



BRAZILIAN FREE-TAILED BAT

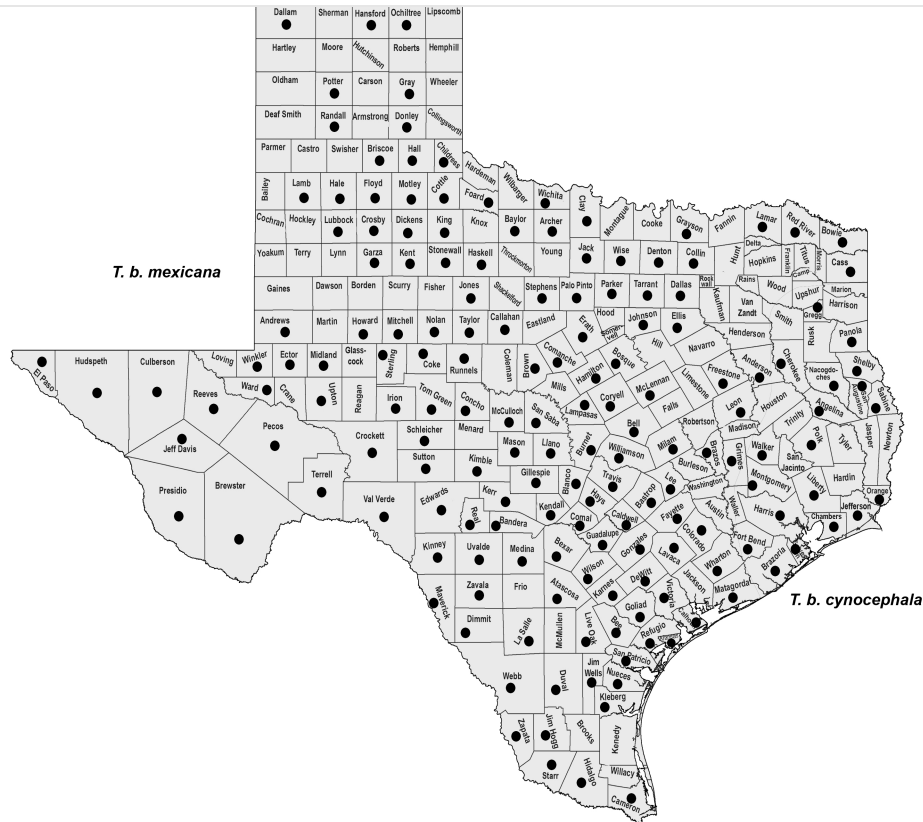
Tadarida brasiliensis (I. Geof. St.-Hilaire 1824)

Order Chiroptera : Family Molossidae

DESCRIPTION. A medium-sized bat with broad ears, large feet, and terminal half of tail free; ears broad, extending to tip of snout when laid forward, apparently, but not actually, united across forehead, with a series of wart-like structures on anterior rim; tragus small and blunt; second joint of fourth finger 6–9 mm long; feet with distinct white bristles on sides of outer and inner toes; ratio of foot to tibia about 0.75; pelage short (3–4 mm) and velvety; upperparts varying from reddish to black; underparts slightly paler; membranes and ears blackish. Dental formula: I 1/2 or 1/3, C 1/1, Pm 2/2, M 3/3 \times 2 = 30 or 32. The total number of lower incisors is variable, usually six, sometimes four, and occasionally five. Averages for external measurements: total length, 95 mm; tail, 38 mm; foot, 10 mm; ear, 19 mm; forearm, 42 mm. Weight, 11–14 g.



DISTRIBUTION. This bat has a statewide distribution in the summer. Many populations of the western subspecies migrate to Mexico in autumn, although a few appear to be year-round residents. All of the populations of the eastern subspecies are year-round residents.



SUBSPECIES. *Tadarida b. cynocephala* in the eastern fourth of the state and *T. b. mexicana* elsewhere.

HABITS. These bats utilize caves, mine tunnels, old wells, hollow trees, human habitations, bridges, and other buildings as daytime retreats. The prime necessity for a roost seems to be some relatively dark, dry retreat where from several dozen to several million individuals can hang up in close association and have an unobstructed space below into which they can drop when taking wing. Hollows under roofs, spaces between downtown buildings, attics, narrow spaces between signs and buildings, and spaces in the walls of buildings all offer suitable refuge sites for these bats. Because of their frequent occurrence about and in buildings, they frequently are termed house bats.

Brazilian free-tailed bats appear every year in Texas in multimillion numbers to inhabit a few select caves (known as guano caves) located in the Balcones Escarpment and the adjacent Edwards Plateau. The total population of these bats that inhabit Texas caves during the summer has been estimated at 95 million to 104 million. These same caves have been the summer homes of this animal for at least the past 100 years. Few, if any, of these bats ever overwinter in the Texas guano caves. They spend the depth of winter, from early December to late February, at lower latitudes, probably in Mexico, Central America, or even South America. In East Texas, where these bats are common inhabitants of old buildings and similar structures, they are nonmigratory and are year-round residents of that part of the state.

Bracken Cave, near New Braunfels along the southeastern edge of the Hill Country, is one of the world's largest bat colonies, serving as a nursery colony for adult female Brazilian free-tailed bats and their young with estimates of as many as 20 million to 40



the major tourist attractions in that city. These free-tailed bats are so common and well known in Texas that they are now designated as the state's official flying mammal. Recently, new thermal-imaging techniques have been used to assess the abundance of these bats more accurately, and the results have been surprising. Six major colonies, including those at Bracken, Davis, James River, Frio, and Ney caves in Texas and at Carlsbad Caverns in New Mexico, were censused from 2000 to 2006, and this new technique yielded an estimate of 4 million bats inhabiting these six caves. This is a far cry from historical estimates that totaled 54 million bats for these same colonies. Two factors have been proposed to explain the large discrepancy between the two estimates. First, the decline documented since the late 1950s could be real and severe. Second, methods used to count bats in the 1950s had high error rates, which resulted in large overestimates. It seems likely that a combination of these two factors explain the large differences in estimates.

Brazilian free-tailed bats appear on the wing several minutes before dark. The famous bat flights at Carlsbad Caverns are made up almost entirely of this species. The late William B. Davis, an earlier expert on Texas mammals, watched these bats emerge from the attic of a house one evening. They fell from the exit, dropped nearly to the ground, then zoomed upward and, flying high, disappeared from view, each bat following the general direction of the one in front of it. In foraging, the bats fly rather high (15 m [50 ft.] or more as a rule), except when sweeping over some body of water to drink. Their flight is rapid and aggressive, reminding one of swifts, and their long, angular, narrow wings, plus relatively large size, make them easy to identify.

Samples of their droppings collected at San Antonio contained remains of the following insects: moths (nearly 90% of the total number of insects eaten), ground beetles, leaf chafers, weevils, leaf beetles, flying ants, water boatmen, green blowflies, and leafhoppers. A separate food-habits study showed these bats take small prey, 2–10 mm in length, and listed the following food items and proportions: moths (34%), flying ants (26.2%), June beetles and leaf beetles (16.8%), leafhoppers (15%), and true bugs (6.4%). *Tadarida brasiliensis* often feeds on swarms of insects. The huge summer colonies of these bats clearly would have a great impact on nearby insect populations; they are estimated to consume from 6,000 to 18,000 metric tons of insects annually in Texas.

This bat has received considerable attention because it is a known carrier of rabies. Specimens of the Brazilian free-tailed bat are submitted to the Texas Department of State Health Services (DSHS) more often than any other species, and the species typically has the highest incidence of rabies of those submitted. Of 1,455 specimens submitted to the DSHS from 1994 to 1998, 258 (18%) tested positive for the rabies virus. Although the total number of confirmed rabies cases is minuscule when compared with the population of bats as a whole, caution should be exercised when one of these bats is encountered, or any species of bat for that matter.

The major event in the life of the Brazilian free-tailed bats summering in Texas is the birth and development of their young. Well over 90% of the returning females produce young each year. Most mating in the Texas population is accomplished each spring before the bats arrive at the Texas caves. Males predominate at the caves for a brief period in early spring, but they are quickly outnumbered by females as populations build steadily with the approach of parturition. By mid-June, adult females outnumber adult males more than three to one.



continuous colonies and are not carried by their mothers during the nocturnal feeding flights.

The almost simultaneous arrival of the babies creates marked crowding in the cave colony clusters. In the past it was thought that adult females made no attempt to locate their own young within these masses but nursed the first two young encountered on their nightly return to the roost. Studies have shown that females do indeed recognize their own young, which is a remarkable feat given the confusion with such huge swarms of bats. The mothers locate their pups using a combination of locational, vocal, and olfactory information. The babies grow rapidly in the incubator-like climate of the caves. Within a month after birth, the majority of babies are furred, of body length almost equal to that of the adults, and capable of flying out to feed on their own.

The sudden increase in numbers of flying bats resulting from the mass achievement of fledgling status among the babies creates additional congestion in the caves. The congestion is relieved by the rapid disappearance of the adults as the fledglings appear. These adults presumably move rapidly south out of Texas; the missing adults have not been found elsewhere in Texas at this time. After late July, fledglings predominate in the diurnal feeding flights from the caves, and they tend to reside at the cave of their birth until the onset of cool weather in October and November drives them south out of Texas. In Texas, the Brazilian free-tailed bat seems to be primarily a cave dweller, and its use of buildings as roosts is likely a relatively recent, possibly expanding, practice. Only a small fraction of the numbers of bats found in caves is ever found in the total of all roosts in buildings. Every town in the Brazilian free-tailed bat's range in Texas is likely to have at least 15 roosts per 5,000 human population, but the occupation of buildings is especially common in eastern Texas. Most roosts in buildings house fewer than 100 bats at a time, but a few buildings traditionally house many hundreds each year. Overwintering in buildings occurs infrequently in the southern Gulf Coast prairies of Texas.

No particular style, size, age, state of repair, or use by humans exempts a building from use by Brazilian free-tailed bats. The critical feature is whether the building has any accessible small cracks or niches that permit bats to retreat into semidarkness during the day. Such openings usually are to be found even in the most modern, compact types of structure. One architectural type common in South Texas, the Spanish-style building with clay tile roof, is among the most vulnerable to invasion by Brazilian free-tailed bats. The bats roost under the tiles, and seldom can they be driven out permanently either by killing those present or by chemical treatment of the surface of the roost. The simplest, most effective method is to close the entrance to the roost. With clay tile roofs this is almost impossible, unless the tile is replaced by some other kind of roofing material.

The abundance of Brazilian free-tailed bats roosting in Texas buildings follows an annual pattern of one peak in spring and another in fall, with general midsummer and midwinter lows or periods of complete absence. This pattern complements that of bat abundance in the guano caves. Brazilian free-tailed bats in Texas buildings during spring and fall usually are itinerants between tropical latitudes and the midlatitude guano caves of Texas, Oklahoma, Kansas, and New Mexico. Sufficient interchange of banded Brazilian free-tailed bats has occurred among the guano caves of Texas and between those in Texas and the ones in neighboring states to demonstrate that individual bats are not compelled to return each year to the cave of their birth. Rather, Brazilian free-tailed bats exhibit the ability to range over great distances and find the



Bridges in Texas provide important stopover roosts for migrating bats and in the spring are used as mating sites. Colony size increases at bridges in south-central Texas (Travis and Williamson counties) in early March, two months before such an increase occurs in maternity roosts in caves. In autumn, bridges are used later into the fall migration period than are caves. Activity at bridges has been detected into October, when no activity was recorded at caves in the same area. This may be because the crevices used as roosting sites in bridges warm up more quickly during cooler months than do caves. Although it seems that the noise and pollution produced by traffic, as well as higher ambient-light levels found under bridges, would negatively impact bat colonies living there, this does not appear to be the case.

The flight of Brazilian free-tailed bats on leaving and returning to a roost is accomplished uniformly in groups. It is presumed, therefore, that group flight is the norm in this animal. Yet, in the roosting clusters, where grouping is also the norm, there is strong evidence that each bat has an affinity not to a specific, stable group of acquaintances but to any convenient group of its kind.

The gestation period of Brazilian free-tailed bats appears to be slightly in excess of 90 days. No more than one young is born per year by each adult female. Females in Texas are almost all pregnant the summer following birth. The left horn of the uterus does not carry an embryo. Lactation begins after delivery of the young, and two long mammae are located laterally, each with one functional pectoral teat. A vaginal plug still exists in some females arriving at the Texas caves in early spring.

Adult male Brazilian free-tailed bats arriving in Texas in spring are still sexually active, but sperm production is waning. Their sex glands decrease steadily in size in spring and reach a resting-stage size by early May. The small proportion of the male population that shows no sexual activity is composed principally of the youngest age class. In these males, the testes, prostate, and hedonic glands are smaller than the resting-stage sizes of the same glands in adult males. In late fall, the few adult males remaining in Texas again show some increase in size of testes and prostates, but sperm are absent. Peak production of sperm, thus, must occur during winter while the males are in lower latitudes. Since the highly disproportionate ratio of male to female Brazilian free-tailed bats in Texas cannot be explained easily as resulting from higher mortality among males, it must be that most males do not summer in Texas.

Another colonial bat (*Myotis velifer*) is a common associate of the Brazilian free-tailed bat in the guano caves. This bat also gives birth to its young in the guano caves, but at a time about 2 weeks in advance of the Brazilian free-tailed bats. Although the two kinds of bats tend to roost in separate clusters, some mixing may occur.

A number of species of snakes, birds, and mammals prey on bats at the caves, but this loss of bats represents a very small proportion of the total bat population.

The annual movement of this animal between Texas and Mexico may be accomplished by most individuals in a few direct, long-distance flights between guano caves. Most adult male Brazilian free-tailed bats apparently do not leave the tropical and subtropical portion of the range and play no part in the sociology of bearing and rearing the young.

The accumulation, under crowded conditions, of millions of Brazilian free-tailed bats per guano cave each summer in Texas for the purpose of giving birth and rearing young



probably is great, with an average of >11 years.

POPULATION STATUS. Common, year-round resident (central and West Texas populations migratory). The Brazilian free-tailed bat is the commonest species of bat in Texas. These bats appear every year in the state in multimillion numbers to inhabit a few select caves (known as guano caves) located in the Balcones Escarpment and the adjacent Edwards Plateau. Those caves with the largest populations of *Tadarida brasiliensis* in Texas include, in descending order, Bracken, Goodrich, Rucker, Frio, Ney, Fern, Devil's Sink Hole, and James River caves. Over most of Texas their presence is seasonal, although they are nonmigratory and year-round residents of the eastern part of the state.

CONSERVATION STATUS. The IUCN status of Brazilian free-tailed bats is least concern in view of its wide distribution and presumed large population, and it is not included on the federal or state lists of concerned species. Its major threat would be destruction and disturbance of cave sites, either in the United States or Mexico, where the bats roost in great concentrations. Several of its roosting sites (e.g., Bracken Cave, James River Bat Cave in Mason County, and the Fredericksburg railroad tunnel in Gillespie County) are protected by private conservation organizations or TPWD. Other cave sites are on private property. The species also occupies large structures and bridges across the state. In Mexico, cave destruction has been on the increase under the mistaken belief that it is a way to control vampire bats. So, although this species appears to be in good shape in Texas, it is vulnerable while it overwinters in Mexico. A new potential threat is wind turbines; in Oklahoma >86% of bat fatalities around wind farms were of this species.

REMARKS. The taxonomy of *T. brasiliensis* and its various subspecies has been one of confusion for many years. Two subspecies are known from Texas, according to the latest taxonomic revision of the species in the state. *Tadarida b. cynocephala* is a nonmigratory resident of the eastern one-fourth of the state, and *T. b. mexicana* is the highly migratory subspecies found throughout the remainder of Texas. Morphologically, these two subspecies are distinguished by differences in several skull characteristics (e.g., greatest length of skull, zygomatic breadth, and breadth of cranium), all of which are larger in *T. b. cynocephala*.

Most populations of the migratory subspecies *mexicana* have normally completed their move into Mexico before the onset of breeding, whereas *cynocephala* remains in the United States during the breeding season. This movement pattern would indicate that the two races are reproductively isolated and possibly separate species. Overwintering populations of *mexicana*, however, have been discovered in an area of contact between the two in southeastern Texas. A colony of *mexicana* was known to overwinter at the old animal pavilion and the football stadium on the Texas A&M University campus in College Station (Brazos County), which is only 160 km (99 mi.) from colonies of *cynocephala* in extreme eastern Texas. A morphological analysis of cranial measurements from free-tailed bats captured near Navasota (Grimes County) found these bats to be intermediate between *cynocephala* and *mexicana*. Thus, it appears the two subspecies are not reproductively isolated and that they likely interbreed in this part of Texas.

These morphological data dictate that *cynocephala* and *mexicana* should be regarded only as subspecies rather than as separate species, which has been the tendency in the past. Recent biochemical genetic studies of these bats have pointed strongly to specific



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