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Glossophaga soricina.

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Glossophaga soricina (Pallas, 1766)

Pallas' Long-tongued Bat

Vespertilio soricinus Pallas, 1766:48. Type locality not given; restricted to Surinam by Miller (1912:39).

Glossophaga soricina: É. Geoffroy St.-Hilaire, 1818:418. First use of current name combination.

Glossophaga amplexicaudata Spix, 1823:66. Type locality "Rio de Ianeiro," Brazil.

Phyllophora nigra Gray, 1844:18. Type locality "tropical America." Based on the same specimen as *Phyllophora nigra* Gray, 1843 (a *nomen nudum*), from Brazil, which therefore is the type locality.

Glossophaga villosa H. Allen, 1896:479. Type locality "La Guayra, Venezuela."

Glossophaga truei H. Allen, 1897:153 (renaming of *G. villosa* H. Allen, preoccupied by *G. villosa* Rengger, 1830, not a member of the genus *Glossophaga* as currently understood).

CONTEXT AND CONTENT. Order Chiroptera, Suborder Microchiroptera, Family Phyllostomidae, Subfamily Glossophaginae. The genus *Glossophaga* contains five species (Webster and Handley, 1986; Webster and Jones, 1980), keys to which are in Webster (1983) and Webster and Jones (1984). Five subspecies of *Glossophaga soricina* are recognized (Webster, 1983; Webster and Jones, 1980):

G. s. antillarum Rehn, 1902:37. Type locality "Port Antonio, Jamaica."

G. s. handleyi Webster and Jones, 1980:5. Type locality "Colegio Peninsular, Mérida, Yucatán, México."

G. s. mutica Merriam, 1898:18. Type locality "Maria Madre Id., Tres Marias Ids. [Nayarit], Mexico."

G. s. soricina Pallas, 1766:48, see above (*microtis* Miller is a synonym).

G. s. valens Miller, 1913:420. Type locality "Balsas, Province of Cajamarca [=Amazonas], Peru."

DIAGNOSIS. *Glossophaga soricina* is a medium-sized representative of the genus (Fig. 1). First upper incisor large and noticeably procumbent, larger in bulk than I2; fourth upper premolar with conspicuous posterolingual cingular shelf; parastyle of M1 well developed and directed anterolabially from the paracone; mesostyle of both m1 and m2 well developed; lower incisors relatively large, usually in contact, more or less filling gap between canines; premaxillae elongate anteriorly; pterygoid "wings" usually present, frequently well developed; presphenoid ridge conspicuous and prominent throughout its length; mandibular symphyseal ridge well developed (Webster, 1983). Pallas' long-tongued bat can be distinguished from other species of the genus *Glossophaga* by various combinations of the above-listed characteristics.

GENERAL CHARACTERS. The pelage of *G. soricina* is avellaneous to fuscous black dorsally, buffy to fuscous ventrally. Cranial characters (Webster, 1983) other than those given above include: slope of rostrum to braincase gradual (Fig. 2); basisphenoid pits shallow; posterior palatine process usually well developed; dental formula i 2/2, c 1/1, p 2/3, and m 3/3, total 34. *G. sorcina* was included in electrophoretic and immunologic studies of relationships among brachyphylline and glossophagine bats by Baker et al. (1981), who found that biochemical data did not support the close association of *Glossophaga* and *Monophyllus* claimed by Varona (1974) on morphologic grounds.

This long-tongued bat is largest, both externally and cranially, on Jamaica and the Tres Marías Islands, and in western Ecuador and Perú. Smaller individuals inhabit the remainder of the South and Middle American mainland. *G. s. soricina* is the smallest of the five subspecies. Means (in mm, ranges in parentheses) for selected external and cranial measurements (Webster, 1983), those of males followed by those of females, of the subspecies *G. s. antillarum* (*n* = 2 and 10), *G. s. handleyi* (*n* = 147 and 234), *G. s. mutica* (*n* = 6 and 18), *G. s. soricina* (*n* = 43 and 86), and *G. s. valens* (*n* = 16 and 40), respectively, are: total length, 66.5 (65–68), 64.0 (61–68); 63.0 (51–57), 64.7 (52–79); 62.6 (57–80), 62.2 (61–65); 62.0 (50–70), 62.6 (54–73); 65.9 (58–74), 67.8 (61–90); length of tail, 6.0 (5–7), 7.7 (6–9); 7.9 (4–13), 8.0 (4–12); 6.4 (5–9), 6.3 (5–8); 7.5 (4–11), 7.4 (4–11); 6.8 (5–10), 7.8 (6–10); length of foot, 12.0 (12), 12.0 (12); 10.6 (6–13), 10.9 (9–17); 10.4 (8–12), 10.0 (8–12); 10.0 (7–12), 10.1 (8–12); 10.8 (10–12), 10.7 (9–12); length of ear from notch, 15.0 (15), 13.7 (13–14); 13.7 (9–16), 14.2 (8–16); 14.1 (13–15), 13.8 (12–15); 13.8 (9–17), 13.7 (8–16); 14.0 (12–16.5), 15.3 (8–16); length of forearm, 36.5 (35.9–37.4), 37.2 (36.3–38.4); 35.2 (33.1–37.8), 35.8 (33.2–37.6); 36.4 (35.2–37.8), 37.3 (36.4–38.2); 34.4 (32.2–36.2), 35.0 (31.7–38.0); 35.2 (31.8–37.5), 36.5 (34.6–37.9); greatest length of skull, 22.2 (21.5–22.8), 22.2 (20.6–22.6); 21.3 (20.0–22.3), 21.4 (20.4–22.6); 22.0 (21.4–22.5), 22.0 (21.6–22.6); 20.3 (19.0–21.6), 20.5 (19.7–21.7); 22.2 (21.6–23.1), 22.2 (20.9–23.2); condylobasal length, 20.6 (20.1–21.0), 20.6 (20.1–21.0); 19.6 (18.5–20.7), 19.8 (18.7–21.9); 20.2 (19.6–20.8), 20.4 (19.8–21.2); 18.7 (17.6–19.6), 18.9 (18.2–20.1); 20.6 (20.0–21.4), 20.7 (19.5–21.5); zygomatic breadth, 9.7 (9.5–9.9), 9.6 (9.4–9.8); 9.4 (8.7–10.0), 9.4 (8.6–9.9); 9.4 (9.0–9.8), 9.2 (8.9–9.5); 9.0 (8.2–9.5), 9.0 (8.6–9.9); 9.6 (9.3–9.9), 9.5 (9.0–9.8); breadth of braincase, 8.6 (8.2–8.9), 8.7 (8.2–8.9); 8.5 (8.0–9.0), 8.5 (7.9–9.0); 8.6 (8.2–8.9), 8.5 (8.4–8.6); 8.4 (8.0–9.0), 8.5 (8.0–8.9); 8.6 (8.3–9.2), 8.6 (8.2–9.1); mastoid breadth, 9.0 (8.6–9.2), 9.0 (8.8–9.3); 9.0 (8.5–9.5), 9.0 (8.4–9.7); 9.1 (8.9–9.5), 9.0 (8.8–9.1); 8.7 (8.3–9.1), 8.7 (8.4–9.3); 9.2 (8.9–9.6), 9.2 (8.6–9.6); interorbital breadth, 4.3 (4.1–4.3), 4.3 (4.1–4.5); 4.2 (3.6–4.6), 4.2 (3.8–4.6); 4.1 (3.8–4.5), 4.1 (3.9–4.3); 3.9 (3.7–4.2), 4.0 (3.7–4.3); 4.2 (4.0–4.5), 4.3 (3.8–4.5); length of maxillary toothrow, 7.5 (7.4–7.7), 7.5 (7.3–7.7); 7.2 (6.8–7.6), 7.3 (6.8–7.8); 7.5 (7.2–7.7), 7.6 (7.4–7.9); 6.9 (6.4–7.4), 7.0 (6.5–7.5); 7.6 (7.3–8.0), 7.7 (7.4–8.3); width across molars, 5.8 (5.7–6.0), 5.8 (5.7–5.9); 5.5 (5.2–6.0), 5.5 (5.0–6.0); 5.5 (5.3–5.7), 5.5 (5.2–5.7); 5.2 (4.8–5.7), 5.3 (4.9–5.7); 5.7 (5.4–6.0),

FIG. 1. *Glossophaga soricina* from Jalisco, México. Photograph by R. R. Hollander.

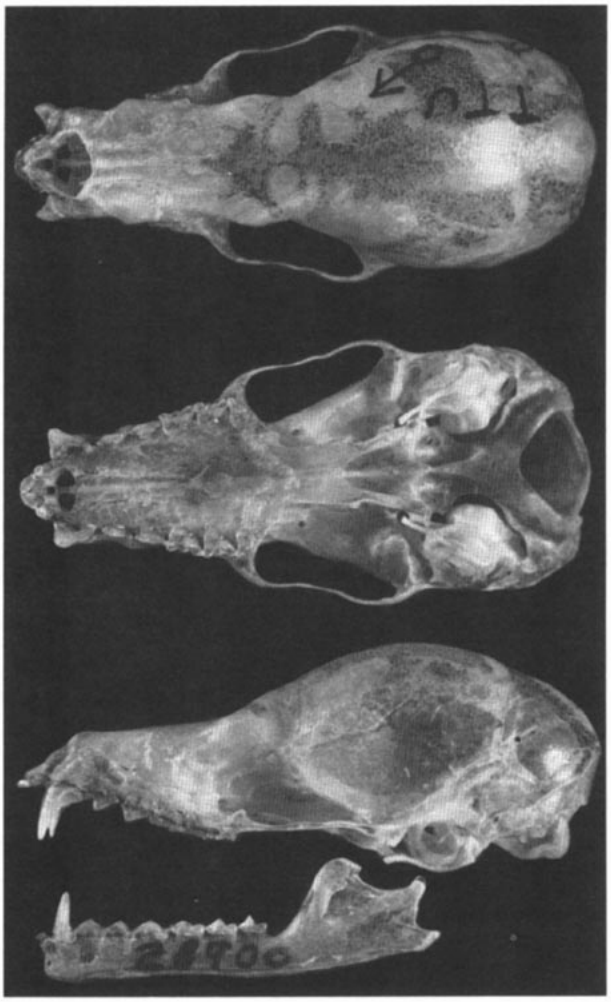

FIG. 2. Dorsal, ventral, and lateral views of the cranium and lateral view of the mandible of *Glossophaga soricina* (Texas Tech University 28900, adult male) from Veracruz, México. Greatest length of skull is 21.6 mm.

5.7 (5.4–6.0); length of mandibular toothrow, 8.0 (7.9–8.2), 7.9 (7.8–8.1); 7.7 (7.2–8.2), 7.7 (7.1–8.2); 7.8 (7.6–8.0), 8.0 (7.7–8.3); 7.3 (6.8–7.7), 7.4 (6.8–7.8); 8.0 (7.6–8.4), 8.1 (7.7–8.7).

Weights (in g) of males, followed by those of nonpregnant females, from throughout the ranges of four subspecies, *G. s. handleyi* (n = 77 and 57), *G. s. mutica* (n = 12 and 6), *G. s. soricina* (n = 23 and 13), and *G. s. valens* (n = 11 and 9), are, respectively (Webster, 1983): 9.80 (7.0–15.0), 10.24 (8.3–13.4); 9.50 (7.0–12.0), 10.50 (9.0–14.0); 9.52 (7.5–17.0), 8.88 (5.0–13.0); 9.14 (6.0–12.5), 9.50 (8.0–11.0).

Females were larger than males in seven of 16 characters (length of forearm, greatest length of skull, condylobasal length, length of rostrum, length of maxillary toothrow, length of mandibular toothrow, and mandibular length), whereas males were significantly larger than females in only one character, width across upper molars (Webster, 1983). Willig et al. (1986) reported a discrepancy in the conclusions obtained from analyses of 22 mensural characters for sexual dimorphism in *G. s. soricina* using univariate and multivariate techniques. Univariate analyses revealed sexual dimorphism in six external and six cranial characters (see also Willig, 1983), whereas no such pattern was revealed in multivariate analysis of the same data.

DISTRIBUTION. *Glossophaga soricina* is known from northern México (Sonora in the west and Tamaulipas in the east) southeastward into South America to Paraguay and northern Argentina; it also is recorded from Jamaica, the Tres Marías Islands, and several islands adjacent to northern South America (Fig. 3). It occurs in a wide variety of habitats, ranging from arid-subtropical

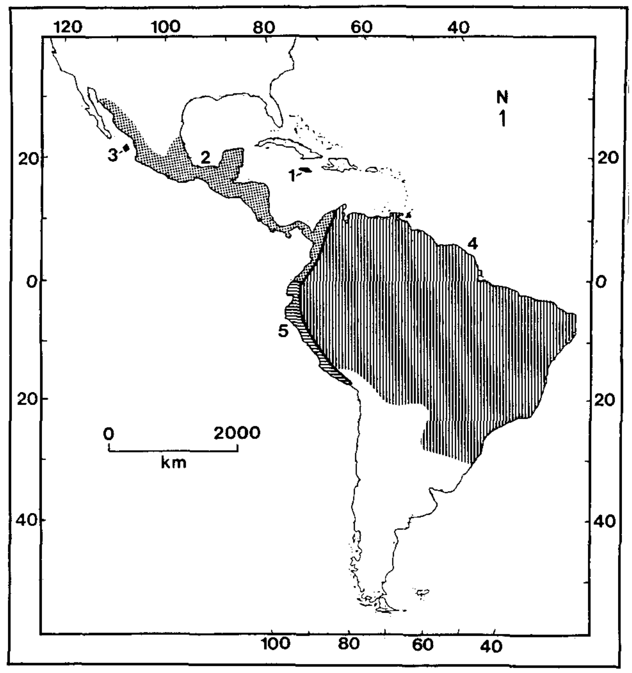

FIG. 3. Geographic distribution of subspecies of *Glossophaga soricina*: 1, *G. s. antillarum*; 2, *G. s. handleyi*; 3, *G. s. mutica*; 4, *G. s. soricina*; 5, *G. s. valens*.

thorn forest to tropical rainforest and savannas, and is distributed altitudinally from sea level to approximately 2,600 m, but is most common in lowland habitats. *G. s. antillarum* is restricted to Jamaica. *G. s. handleyi* is found on the North American mainland from western and eastern México (excluding most of the Mexican Plateau) southward throughout Central America to northwestern South America. *G. s. mutica* is restricted to the Tres Marías Islands. *G. s. soricina* occupies most of the South American range of the species east of the Andes, including Trinidad and Isla Margarita. *G. s. valens* occurs to the west of the Andes, in the western parts of Ecuador and Perú.

FOSSIL RECORD. All fossil records of *G. soricina* are from late Pleistocene to Recent deposits. Fossil specimens have been reported from Grutas de Loltún, Yucatán, México (Alvarez, 1982; Arroyo-Cabrales, 1985). Individuals from Cueva de Quebrada Honda (Aragua, Venezuela), considered by Linares (1968) to be *G. soricina*, actually represent *G. longirostris* (Webster and Handley, 1986).

FORM. Individuals from north of the Equator have been reported in molt in all months except November, whereas molt is known from south of the Equator only in August and September (Webster, 1983). Molt "begins as an overall growth of new hair beneath the old, worn, reddish-brown pelage. Progressively, as the new dark pelage lengthens, old hairs drop out in patches. Although loss of worn pelage appears to be random over much of the body, that on the head and shoulders seems to be lost first. Near the termination of molt, individual hairs of the old pelage remain more or less uniformly distributed over the dorsum, giving the pelage a pale, somewhat washed appearance" (Jones et al., 1973:14). Albinism has been reported in three individuals of *G. soricina* (Goodwin and Greenhall, 1964; Schneider, 1925; Webster, 1983).

Middorsal hairs average 7 mm long and are 23.8–25.5 μ in diameter. Cuticular scales are annular and they vary in form between entire coronal and hastate coronal. Melanin granules are disposed generally in the cortex, but are most abundant in the distal one-third of the filament. A medulla is absent (Benedict, 1957). Scales diverge from the main shaft of the hair, thought to be an adaptation for trapping pollen by Howell and Hodgkin (1976), who provided a microphotograph of an interscapular overhair from *G. soricina*. However, Thomas et al. (1984) noted that divergent or divaricate scalation on hairs occurs independently in a number of chiropteran families, and found evidence lacking for special adaptations in nectivorous bats.

Glossophagines as a group have relatively short wings in comparison to other phyllostomids (Smith and Starrett, 1979). The length of the forearm averages about 60% of the length of head and body. The third digit is relatively long, as is the second phalange of the fifth digit. Overall aspect ratio of the wing in *Glossophaga* averages 5.71 (5.64–5.80), and the aspect ratio of the wing tip is 4.62 (4.58–4.67).

The milk of *G. soricina* (Jenness and Studier, 1976) has low energy content (0.74 Kcal/g), because of low fat (5.2 g/100 g) and whey protein (0.75 g/100 g) content. Other components (per 100 g) are lactose (3.9 g), casein (1.1 g), citrate (0.08 g), calcium (9 g), and phosphorous (8 g).

The incisors are well developed and the molars retain much of the primitive insectivorous ectoloph pattern (Howell, 1974). Twenty-two deciduous teeth are present, two of which (the first upper premolars) are not replaced by permanent teeth. Three kinds of abnormal dental conditions (hyperdontia, congenital agenesis, and incomplete duplication), as well as caries, have been documented (Phillips, 1971).

On the dorsal surface of the tongue, there are two proximal pair of median circumvallate papillae, the lateral pair is the larger; distally, there are hairlike papillae on the lateral surface and medial horny papillae. External and internal morphology of the tongue is generally similar to that of other members of the subfamily. There is a single, midline, lingual artery anteriorly, with two large lingual veins to either side. Veins and artery are connected by artero-venus shunts. Toward the tip of the tongue, the lingual veins pass laterally and dorsally into the interior of each hairlike papilla (Griffiths, 1982).

The brain has a short, stubby cerebrum with relatively long olfactory bulbs; it is indistinguishable externally from those of *G. commissarisi* and *G. leachii* (McDaniel, 1976). Cochlear morphology, including radial and central measurement of the cochlea, thickening and width of the basilar membrane, size of spiral ligaments, and cochlear heights (made at every half-turn in the modiolar plane), suggests that *G. soricina* has no extreme modifications in the inner ear, consistent with its generalized feeding behavior (Pye, 1967, 1980). Neurotransmitters are present in the retina of the eye (Studholme et al., 1987).

The esophagus of *G. soricina* lacks significant corneum, particularly in the lower abdominal portion (Forman et al., 1979). The cells lining the esophageal lumen are ovoid, unlike those characteristic of dead, cornified cells. Forman et al. (1979) suggested that this feature probably reflects the general absence of abrasive food in the diet. The stomach is large and saccular, and is more specialized than that of any phyllostomine. The fundic caecum is dilated and bulbar. Among species he studied, Forman (1972:635) found the stomach to be "most distinctive in the presence of a rounded, spacious fundic caecum prominently dilated on the dorsal surface, and unique among bats examined with the presence of a distinct sulcus delimiting the fundic pouch from the remaining stomach." Other studies of the digestive system of *G. soricina* include gross anatomy, general histology, and comparative ultrastructure of the salivary glands (Phillips et al., 1977, 1987; Tandler et al., 1990); anatomy of the tongue and stomach (Park and Hall, 1951); structure of the Peyer patch at the iliocolonic junction (Forman, 1974*a*, 1974*b*); and histology of the pyloric region (Mennone et al., 1986).

The mean and range (in parentheses) of dimensions of spermatozoa (in μ) are: length of head, 3.80 (3.53–4.00); length of acrosome, 3.19 (3.09–3.26); nuclear length, 2.86 (2.70–3.26); width of head, 3.19 (3.07–3.26). The sperm head is small, short, and rounded, and the base is shovel-like in shape with a well-developed concavity. The acrosome, which is never wider than the nucleus, has a nearly symmetrical apex (Forman and Genoways, 1979).

FUNCTION. Resting body temperature, resting basal metabolic rate, and resting conductance are 35.5°C, 3.06 ml O_2 g^{-1} h^{-1}, and 0.45 ml O_2 g^{-1} h^{-1} $°C^{-1}$, respectively. The lower lethal body temperature and lower lethal ambient temperature are 6.8 and 6.0°C, respectively; upper limits have not been determined. Body temperatures after 2–5 h at ambient temperatures of approximately 20, 15, and 10°C were 31.0–37.0, 25.5–38.8, and 11.5–36.0°C, respectively (McManus, 1977).

During daylight hours, a minimum body temperature of 37.2°C occurred at 1400 h and a maximum temperature of 39.5°C occurred at 1100 h (Morrison and McNab, 1967). Although Morrison and McNab (1967) and McNab (1969) reported homeothermy in *G. soricina*, Studier and Wilson (1970) reported poor ability to regulate temperature, in that body temperature was directly proportional to ambient temperature in the one specimen they studied. Studier and Wilson (1979) later suggested that acclimatization of bats to captive conditions may have been responsible for differences displayed in previous studies.

Food deprivation for 1 night (either in the laboratory or the field) results in estivation on the following day. Estivation is characterized by marked behavioral changes and, in the laboratory, by a drop in body temperature of about 3.3°C. Food-deprived animals exhibit clustering reaction in both males and females, partial unfolding of the wings, and roosting in relatively well-illuminated areas. Body temperature of individuals deprived of food for 1 night is significantly higher than that of bats deprived of food for 2 consecutive nights. The ability to estivate probably facilitates survival during periods of inclement weather or temporary food shortages in tropical habitats (Rasweiler, 1973).

Average dawn-to-dusk weight loss of clustered bats was 5.5% of original body weight, whereas loss by solitary individuals averaged 18.3% of original body weight. One cluster of bats maintained high body temperatures (mean, 37.5°C) throughout the day, whereas five solitary bats had more variable and lower body temperatures (mean, 33.5°C). The average rate of weight loss was higher for solitary bats (0.157 g/h) than for those in clusters (0.048 g/h). The rate of weight loss for both groups was greater in the first 4 h than in the last 6 h of the experiment. Clustering behavior may be important in the maintenance of homeothermy and prevention of excessive pulmocutaneous water loss (Howell, 1976). There is no difference in the rate of evaporative water loss between adult males and females, regardless of the reproductive condition of the females. Both sexes exhibited a steady decrease in body weight throughout the day due to the loss of evaporative water (Studier, 1970).

In Jamaica, *G. soricina* had a significant decrease in fat reserves during the dry season (December to July). No differences in fat deposition were found between the sexes (McNab, 1976).

ONTOGENY AND REPRODUCTION. Reproductive patterns and development of *G. soricina* have been studied extensively (Bleier, 1979; Rasweiler, 1972, 1974, 1979; Wilson, 1979). Ovulation is spontaneous and usually only one ovum is released per cycle. Ovulation may occur from either ovary, but tends to alternate between the two. Menstruation and ovulation take place at approximately the same time. The two-cell stage of development is reached by day 2 or 3 after fertilization, the eight-cell stage by days 5–7, the 32-cell stage by day 8, and the blastocyst stage by day 10. The embryo is contained within the ampulla of the oviduct until day 12 or 13, by which time the zona pellucida usually is lost. Implantation occurs in the uterotubal junction on days 12–14. Implantation is initially central and secondarily interstitial. No evidence for differentiation of germ layers appears during the implantation period. Rasweiler (1974) divided the process of implantation into eight stages and Hamlett (1935*a*) described the embryonic growth thereafter. The placenta is discoidal and haemochorial (Hamlett, 1935*a*; Rasweiler, 1974). The occurrence of menstruation and interstitial implantation suggests that *G. soricina* might possess considerable potential for development as an animal model in human reproductive research (Rasweiler, 1974).

Young are born well furred (Kleiman and Davis, 1979). One offspring is the rule, but twins have been reported (Barlow and Tamsitt, 1968). One female continued lactating for approximately 2 months (Kleiman and Davis, 1979). A juvenile was capable of hanging from the ceiling at the age of 18 days, but it remained attached to the nipple. It first was found separate from its mother and flying at age 25–28 days. Females carry their young (Davis, 1970; Tamsitt and Valdivieso, 1963) in a cross-wise or lateral position (Kleiman and Davis, 1979).

Although early reports suggested that *G. soricina* was monoestrous (Hamlett, 1934), subsequent work has suggested aseasonal polyestry in México (Cockrum, 1955) and Colombia (Tamsitt, 1966), or bimodal polyestry in Panamá (Fleming, 1973), Costa Rica (Heithaus et al., 1975), and northeastern Brazil (Willig, 1985). This species is polyestrous in captivity with a cycle of 22–26 days (Rasweiler, 1972). Copulation does not precede ovulation, but probably occurs simultaneously with it (Hamlett, 1935*b*).

ECOLOGY. *Glossophaga soricina* roosts in a variety of retreats that include caves, tunnels, abandoned mines, hollow trees and logs, buildings, culverts, and beneath bridges (Tuttle, 1976;

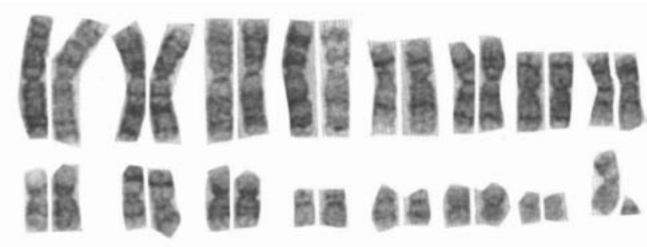

FIG. 4. G-banded karyotype of a male *Glossophaga soricina* (courtesy of R. J. Baker).

Webster, 1983). Colonies usually contain both sexes, but females and their young form maternity colonies during certain times of the year (Webster, 1983; Willig, 1983). About 30 species of bats, including members of the families Emballonuridae (Emballonurinae), Molossidae, Mormoopidae, Noctilionidae, Phyllostomidae (Phyllostominae, Carolliinae, Desmodontinae, Stenodermatinae, Glossophaginae), Natalidae, Furipteridae, and Vespertilionidae (Vespertilioninae), roost in association with *G. soricina* (Goodwin and Greenhall, 1961; Graham, 1988; Ortiz de la Puenta, 1951; Ramírez et al., 1984; Webster, 1983; Willig, 1983). In the eastern Peruvian Andes, 60% of the roosting sites of *G. soricina* were shared with *Carollia perspicillata*, with the two species co-occurring in at least three different types of roosts, and in most cases co-habiting the same sites in the roost (Graham, 1988). This suggests a beneficial association between the two kinds of bats by reducing the costs of thermoregulation. Mares et al. (1981) also found *Glossophaga* and *Carollia* occupying the same roosts in caves and man-made structures in northeastern Brazil.

Recapture data from Costa Rica and México suggest that *G. soricina* possesses a small home range compared to larger species in the same area, supporting a possible relationship between body size and home range size (Heithaus et al., 1975; Ramírez-Pulido and Armella, 1987). In contrast, Fleming et al. (1972) reported relatively large ranges for *G. soricina* in Panamá and Costa Rica. *G. soricina* does not seem to exhibit fidelity to particular flyways (Heithaus et al., 1975), and may shift habitats seasonally (Bonaccorso, 1979).

This species feeds on insects, fruits, pollen, nectar, and flower parts (Gardner, 1977). Although Arata et al. (1967) inferred carnivorous habits based upon finding a specimen with hair attached to flesh in the stomach, Gardner (1977) suggested that this may have represented cannibalism between the time the specimen was caught and its death. The diet appears to be geographically variable. From México through Costa Rica, Howell (1974) reported that *G. soricina* feeds on nectar and pollen only from April to June, then shifts to feed exclusively on insects. Similarly, Bonaccorso (1979) reported that *G. soricina* in Panamá feeds on nectar and pollen during the dry season (January through March) and fruit during the wet season (May through November). Conversely, *G. soricina* from dry forest of Costa Rica used flowers all year long, even during the dry season when flower abundance was low (Heithaus et al., 1975), and Fleming et al. (1972) found no seasonal differences in food habits in Costa Rica and Panamá. Pollen is a major food resource in habitats above 800 m in elevation in México, but is seldom used at lower elevations (Alvarez and González Quintero, 1970). In the Caatinga of northeastern Brazil, *G. soricina* reduces competition with *Lonchophylla mordax* by feeding almost exclusively on fruit (Willig, 1986). From late August to early June in Colombia, agave (*Agave desmettiana*) was visited more frequently by Pallas' long-tongued bat than all other species of plants combined (Lemke, 1984).

Endoparasites reported from *G. soricina* (Ubelaker et al., 1977) include: cestodes, *Oochoristica immatura* (Anoplocephalidae) and *Vampirolepis elongatus* (Hymenolepididae); nematodes, *Litomosoides* sp., *L. brasilensis*, *L. fosteri*, and *L. quiterasi* (Dipetalonematidae); and protozoans, *Polychromophilus deanei* (Plasmodidae), *Trypanosoma cruzi*, *T. cruzi*-like, *T. evansi*, *T. rangeli*-like, *T.* sp. (*megadermae*-type), and *T. vespertilionis* (Trypanosomatidae). Ectoparasites (Herrin and Tipton, 1975; Saunders, 1975; Webb and Loomis, 1977; Wenzel, 1976) reported from *G. soricina* include the argasids (Venezuela), ixodids (Venezuela), labidocarpids (Nicaragua), macronyssids (Trinidad, Panamá, Venezuela, and Brazil), psorergatids (Surinam), sarcoptids (Surinam), spelaeorhynchids (Amazon), spinturnicids (Brazil, Panamá, Surinam, Trinidad, and Venezuela), streblids (Colombia, Costa Rica, El Salvador, Guatemala, Guyana, México, Panamá, Paraguay, Perú, Trinidad, and Venezuela), and trombiculids (Costa Rica, México, Nicaragua, Panamá, Surinam, and Venezuela).

Several bacterial, mycotic, protozoan, and viral diseases are harbored by *G. soricina* (Jones, 1976). These include salmonellosis (*Salmonella*) in Panamá, histoplasmosis (*Histoplasma*) in Colombia, Panamá, and Trinidad, scopulariosis (*Scopulariopsis*) in México, superficial mycosis (*Trychophyton, Microsporum, Trychosporum*) in Colombia, trypanosomiasis (*Trypanosoma*) in Colombia, yellow fever in Brazil, and rabies in México. Methods that permit long-term maintenance of *G. soricina* in captivity were given by Rasweiler (1973), who kept bats in wood and wire cages that were 61 cm high, 91 deep, and 122 wide, and provided them with an enclosed, darkened roosting area. Bats were fed a mixture of peach nectar, powdered permix, and corn oil, with protein, sugar, mineral, and other supplements.

BEHAVIOR. According to LaVal (1970) and Heithaus et al. (1975), the nightly activity pattern of *G. soricina* is bimodal, with activity peaks just after dusk and just before dawn. Conversely, Ramírez-Pulido and Armella (1987) reported this species as having a unimodal activity pattern, with greatest activity occurring 3 h after sunset. Moreover, Ramírez et al. (1984) reported that *G. soricina* visits flowers of *Bauhinia ungulata* every 1–2 h between 2000 and 0400. Emergence from the roost is inhibited by high light intensities that occur during daytime or high intensities of moonlight. Individuals kept together under constant conditions and able to communicate acoustically do not become synchronized; rather they have free-running circadian rhythms with individual periods of different length. Resynchronization does not occur until 6–20 days have elapsed, depending on the direction of the shift (Erkert, 1982).

Glossophaga soricina visits gourd trees (*Crescentia cujete*) by hovering or landing on the flowers, landing being more common than hovering (Lemke, 1984). Bats approach the flowers from below, and push themselves up into the corolla. During landing, bats use thumbs for support. *G. soricina* forages in the upper levels of Panamanian forest (Bonaccorso, 1979). Mixed loads of pollen adhere to the wings, head, and body of *G. soricina* (Heithaus et al., 1974). Individuals covered with *Mucuna* pollen were reported by Howell and Burch (1974).

In Panamá, *G. soricina* uses a mixed-foraging strategy (searches and commutes simultaneously) when food has a moderately patchy distribution (for example, *Piper*), but a separate strategy (commutes directly to a feeding area before beginning to search for food) when feeding on the fig, *Ficus ovalis* (Fleming et al., 1977). Lemke (1984) suggested that *G. soricina* employed two foraging tactics: territorial defense of concentrated food resources or trapline foraging along regularly used feeding routes. Tactics depended on availability of *Agave desmettiana* nectar and the ability of a particular individual to dominate conspecifics. Wind is the only weather factor that affects feeding techniques and rates (Lemke, 1984); however, this research was conducted in the city limits of Cartagena, Colombia, where artificial lighting desensitized bats to the effects of moonlight. When available, *G. soricina* visits groups of larger trees where there are more flowers rather than groups of smaller trees (Ramírez et al., 1984).

Territorial bats displace conspecifics by flying directly at them on a collision course. Intruders usually stop feeding and flee immediately, pursued by the aggressor. High-pitched chattering vocalizations are made during some chases. Aggressive encounters increase as nectar becomes scarce. Feeding territories were limited to the bloomed panicles and the airspace within 1 m of the central flower stalk. In a horizontal plane, a feeding territory included a circular area of 3.14 m^2. The territories extended vertically from the level of lowest bloomed panicle to approximately 1 m above the plant. Females shared feeding territories with their immature offspring (Lemke, 1984).

Pallas' long-tongued bat produces frequency modulating pulses ranging from 48 to 75 kHz (Pye, 1980) and is able to detect wires with a diameter of 0.152 mm. In flight, this species increases the repetition rate of pulses upon approaching a detectable wire array (Howell, 1974).

GENETICS. *Glossophaga soricina* has a diploid number of 32 chromosomes (Baker, 1967, 1979) and a fundamental number of 60 (Fig. 4). The autosomes are biarmed and include eight metacentric, six submetacentric, and one subtelocentric pair. The X chromosome can be metacentric or submetacentric. The Y chromosome is a minute acrocentric. The karyotypes of *G. commissarisi* and *G. leachii* are indistinguishable from that of *G. soricina*. There is a polymorphism in fractions of the alpha- and beta-globulin regions (Valdivieso and Tamsitt, 1974). One electrophoretic locus (Peptidase-1) is fixed for a different allele in *G. soricina* than in the other four species of *Glossophaga* (Webster, 1983).

REMARKS. The type locality of *Vespertilio soricinus* is unknown, but Pallas examined specimens from Surinam and the Caribbean Islands. The type locality was restricted to "northern South America" by Rehn (1902) and later to Surinam by Miller (1912). There is a dubious record of *G. s. antillarum* from the Bahamas (Webster, 1983).

In the past, several species of *Glossophaga* were classified under the name *G. soricina*. Four species currently are known from southern México (Webster and Jones, 1980), for example, but all were referred to as *G. soricina* until 1962, the year in which *G. commissarisi* was named. Some specimens of *G. leachii* and *G. morenoi* (=*mexicana*) were listed as *G. soricina* until well into the 1970s. As a result, it sometimes is impossible to distinguish reports in the literature on *G. soricina* from those that actually may represent other species of *Glossophaga*, underscoring that some of the earlier literature purporting to relate to *G. soricina* is open to question.

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