Wallace for reviewing previous versions of this document. Illustrations of bats and their diagnostic physical characteristics were produced and provided by K. Demere.

Appendix

Online resources available to assist with bat species identification.

Bat Conservation International's bat species profile page: http://www.batcon.org/resources/media-education/species-profiles

Bats of Oklahoma Field Guide - Oklahoma Department of Wildlife Conservation: https://www.wildlifedepartment.com/Batfieldguide.pdf

Eastern Bat ID Tables available from Tim Carter Field Research Page: https://tccarterlab.wordpress.com/equipment-how-to-documents/

Key to the bats of Colorado – The Colorado bat matrix: www.cnhp.colostate.edu/batmatrix/speciesList.aspx

Maryland bat dichotomous key: http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/bats/bat_key.aspx

Montana online field guide (bats): http://fieldguide.mt.gov/displaySpecies.aspx?family=Vespertilionidae

Myotis from western Mexico, Knox Jones et al. 1970: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1063&context=museummammalogy

Wisconsin Bat Program page: http://wiatri.net/Inventory/Bats/AboutBats/WIBats.cfm

Literature Cited

Ammerman LK, Hice CL, and Schmidly DJ. 2012 Bats of Texas. Texas A&M University Press, College Station.

Ammerman LK, Lee DN, and Pfau RS. 2016 Patterns of genetic divergence among *Myotis californicus*, *M. ciliolabrum*, and *M. leibii* based on amplified fragment length polymorphism. Acta Chiropterologica 18:337–347.

Baird AB, Braun JK, Engstrom MD, Holbert AC, Huerta MG, Lim BK, Mares MA, Patton JC, and Bickham JW. 2017 Nuclear and mtDNA phylogenetic analyses clarify the evolutionary history of two species of native Hawaiian bats and the taxonomy of Lasiurini (Mammalia: Chiroptera). PloS one 12(10):e0186085 10.1371/journal.pone.0186085 [PubMed: 29020097]

Ceballos G, ed. 2014 Mammals of Mexico. Johns Hopkins University Press, Baltimore, Maryland.

Gannon MR, Kurta A, Rodriguez-Duran A, and Willig MR. 2005 Bats of Puerto Rico An island focus and a Caribbean perspective. Texas Tech University Press, Lubbock, Texas.

Harvey MJ, Altenbach JS, and Best TL. 2011 Bats of the US and Canada. Johns Hopkins University Press, Baltimore, Maryland.

IUCN 2010 IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>. Downloaded on 21 September 2010.

Jacobs DS, 1996 Morphological divergence in an insular bat, *Lasiiirus cinereus semotus.* Functional Ecology 10:622–630.

Menzel MA, Menzel JM, Castlebery SB, Ozier J, Ford WM, and Edwards JW. 2002 Illustrated key to skins and skulls of bats in the southeastern and mid-Atlantic states Research Note NE-376, US Department of Agriculture Forest Service, Newtown Square, Pennsylvania.

Reid FA 2006 A field guide to mammals of North America, north of Mexico, 4th ed. Peterson Field Guide Series, Houghton Mifflin Company, Boston, Massachusetts.

Schmidly DJ and Bradley RD. 2016 The Mammals of Texas. University of Texas Press, Austin, Texas.

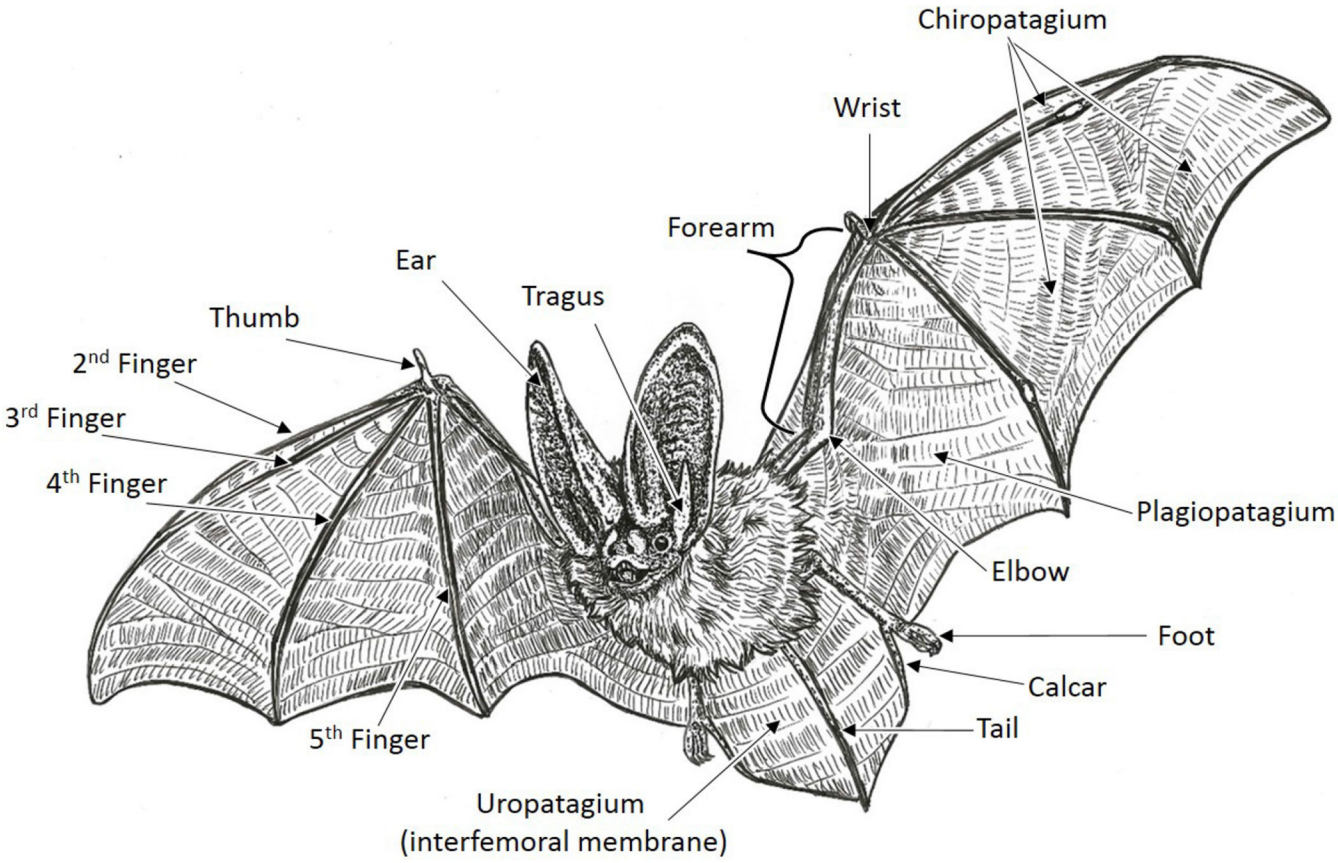


Figure 1.
The general anatomy of a bat.

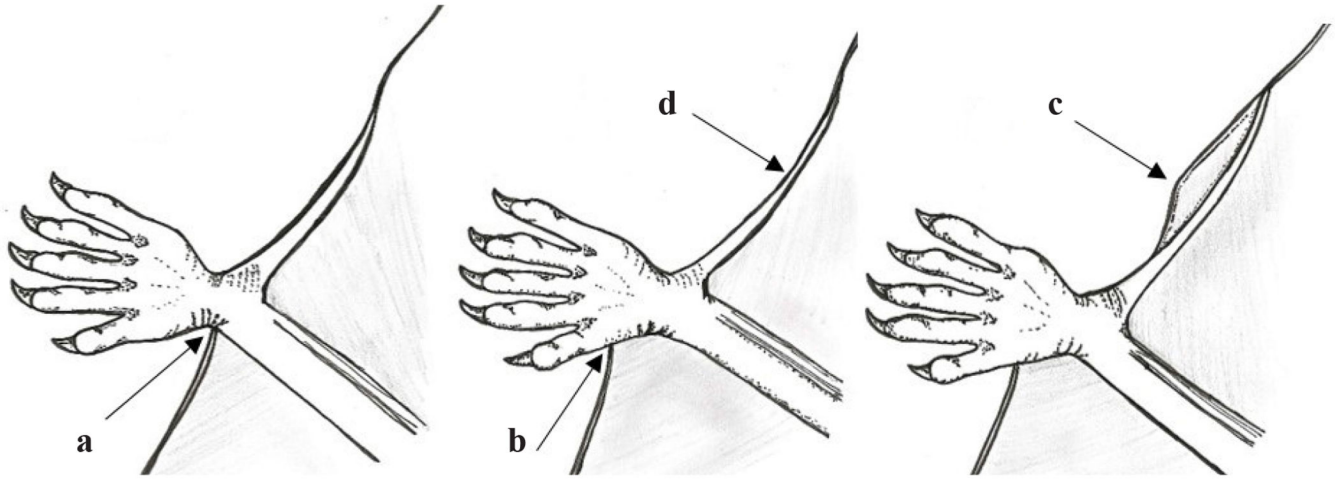


Figure 2.

Illustration of anatomical traits associated with the hind limb in various species of *Myotis*. The plagiopatagimn of *M. grisescens* attaches to the tarsus (a), whereas that of *M. lucifugus* (and others) attaches to the foot at the base of the toes (b). A keeled calcar (c) is present in both *M. sodalis* and *M. leibii.* whereas the calcar of *M. lucifugus* and *M. austroriparius* is unkeeled (d).

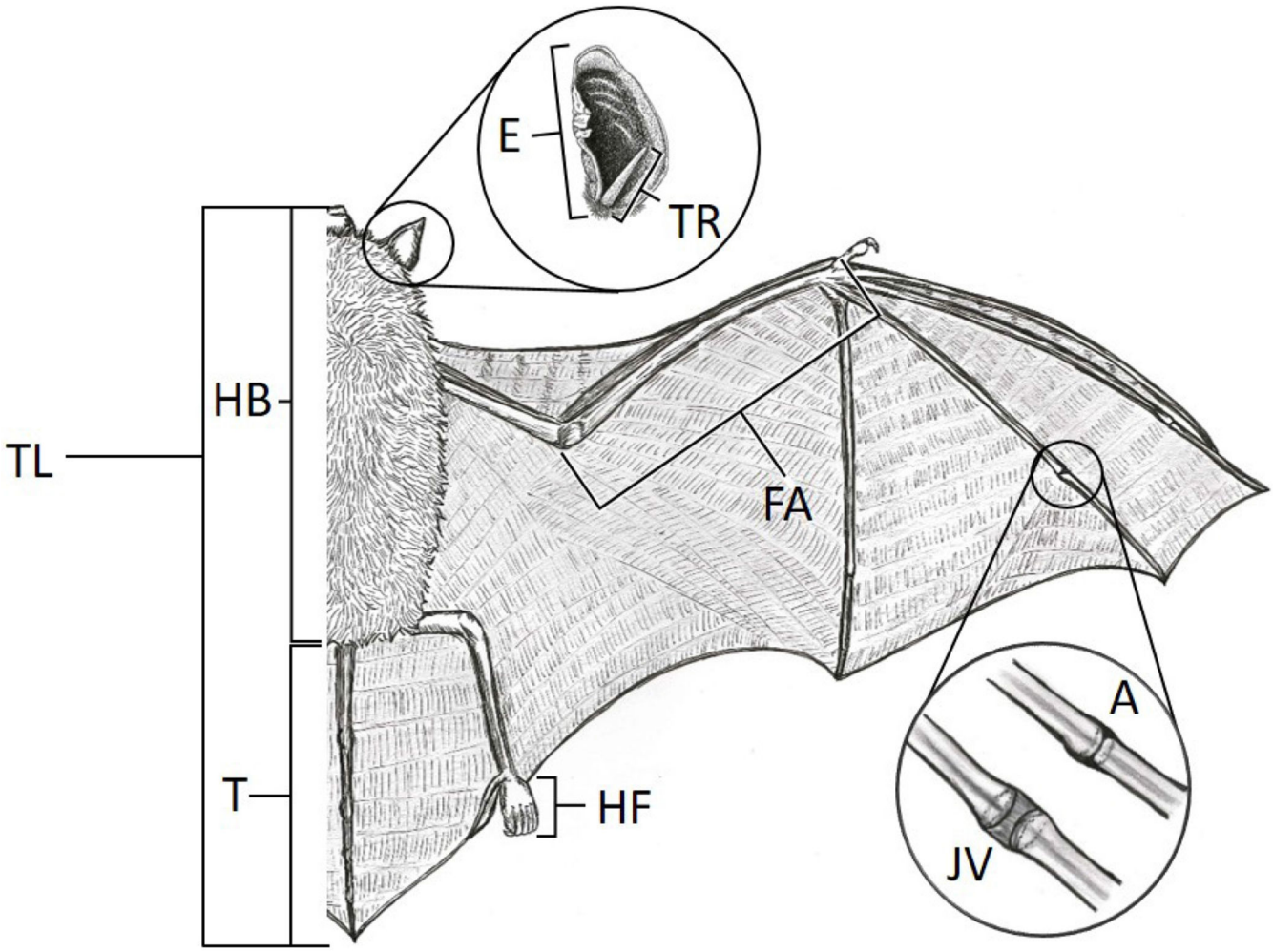


Figure 3.

Typical measurements taken in millimeters. TL = total length. HB = head and body length, T = tail length, TR = tragus, E = ear, HF = hind foot, and FA = foreann. Juveniles (JV) and adults (A) can be distinguished based on amount of epiphyseal-diaphyseal fusion (inset figure).

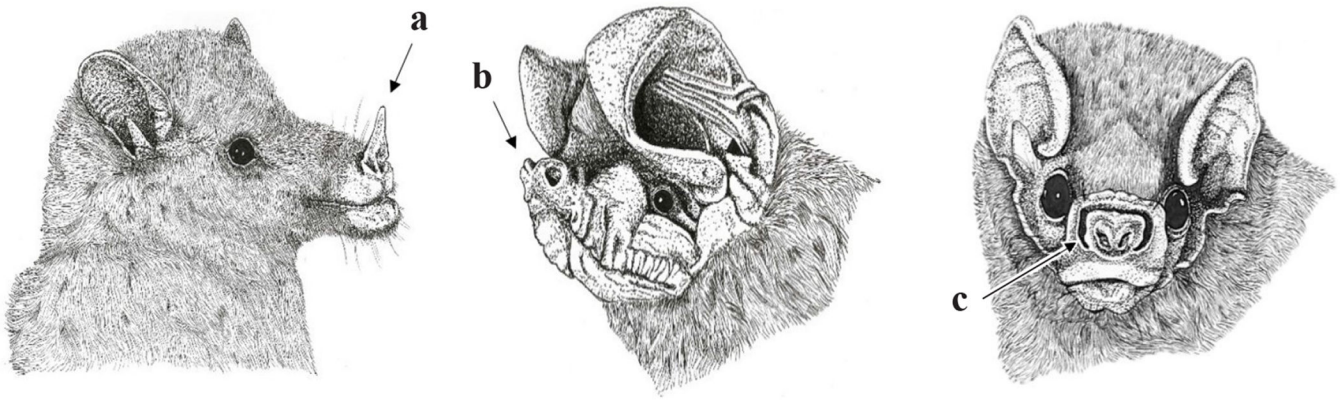


Figure 4.

Distinct nasal types of different bat taxa: a) nose leaf characteristic of nearly all phyllostomids, depicted here with the Mexican Long-nosed Bat (*Leptortvcteris nivalis*): b) lack of nose leaf characteristic of all other families of bats in the U. S., depicted here with the Big Free-tailed Bat (*Nyctinomops macrotis*): and c) square nose pad as found in the Hairy-legged Vampire Bat (*Diphylla ecaudata*).

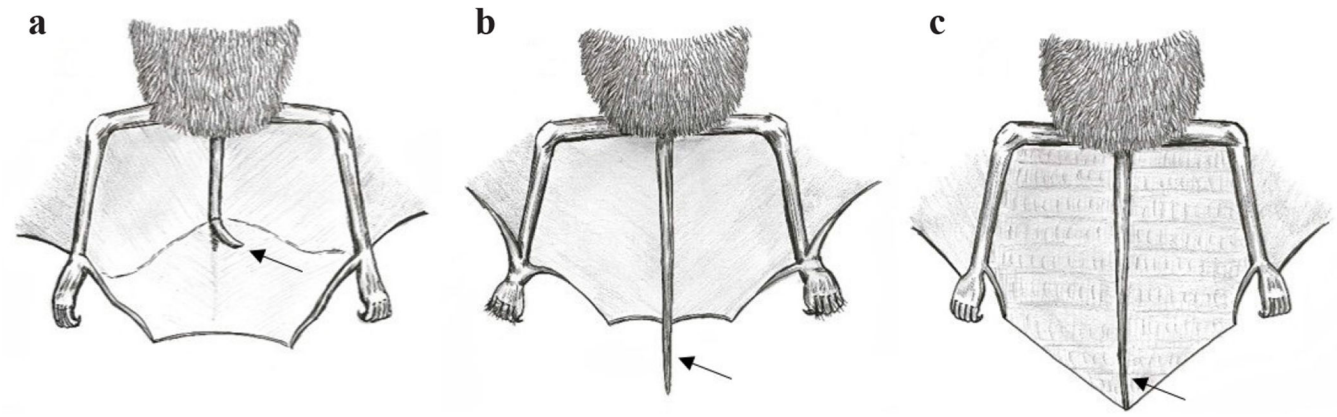


Figure 5.

Distinct uropatagium and tail morphologies for various bat taxa: a) tip of tail protrudes from the dorsal side of the uropatagium, indicative of the only mormoopid present in the U.S., *Mormoops megalophylla*; b) the tip of the tail extends significantly past the rear edge of the uropatagium, indicative of the family Molossidae; and c) the tip of the tail ends at or near the rear edge of the uropatagium, indicative of the family Vespertilionidae.

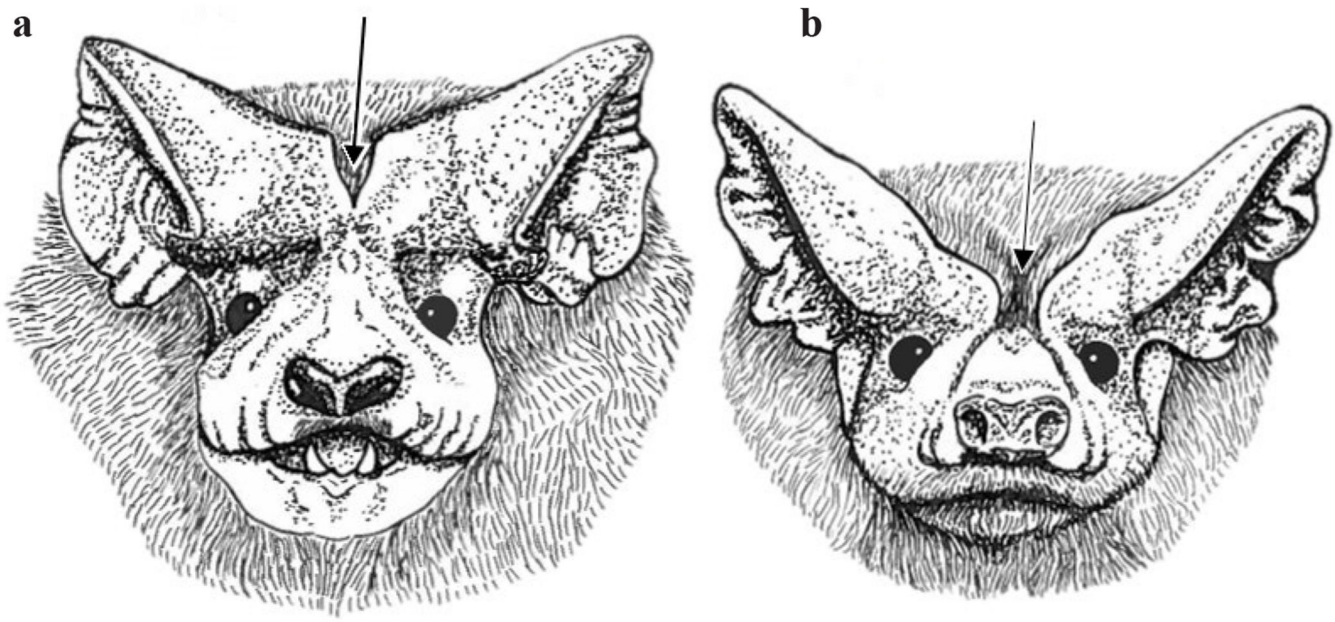


Figure 6.
Variation in molossid ears: a) ears merge at base, as found in *Nyctinomops femorosaccus* and *Nyctinomops macrotis*; b) ears not joined at base, as found in *Tadarida brasiliensis* and *Molossus molossus*.

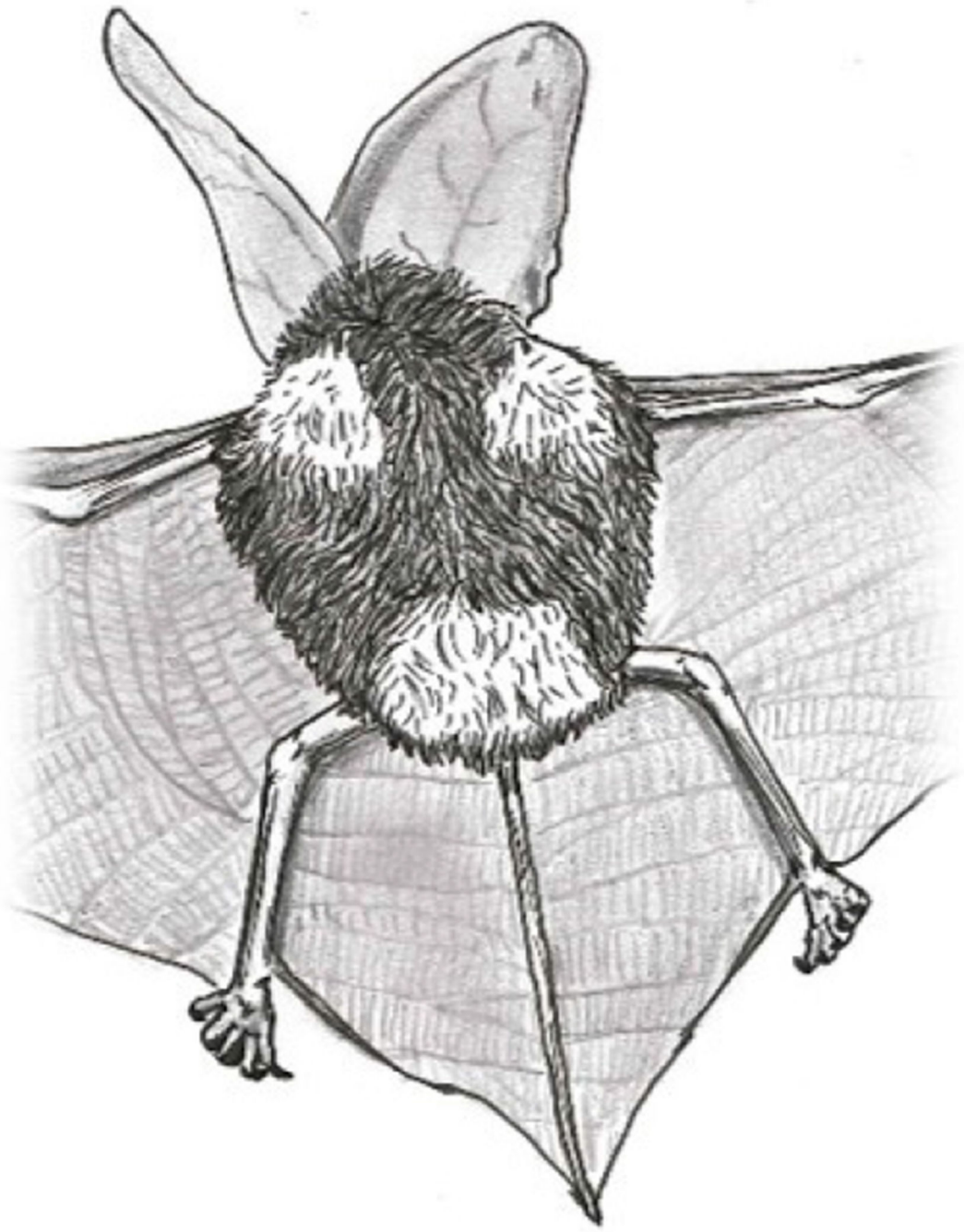


Figure 7.
Dorsal view of the Spotted Bat (*Euderma maculatum*) with three conspicuous white patches.

Figure 8.
Face of *Corynorhinus townsendii* with glands (large bumps) present on either side of nose.

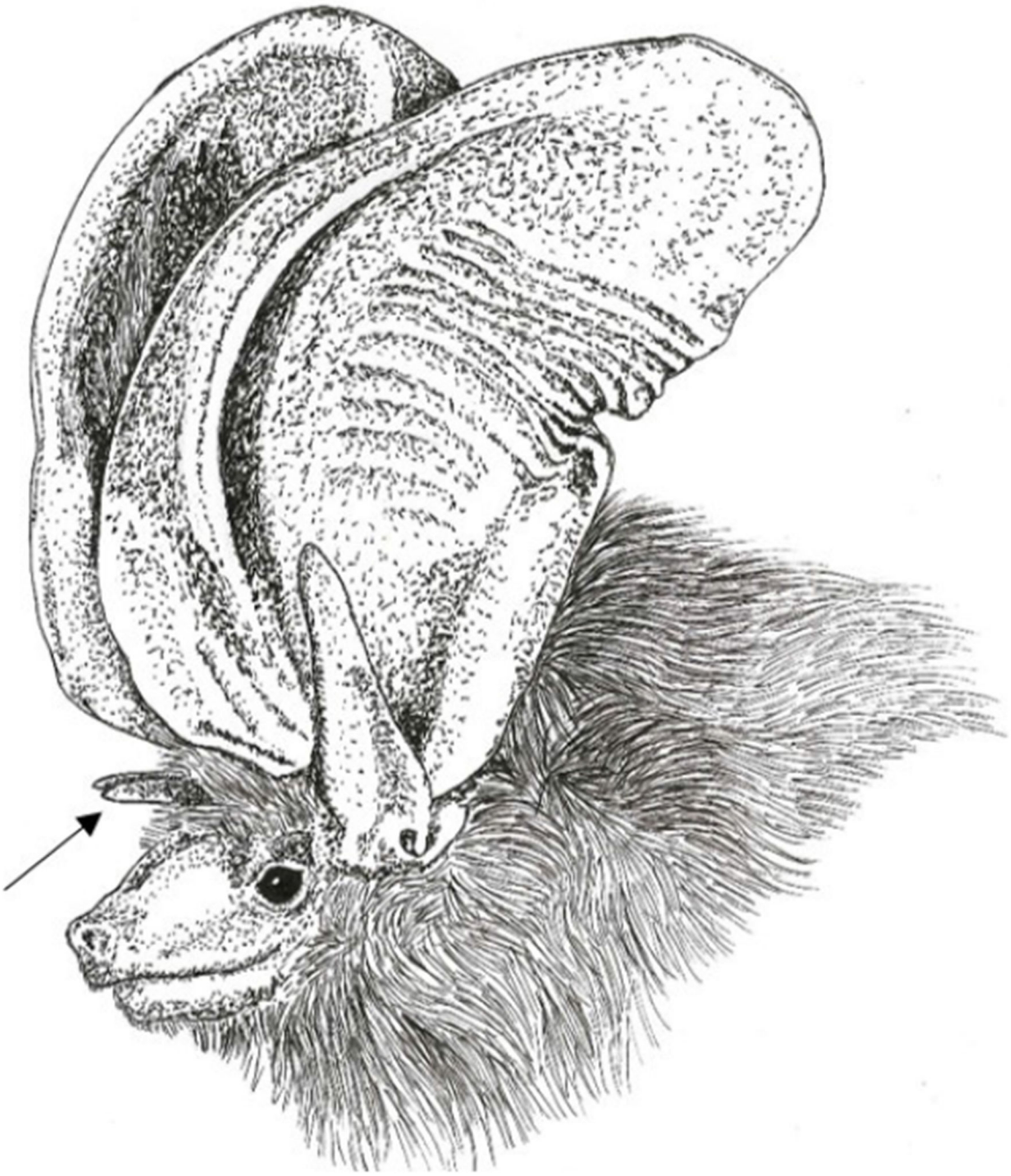


Figure 9.
Face of *Idionycteris phyllotis* with lappets (flaps) projecting forward from base of ears.

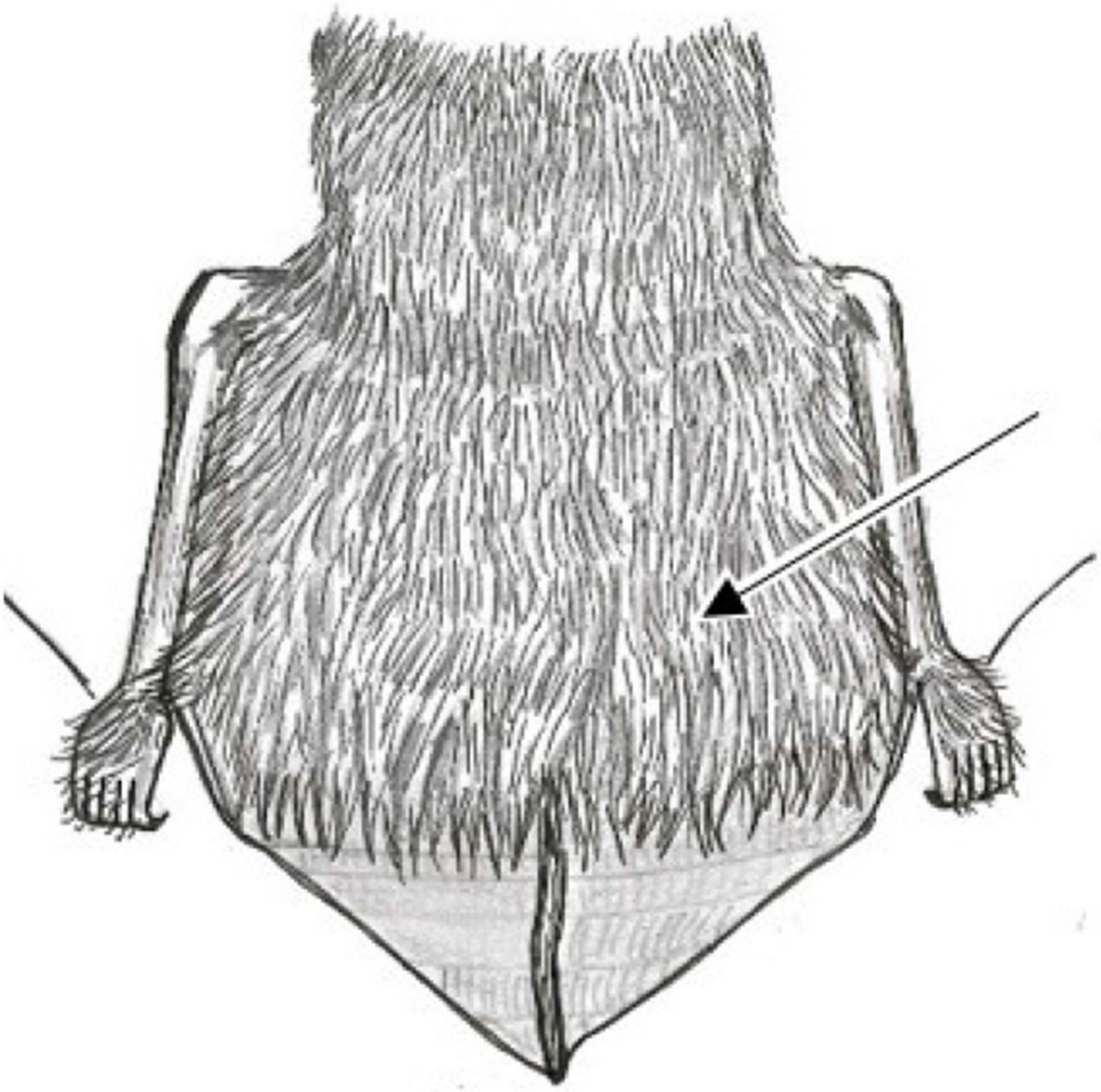


Figure 10.
Densely furred anterior half of the dorsal uropatagium, indicative of lasiurines and *Lasionycieris noctivagans*.

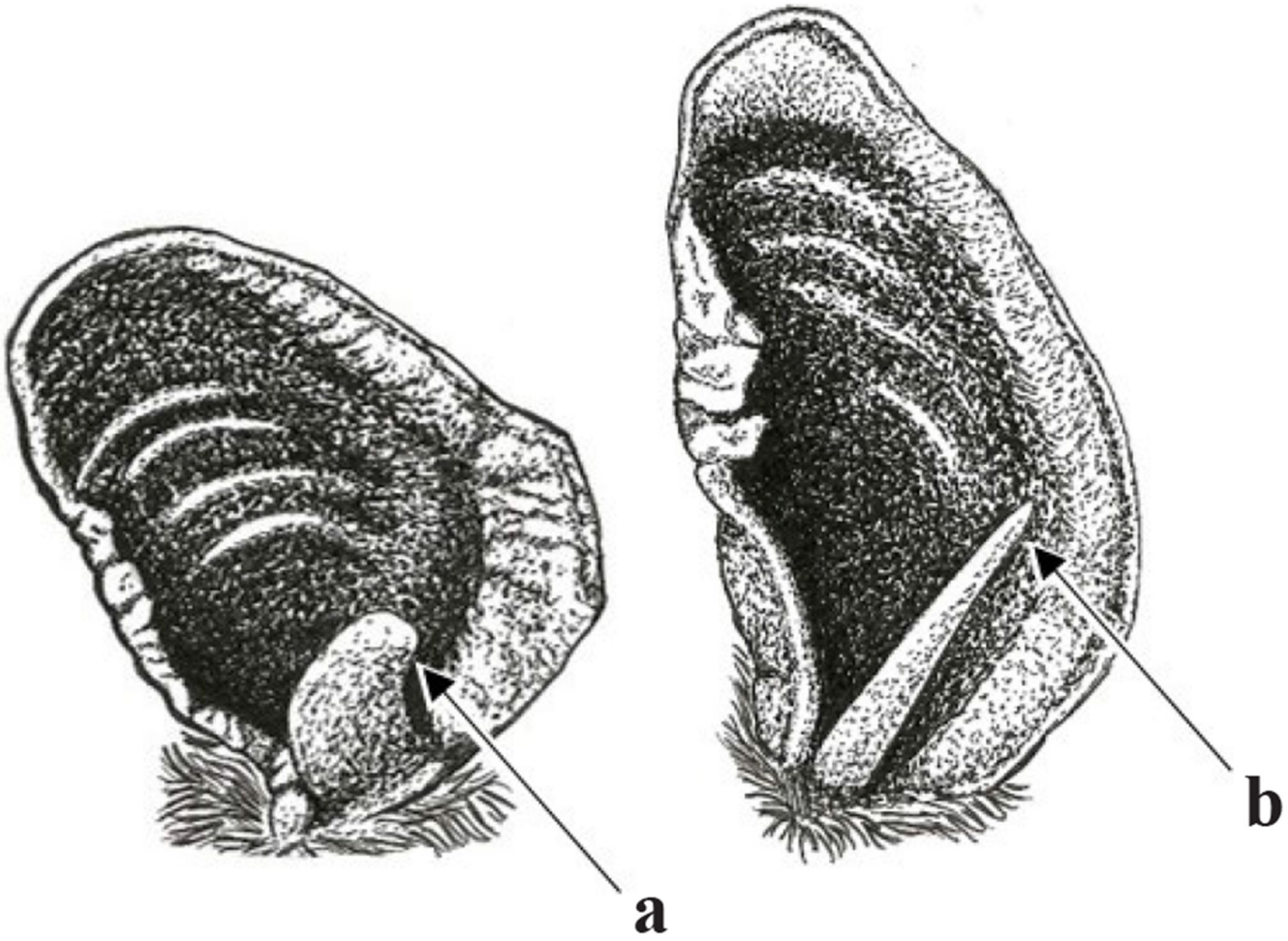


Figure 11.
Tragus shapes: a) short and blunted tragus, indicative of many bats including *Eptesicus fuscus*; b) longer, pointed tragus, as found in a number of bats including *Myotis sodalis*.

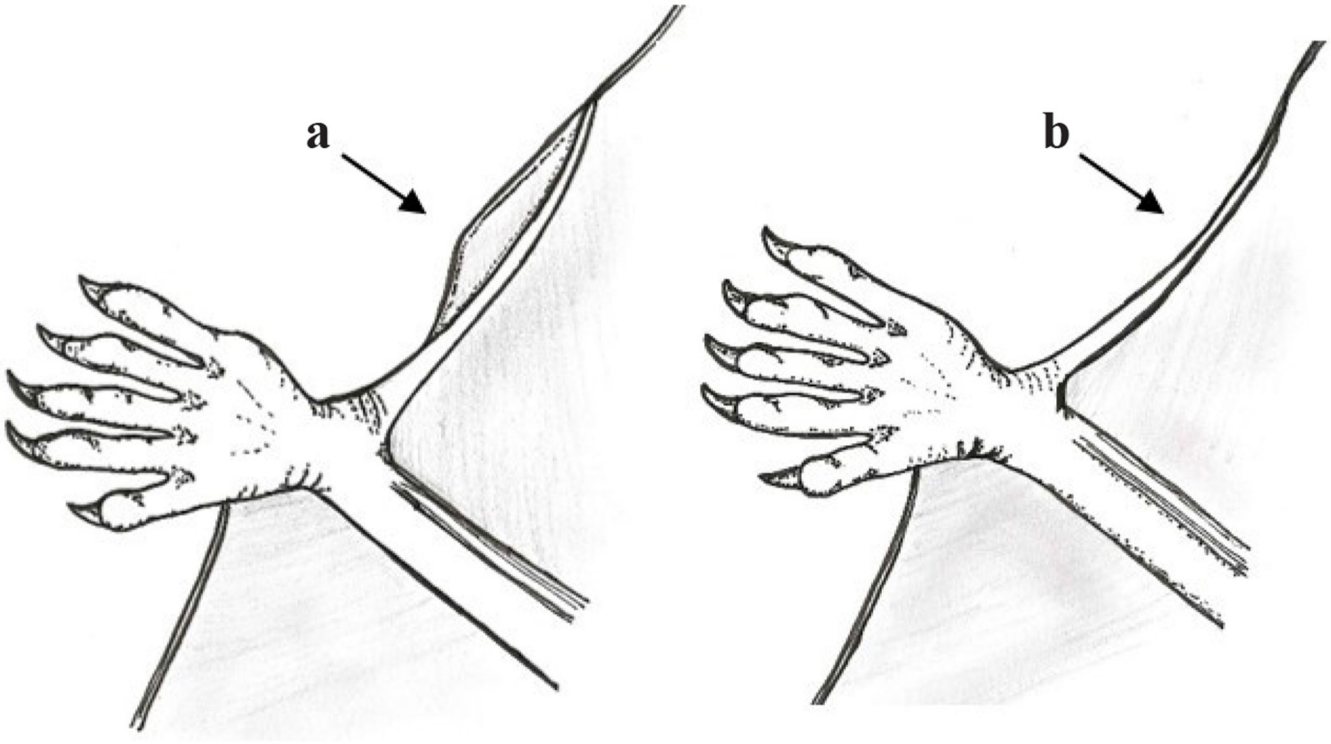


Figure 12.
Variation in calcar as a useful diagnostic feature: a) keeled calcar; b) calcar not keeled.

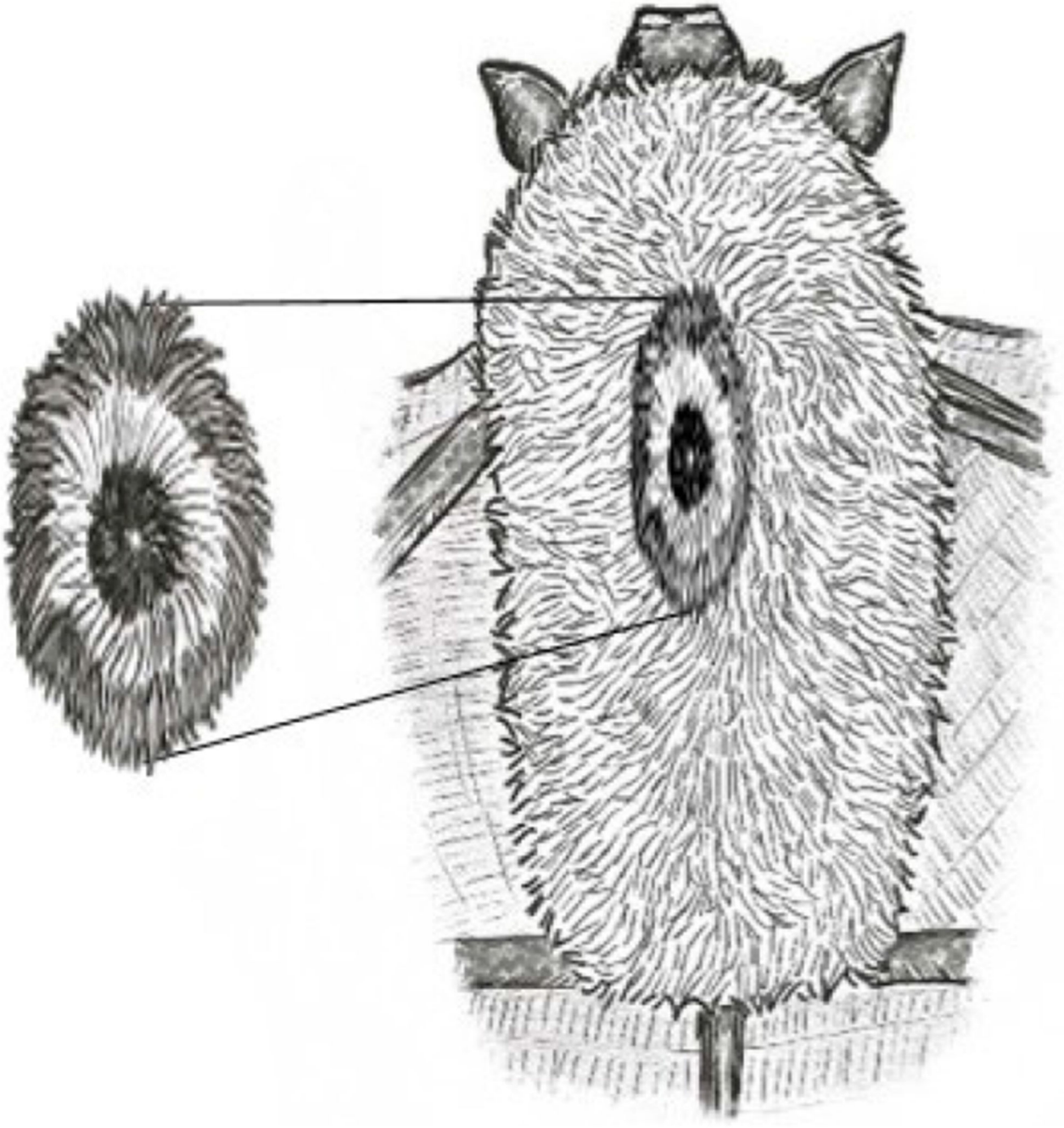


Figure 13.
Dorsal view of the Tricolored Bat (*Perimvotis subflavus*), when hair is parted at the base.

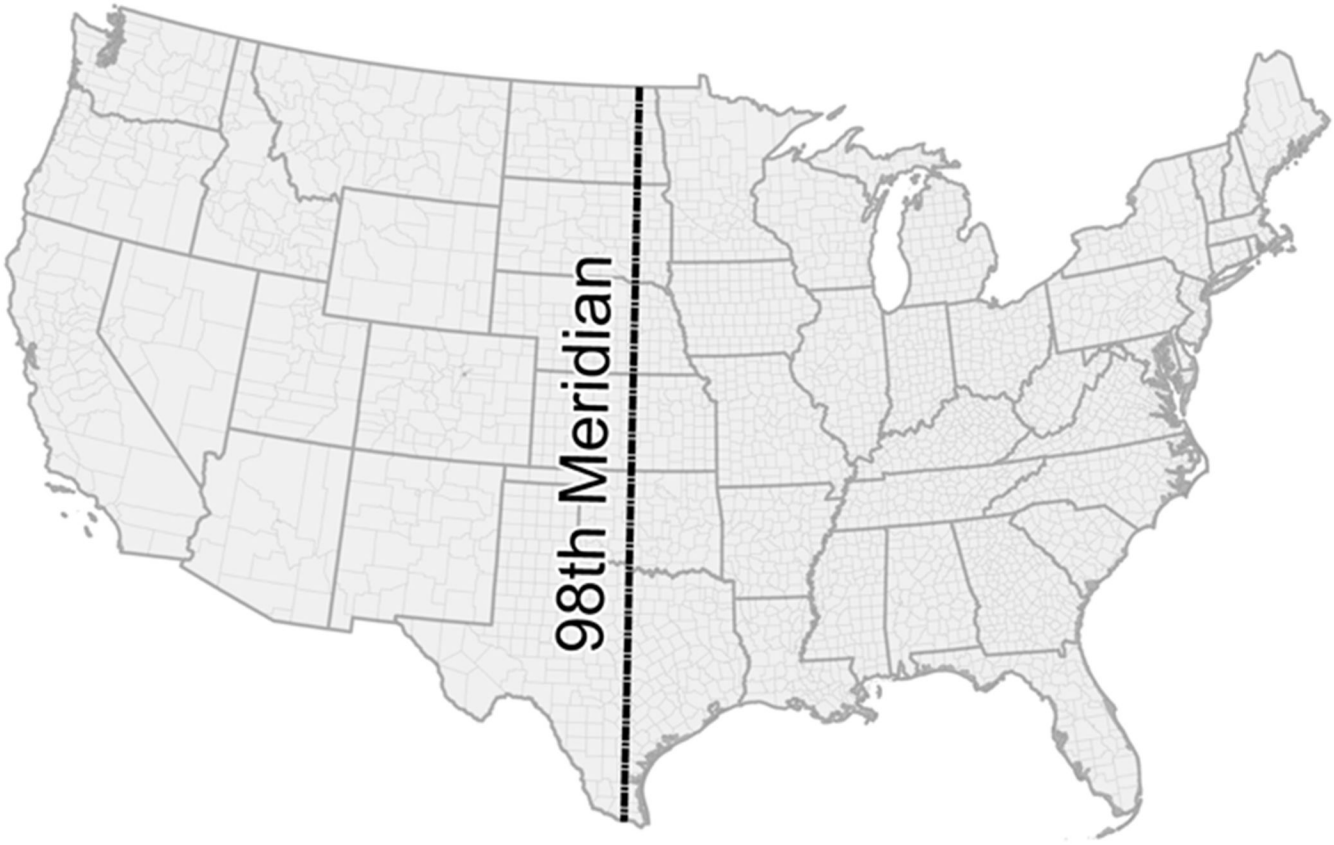


Figure 14.
The 98thMeridian (98°W) can be used as an additional data point to help identify some species of the genus *Myotis* based on their geographic distribution.

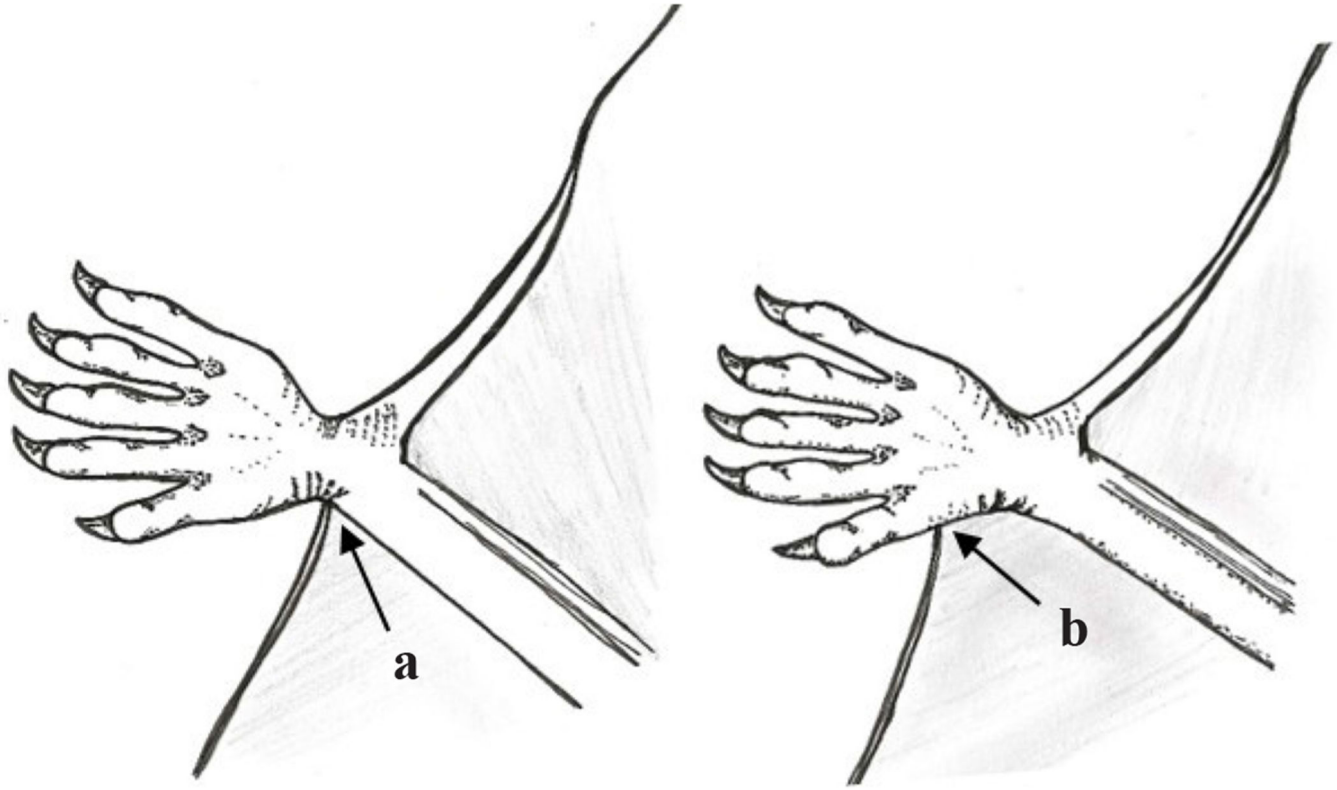


Figure 15.

Attachment site of the plagiopatagium can help distinguish some species of the genus *Myotis*: a) attached at the ankle, as found in *Myotis grisescens*; b) attached to the foot at the base of the toes, as found in *Myotis austroriparius*.