

*Nyctinomops femorosaccus*.

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Published 26 April 1990 by The American Society of Mammalogists

***Nyctinomops* Miller, 1902**

*Nyctinomops* Miller, 1902:393. Type species *Nyctinopus femorosaccus* Merriam, 1889, by original designation.

**CONTEXT AND CONTENT.** Order Chiroptera, Suborder Microchiroptera, Family Molossidae. The genus *Nyctinomops*, restricted to the warmer parts of the New World, contains four species, a key to which follows:

1. Greatest length of skull >22.0 mm; length of maxillary tooththrow usually >8.5 mm; length of forearm >54 mm (usually 58-64)..... *N. macrotis*  
 Greatest length of skull <22.0 mm; length of maxillary tooththrow usually <8.5 mm; length of forearm <54 mm..... 2
- 2 Length of maxillary tooththrow ≥7.9 mm; greatest length of skull usually ≥20.0 mm; length of forearm >47 mm (usually 48-53)..... *N. aurispinosus*  
 Length of maxillary tooththrow ≤7.5 mm; greatest length of skull usually <20.0 mm; length of forearm ≤49..... 3
- 3 Length of forearm usually 45-49 mm; length of maxillary tooththrow >7.0 mm; length of ear, 22-24 mm; occurring in southwestern United States and adjacent México southward to Guerrero..... *N. femorosaccus*  
 Length of forearm usually 41-45 mm; length of maxillary tooththrow <7.0 mm; length of ear 19-21 mm; occurring from Tamaulipas and Jalisco, México, southeastward into South America..... *N. laticaudatus*

**DIAGNOSIS.** Free-tailed bats with large, rugose ears that are joined anteriorly, at their bases, over the nose; second phalanx of fourth digit noticeably shortened; rostrum narrow and more or less tubelike (Fig. 1). The palatal emargination is relatively narrow; premaxillae separated anteriorly by a narrow space; mandible thin and delicate; sagittal crest poorly to moderately developed; coronoid processes low; basisphenoid pits deep. There are two pair of lower incisors; upper incisors more or less parallel; P3 relatively large; M3 with complete posterior commissure (Freeman, 1981; Miller, 1902). In the characters assessed by Freeman (1981:107), *Nyctinomops* "... averages closer to the Old World *Tadarida* than to any other genus."

***Nyctinomops femorosaccus* (Merriam, 1889)**

Pocketed Free-tailed Bat

*Nyctinopus femorosaccus* Merriam, 1889:23. Type locality "Agua Caliente [Palm Springs], Colorado Desert," Riverside Co., California.

*Nyctinomops femorosaccus*: Miller, 1902:393. First use of current name combination.

**CONTEXT AND CONTENT.** Context as given above for the genus *Nyctinomops*. *N. femorosaccus* is a monotypic species.

**DIAGNOSIS.** *Nyctinomops femorosaccus* (Fig. 2) is a small to medium-sized member of the genus, somewhat larger than *N. laticaudatus*, but smaller than *N. aurispinosus* and especially *N. macrotis*; the four species form a graduated size series beginning with *N. laticaudatus* (Freeman, 1981). Ears reaching beyond tip of nose when laid forward and joined basally at midline on head; rostrum elongate and slender; wing tip narrow (as in other species of the genus). Length of forearm usually from 45 to 49 mm; membranous sac, frequently difficult to locate, situated "from inner third of femur to middle of tibia, forming a deep pocket between it and the interfemoral membrane" (Merriam, 1889:23), present to varying

degrees in other *Nyctinomops* as well; baculum drumstick-shaped in dorsal aspect (Brown, 1967); crown of M1 nearly square as opposed to broader posteriorly than anteriorly (Hall, 1981; Hoffmeister, 1986).

Compared to the closely related and mostly allopatric *N. laticaudatus*, aside from being larger, *N. femorosaccus* differs in



FIG. 1. Skulls of four species of *Nyctinomops* showing size relationships (bottom to top): *N. macrotis* (greatest length, 23.6 mm), *N. aurispinosus*, *N. femorosaccus*, *N. laticaudatus*. Photographs by N. L. Olson.



FIG. 2. Pocketed free-tailed bat, *Nyctinomops femorosaccus*. Photograph by B. J. Hayward.

having a shorter thumb, fewer and finer hairs on the membranes, especially the uropatagium, thicker, more rugose ears, and also in cranial and dental details (Benson, 1940). From the larger *N. aurispinosus*, with which it is partly sympatric, *N. femorosaccus* also differs in having a noticeably less inflated braincase, posterior margin of palate terminating posterior to M3, posterointernal cingula of m1 and m2 quadrangular in shape, and in having decidedly smaller teeth (Gardner, 1963; Jones et al., 1972).

**GENERAL CHARACTERS.** Dorsum brownish to grayish brown (occasionally reddish, possibly the result of bleaching prior to annual molt), basal half of hairs whitish; venter slightly paler, sometimes with buffy wash. Anterior border of ear with horny excrescences; second phalanx of fourth finger usually <5 mm. Skull (Fig. 3) elongate in appearance; rostrum not much broader anteriorly than at point of least interorbital constriction; sagittal crest moderately well developed; bony palate terminating slightly posterior to third upper molars; upper incisors simple, well developed, parallel in frontal view, separated by evident gap from canines; lower incisors bifid, forming complete arcade between canines; canines well developed and with distinct cingula. Dental formula, as in related species, is  $i\ 1/2, c\ 1/1, p\ 2/2, m\ 3/3$ , total 30 (Barbour and Davis, 1969; Hall, 1981; Hoffmeister, 1986; Miller, 1907).

Ranges in external measurements (in mm) of 11 males, followed by measurements of one female, from Sinaloa (Jones et al., 1972) are: total length, 100–110, 108; length of tail, 34–44, 41; length of hind foot, 10–12, 11; length of ear, 22–24, 23; length of forearm, 45.6–47.8, 48.7; weight (in g), 11.5–18.0, 14.5. Ranges in cranial dimensions of nine males, followed by those of a female, from the same source are: greatest length of skull, 19.3–19.8, 19.2; zygomatic breadth, 10.4–10.9, 10.3; postorbital constriction, 3.4–3.7, 3.4; breadth of braincase, 8.8–9.3, 8.8; mastoid breadth, 10.1–10.5, 10.3; length of maxillary tooththrow, 7.3–7.5, 7.3. Females average slightly smaller than males, at least cranially.

**DISTRIBUTION.** The pocketed free-tailed bat occurs in western North America (Fig. 4), from southern California, central Arizona, southern New Mexico, and western Texas southward to central Nuevo León and hence to Jalisco, Michoacán, and Guerrero in western México; the distribution also includes Baja California (Hall, 1981; Jones et al., 1988). The distribution of *N. femorosaccus* is sympatric in part with that of *N. aurispinosus* and *N. macrotis*, but evidently is mostly allopatric with respect to the range of the closely related *N. laticaudatus*, which occurs as far north in western Mexico as Jalisco. The altitudinal distribution of *N. femorosaccus* is from sea level to about 2,250 m based on known localities of occurrence.

No fossils of this bat are known. *N. constantinei*, an extinct Pleistocene species from New Cave, Carlsbad Caverns National Park, New Mexico, is larger and has a flatter skull and broader rostrum than *N. femorosaccus* (Kurtén and Anderson, 1980).

**FORM AND FUNCTION.** Krutzsch (1944b), based on observations of a colony of 50 to 60 *N. femorosaccus*, described the flight of these bats as they left their daytime roost as having a rapid and complete wing beat, unlike the fluttering of *Myotis* and *Plecotus*. When flight-tested along with other bats in a simulated tunnel (Hayward and Davis, 1964), pocketed free-tailed bats oriented



FIG. 3. Dorsal, ventral, and lateral views of cranium, and lateral view of left dentary of *Nyctinomops femorosaccus* (male, Texas Tech University 6131) from Baja California. Greatest length of skull is 19.6 mm. Photographs by N. L. Olson.

poorly, crashing into ceiling and walls within 15 m of the point of release, whereas bats of other species oriented well and flew swiftly toward the exit. The individuals *N. femorosaccus* evidently were not echolocating at the time, hence the numerous accidents. The fact that these pocketed free-tailed bats normally roost in rock crevices, from which they drop and immediately gain elevation with no need for echolocation to assist them in orientation, may explain why they performed poorly in the experimental tunnel, which was found much more suited to cave-dwelling bats.

While wire-trapping *N. femorosaccus* over a pool of water, Benson (1940:28) observed that bats that hit the wire and fell into the water started swimming rapidly toward shore, producing a "quick pattering or flopping sound." Swimming was accomplished with a distinct bobbing motion, high in the water, using quick simultaneous strokes of the partly extended wings.

Functional capabilities of the jaws of *Nyctinomops* probably are much the same as those of *Chaerephon* and *Otomops* (Freeman, 1981), because their jaws are similarly structured. *Nyctinomops* probably consumes mostly soft-bodied prey. "In the New World species, *brasiliensis*, *femorosacca*, and *macrotis* . . . a large percentage of [the] diet consists of moths" (Freeman, 1981:69).

The baculum of *N. femorosaccus* (Brown, 1967) has a pronounced drumstick shape in dorsal aspect; viewed laterally it has an outline reminiscent of that of a long stocking. The base may be evenly swollen or irregular in outline; a lateral expansion is found distally in some bacula. In five specimens from Sinaloa, greatest length of baculum averaged 0.76 (range, 0.71–0.85) mm, with greatest breadth at base averaging 0.20 (range, 0.18–0.23) mm.

**ONTOGENY AND REPRODUCTION.** Female molossids characteristically give birth to one young annually (Cockrum, 1955). Insemination evidently occurs just before ovulation in spring. The offspring is born in late June or July and lactation may continue until September (Jameson and Peters, 1988). All available information on *N. femorosaccus* corroborates the above reproductive data (Benson, 1940; Cockrum and Musgrove, 1965; Easterla, 1968, 1973a, 1973b; Hoffmeister, 1986; Jones et al., 1972). Testes of males measured from 2 by 1 to 2 by 1.5 mm from mid-July to early August in Big Bend National Park (Easterla, 1973a); lactating females were taken between 7 July and 8 August and flying young-of-the-year were captured as early as 7 August. A pregnant female from Arizona carried "a nearly full-term (30 mm)" fetus on 15 July (Hoffmeister, 1986:119), and one from New Mexico had a fetus 24 mm in crown-rump length on 4 July (Easterla, 1973b).

**ECOLOGY AND BEHAVIOR.** *Nyctinomops femorosaccus* is colonial and roosts primarily in crevices in rugged cliffs, slopes, and high rocky outcrops (Barbour and Davis, 1969; Cockrum, 1956; Easterla, 1973a; Krutzsch, 1944b, 1945; Neil, 1940); individuals normally leave their roosts well after dark (Benson, 1940; Gould, 1961). From June through December, time of emergence of bats leaving a colony in a building in Arizona was never before solar radiation reached zero, and the average emergence time was 45 min after the zero point (Gould, 1961). These free-tailed bats were found sharing the recesses of a vertical crevice in a large granite boulder with *Eumops perotis* in San Diego County, California (Krutzsch, 1945). *N. femorosaccus* was captured at the narrow upper end of the crevice, whereas *E. perotis* occupied the lower, wider end; there was a distinct separation between the two coexisting species, which Krutzsch considered indicative of an antagonistic relationship. Pocketed free-tailed bats also may roost in crevices in shallow caves (Jones et al., 1972; Loomis and Webb, 1969), in buildings, and under roofing tiles (Barbour and Davis, 1969; Hoffmeister, 1986; Jones et al., 1972).

Cockrum (1956) attributed the relative rarity of *N. femorosaccus* in museum collections to the tendency of bat collectors to visit accessible daytime roosts and also to collect bats by shooting at twilight when most leave their roosts (not well after dark). Cockrum and Musgrove (1965) collected 11 specimens of *N. femorosaccus* in mist nets between midnight and 0345 h on 2 nights in Mohave County, Arizona. *Macrotus californicus*, *Myotis velifer*, *M. yumanensis*, *Pipistrellus hesperus*, *Eptesicus fuscus*, *Antrozous pallidus*, *Tadarida brasiliensis*, and *Eumops perotis* were taken at the same place.

Baker and Christianson (1966:310–311) netted *N. femorosaccus* on 26 November over a waterhole on the Río Alamos, Sonora, at a place "surrounded by mixed tropical deciduous and thorn forest." Pocketed free-tailed bats were captured almost continuously (0.5-h intervals) from 1800 to 2230 h, but most were taken later than *T. brasiliensis* and other species of bats netted there.

Easterla (1968) netted *N. femorosaccus* in the Big Bend of Texas over a dirt water tank in a low, dry, hot valley near rolling hills with small rocky ledges, about 1,000 m elevation, among Chihuahuan Desert dominants such as creosote bush (*Larrea divaricata*), sotol (*Dasyliroton leiophyllum*), candelilla (*Euphorbia anti-syphilitica*), and giant dagger yucca (*Yucca carnerosana*). *Mormoops megalophylla*, *Myotis californicus*, *M. velifer*, *P. hesperus*, *E. fuscus*, *A. pallidus*, *T. brasiliensis*, and *N. macrotis* also were taken there. Across the Río Grande, in adjacent Coahuila, Easterla (1970) captured *N. femorosaccus* in Chihuahuan Desert habitat at a place bordered on one side by a limestone canyon, with high cliffs of the Sierra del Carmens about 6 km distant. Cockrum and Musgrove (1965) netted these molossids in a floodplain in Arizona that was heavily vegetated with sycamore (*Platanus*) and mesquite (*Prosopis*), and in an area bounded by large cliffs and mountains that rose some 1,000 m above the valley. Of five major plant associations in which bats were netted in Big Bend National Park (Easterla, 1973a), this free-tailed species was taken in two, desert shrub and river floodplain arroyo. In January, Findley and Jones (1965) netted

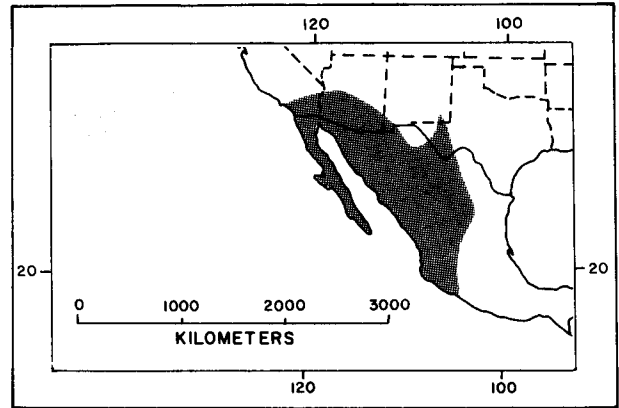


FIG. 4. Map showing distribution of *Nyctinomops femorosaccus* (after Hall, 1981).

pocketed free-tailed bats over pools in the bed of the Río Yaqui, in central Sonora, along with *M. californicus*, *Glossophaga soricina*, *Myotis occultus* (= *lucifugus*), *P. hesperus*, *Lasiurus borealis* (= *blossevillei*), and *T. brasiliensis*.

A nonpregnant female of this free-tailed species was shot in February in Jalisco as it foraged with other bats in pine-oak (*Pinus-Quercus*) forest at an elevation of about 2,160 m (Watkins et al., 1972). Another female was trapped in a mist net in tropical deciduous forest along the Río Juchipila in Zacatecas at about 1,130 m in company with *G. soricina* and *Chiroderma salvini* (Matson et al., 1978). A mummified individual was found hanging from the ceiling of a building in Zacatecas (Matson and Baker, 1986).

Pocketed free-tailed bats squeak or chatter much of the time in day roosts and also squeak when placed in holding bags after capture; they produce shrill, sharp, high-pitched chattering calls when first taking flight (Krutzsch, 1944b). Benson (1940:28) observed these bats arriving at a watering pool about an hour after sunset, flying "swiftly about the pool, making distinctly audible whistling and fluttering sounds with their wings" and occasionally squeaking and chattering shrilly. They also drink while in rapid flight, hitting the surface of the water with a smacking sound (Benson, 1940). Those that hit a wiretrap over the pool were unable to take flight while swimming and were defenseless when handled while in water; however, on reaching solid ground, they were observed to turn and bite and to protest shrilly when seized.

According to Ross (1967), *N. femorosaccus* eats macrolepidopterans (100% in one stomach), but also eats microlepidopterans and coleopterans (85 and 15%, respectively, in another stomach). Easterla and Whitaker (1972) reported that large moths made up 36.9% of the volume in 69.2% of the stomachs in 13 *N. femorosaccus*. They also found that many other flying insects (Formicidae and other Hymenoptera, Hemiptera, Diptera, and Coleoptera) made up a lesser percentage of the volume and frequency, and that prey included such unlikely groups as Gryllidae, Tettigoniidae, Cercopidae, Cicadellidae (all terrestrial insects that may have been captured at roost sites). Eleven *N. femorosaccus* examined by Benson (1940), captured shortly after they had left their roosts, already had full stomachs. Only the bodies of large insects are eaten, but in the case of small prey species, such as flying ants and leafhoppers, the entire insect is consumed (Easterla, 1973a). This species evidently is non-migratory, the distribution being limited by temperature (Easterla, 1973a).

Remains of *N. femorosaccus* were found in owl pellets collected in a cave in Sinaloa (Jones et al., 1972). A California lyre snake, *Trimorphodon vandenburghi*, which recently had fed on *N. femorosaccus*, was captured in a rock crevice used as a roosting site by pocketed free-tailed bats (Krutzsch, 1944a). Easterla (1973a) banded 44 individuals at Big Bend National Park, Texas, but none was recaptured.

*Nyctinomops femorosaccus* is the type host of a wing mite (Loomis and Tanigoshi, 1968), *Trombicula spathi* (Acarina: Trombiculidae). The intranasal chigger, *Microtrombicula merrihewi* (Acarina: Trombiculidae), found primarily in *Tadarida brasiliensis mexicana*, also has been recorded from one *N. femorosaccus* (Davis and Loomis, 1971). Loomis and Lipovsky (1954) noted that *N. femo-*

*rosaccus* harbored large numbers of chiggers and opined that the prevalence of these external parasites possibly adversely affected the presence of internal chiggers in this species. Loomis and Webb (1969) reported *Speleocola tadaridae*, also a trombiculid, as an external parasite of Sinaloa *N. femorosaccus*. A macronyssid acarine, *Chiroptonyssus venezolanus*, is a common ectoparasite of the pocketed free-tailed bat according to Whitaker and Easterla (1975), who also reported one *C. haematophagus* on a *N. femorosaccus* from the Big Bend of Texas. A coccidian, *Eimeria tadarida*, has been described from a specimen of *N. femorosaccus* from Sonora, México (Duszynski et al., 1988).

**GENETICS.** The karyotype of *N. femorosaccus* has a diploid number of 48 and a fundamental number of 58. Autosomes were described (Warner et al., 1974) as consisting of one pair of large metacentrics, three pair of medium-sized submetacentrics, one pair of medium-sized subtelocentrics, one pair of small subtelocentrics, and 17 pair of acrocentrics; one of the pair of medium-sized acrocentrics sometimes appears to be subtelocentric. The X chromosome is a medium-sized submetacentric; the Y is a medium-small submetacentric instead of a small acrocentric as in *Tadarida brasiliensis*.

**REMARKS.** In a multivariate study of the bat family Molossidae, Freeman (1981) used the size-out distance matrix to generate a phenogram showing a distinct cluster of the four New World species (*N. aurispinosus*, *N. femorosaccus*, *N. laticaudatus*, and *N. macrotis*) forming the genus *Nyctinomops*, referred to by Shamel (1931) as the *Tadarida macrotis* group. Freeman (1981) recommended that Miller's (1902) name *Nyctinomops* be accorded generic status for the four species because of the way they clustered in her analysis and we follow Freeman here. Miller (1907) and others used the generic name *Nyctinomus* É. Geoffroy St.-Hilaire for these and some other free-tailed bats, and until Freeman's (1981) study they were placed for many years in the genus *Tadarida* (as *femorosacca*, *aurispinosa*, *laticaudata*), but in *Nyctinomops* the endings revert to masculine because, according to the International Code of Zoological Nomenclature (ICZN, 1985:59), "A genus-group name ending in *-ops* is to be treated as masculine, regardless of its derivation or of its treatment by its author."

In some earlier literature, particularly that dealing with eastern México, *N. femorosaccus* was confused with *N. laticaudatus*, leading to the incorrect use of one name or the other in some instances. The generic name *Nyctinomops* literally means "resembling a night feeder." The specific name alludes to the location of the characteristic interfemoral sac.

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- Editors of this account were TROY L. BEST and ALFRED L. GARDNER. Managing editor was DON E. WILSON.
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