MAMMALIAN SPECIES No. 446, pp. 1–4, 3 figs.

Glossophaga commissarisi.

By Wm. David Webster and J. Knox Jones, Jr.

Published 15 November 1993 by The American Society of Mammalogists

Glossophaga commissarisi Gardner, 1962

Commissaris' Long-tongued Bat

Glossophaga commissarisi Gardner, 1962:1. Type locality "10 kms. S.E. Tonalá, Chiapas, Mexico."

CONTENT AND CONTEXT. Order Chiroptera, Suborder Microchiroptera, Family Phyllostomidae, Subfamily Phyllostominae, Tribe Glossophagini (Baker et al., 1989). The genus *Glossophaga* currently contains five recognized species, a key to which is in Webster and Jones (1984) and Webster (1993). Three subspecies of *Glossophaga commissarisi* currently are recognized (Webster, 1993; Webster and Jones, 1987):

G. c. bakeri Webster and Jones, 1987:2. Type locality "Isla Santa Sofia, 30 km. NW Leticia, Amazonas, Colombia."
G. c. commissarisi Gardner, 1962, see above.
G. c. hespera Webster and Jones, 1982:2. Type locality "Tepehuajes Mine, *ca.* 20 km. N Soyatlán del Oro, Jalisco." México.

DIAGNOSIS. *Glossophaga commissarisi* is a relatively small bat with a moderately elongate rostrum and a prominent noseleaf (Fig. 1). It is the smallest member of the genus in most measurements, particularly those of the wing, rostrum, and toothrows; the upper incisors are not noticeably procumbent, I2 equals or is larger than I1 in bulk; P4 has a conspicuous posterolingual cingular shelf; the parastyle of M1 is directed labially to posterolabially from the paracone; the lower incisors are small, subcircular in occlusal view, with distinct gaps between teeth, the inner pair usually smaller than the outer in bulk; the premaxillae are evenly rounded between the canines and not noticeably elongate; the pterygoid alae are absent; the presphenoid ridge is usually flattened subterminally; the postpalatal processes are poorly developed; the mandibular symphyseal ridge is well developed (Fig. 2; Webster, 1993). In areas where *G. commissarisi* is sympatric with other species of *Glossophaga*, the former is smaller in average external and cranial measurements and darker in pelage coloration, which is Cinnamon Brown to Fuscous dorsally and Avellaneous to Clove Brown ventrally (capitalized terms from Ridgway, 1912; Webster, 1993).

GENERAL CHARACTERS. *Glossophaga commissarisi* exhibits slight secondary sexual dimorphism (Webster, 1993). Females tend to average larger in measurements of the wing and of cranial length, whereas males tend to average larger in those of cranial breadth. Body mass averages (extremes in parentheses) 8.8 (6.8–12) g in males and 9.0 (6.7–12) g in nonparous females from throughout the range of the species (Webster, 1993), whereas individuals of both sexes, including gravid females, of *G. c. commissarisi* from Costa Rica (LaVal and Fitch, 1977) and *G. c. hespera* from Nayarit (Sánchez Hernández and Gaviño de la Torre, 1988) averaged 9.3 (extremes not given) and 10.6 (10.2–11.4) g, respectively. Occasional individuals have small, randomly placed patches of white fur interspersed throughout otherwise normally colored pelage (Webster, 1993).

The three subspecies of *Glossophaga commissarisi* differ in cranial and dental characters, pelage coloration, and size (Webster, 1993). In *G. c. bakeri*, the presphenoid ridge is better developed (rather than noticeably flattened subterminally), the parastyle of M1 is reduced (rather than better developed and directed posterolabially), the upper and lower molars are relatively larger, and the lower incisors are subequal in size (rather than unequal, the outer pair the larger). In *G. c. commissarisi*, the angle between the rostrum and cranium is less abrupt than in other races, the braincase is less domed, and the posterior extension of the presphenoid is well developed and noticeably raised (in ventral view) from the basisphenoid septum. In *G. c. hespera*, the braincase is more domed, the angle between the rostrum and cranium is more abrupt, and the posterior presphenoid extension is small and continuous (in ventral view) with the basisphenoid septum. The pelage of *G. c. commissarisi* averages darker in color than that of *G. c. bakeri* or *G. c. hespera*.

Quantitatively, *G. c. commissarisi* is the smallest of the three subspecies and *G. c. hespera* is the largest, especially in measurements that reflect cranial breadth. Average external measurements (in mm) for males (n = 105) and females (n = 103), respectively, from throughout the range of *G. c. commissarisi* are (Webster, 1993): total length, 59.1, 59.6; length of tail, 6.5 (92 specimens), 7.0 (93 specimens); length of hind foot, 10.2, 10.4; length of ear from notch, 13.5, 13.4. The same measurements for males (n = 12) and females (n = 20), respectively, from throughout the range of *G. c. hespera* are: 59.8, 63.5; 6.1 (11 specimens), 7.4 (19 specimens); 10.3, 10.1; 14.8, 13.8. Average length of forearm and cranial measurements (extremes in parentheses) for a series of males (n = 47) and females (n = 44), respectively, of the nominate subspecies from Costa Rica and Panamá (Webster and Jones, 1982) are: length of forearm, 32.8 (31.3–35.3), 33.6 (32.0–35.3 in 43 specimens); greatest length of skull, 20.1 (19.1–21.0 in 45 specimens), 20.2 (19.7–21.1 in 43 specimens); condylobasal length, 18.4 (17.5–19.2 in 45 specimens), 18.6 (17.9–19.4 in 43 specimens); zygomatic breadth, 9.3 (8.6–9.8), 9.4 (8.8–10.0 in 41 specimens); mastoid breadth, 8.9 (8.5–9.4), 9.0 (8.5–9.5 in 43 specimens); interorbital breadth, 4.0 (3.8–4.3), 4.1 (3.8–4.3); length of maxillary toothrow, 6.8 (6.3–7.1), 6.9 (6.6–7.2); breadth across upper molars, 5.5 (4.8–5.8), 5.6 (5.3–6.0). Corresponding averages for males (n = 12) and females (n = 30), respectively, of *G. c. hespera* from western México (Webster and Jones, 1982) are: 34.4 (32.7–35.6), 35.0 (33.2–36.6 in 28 specimens); 20.6 (20.3–21.1), 20.7 (20.2–21.3 in 29 specimens); 18.7 (18.5–19.1), 18.8 (18.3–19.3 in 29 specimens); 9.6 (9.4–9.9), 9.5 (8.9–9.8 in 27 specimens); 9.2 (9.0–9.4), 9.1 (8.7–9.5); 4.3 (4.2–4.4), 4.2 (3.9–4.4); 6.9 (6.5–7.2), 7.0 (6.7–7.5); 5.7 (5.4–5.9), 5.7 (5.4–5.8). The subspecies *G. c. bakeri* approaches the large size of *G. c. hespera* in external dimensions and measurements that reflect cranial length,

FIG. 1. Photograph of live *Glossophaga commissarisi* (courtesy of Merlin D. Tuttle, Bat Conservation International).

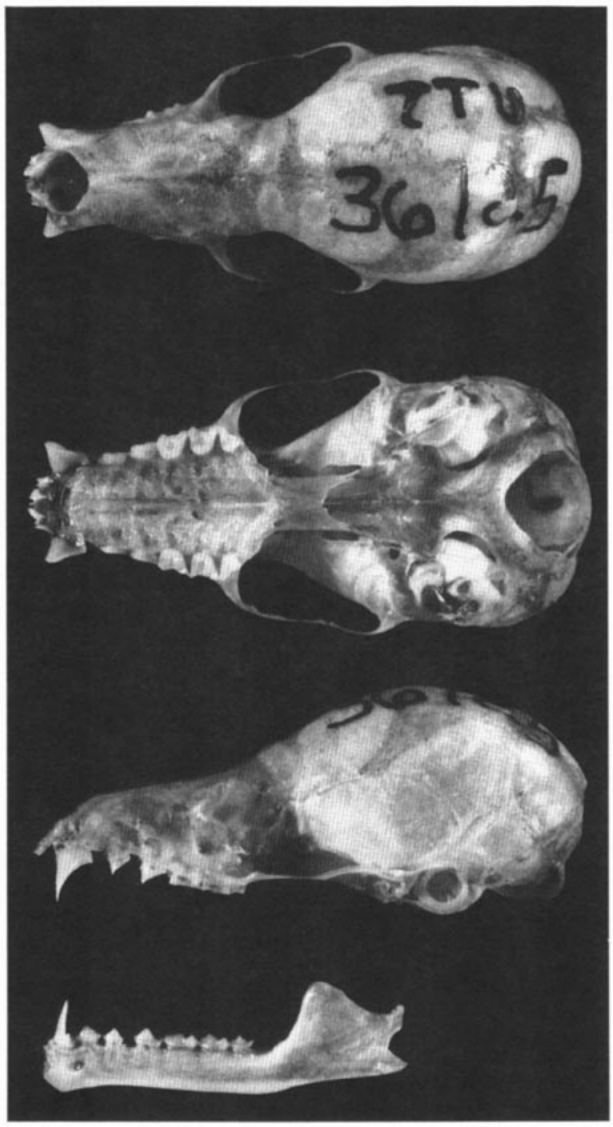

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of lower jaw of *Glossophaga commissarisi commissarisi* (male, The Museum, Texas Tech University, 36125, from Chiapas, México). Greatest length of skull is 20.6 mm. Photograph by N. L. Olson.

but more closely approaches *G. c. commissarisi* in measurements that reflect cranial breadth.

DISTRIBUTION. This bat has a disjunct distribution (Fig. 3). *G. c. hespera* occurs in western México from central Sinaloa and southwestern Durango southward at least to Colima. The nominate race occurs from southern México (central Veracruz and eastern Oaxaca, excluding the Yucatán Peninsula) southeastward to eastern Panamá, and probably occurs in western Columbia as well. *G. c. bakeri* is known from the upper Amazon Basin of southern Colombia, eastern Ecuador and Perú, and western Brazil. Records for *G. c. hespera* and *G. c. commissarisi* are from less than 2,000 m in elevation, whereas those for *G. c. bakeri* are from less than 300 m. Fossils of *G. commissarisi* have not been found.

FORM AND FUNCTION. Little is known about the anatomy and physiology of *G. commissarisi*. Webster (1993) noted two osteological aberrations—an adult male from Costa Rica lacked the joint between the metacarpal and phalanx on the fourth digit, and another male from Chiapas had a small medial invagination on the posterior border of the palate.

Hyperdontia was found in seven of 296 specimens (2.4%) of *G. commissarisi* as follows: two specimens had an extra lower incisor on the right side and five others had an extra premolar between C1 and P3, one on the right side, three on the left side, and one on

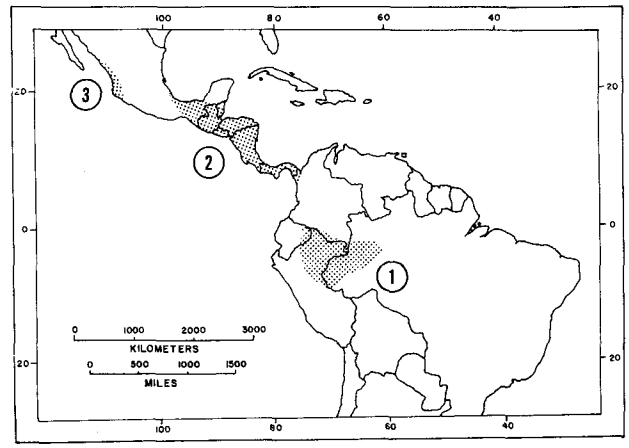

FIG. 3. Geographic distribution of *Glossophaga commissarisi* after Webster and Jones (1982, 1987): 1, *G. c. bakeri*; 2, *G. c. commissarisi*; 3, *G. c. hespera*.

both sides (Webster, 1993). Anodontia of a left i2 was reported in one individual from México (Ramírez-Pulido and Müdespacher, 1987), but Phillips (1971) found no dental anomalies in 101 specimens of *G. commissarisi*.

Compared to other phyllostomids, the wing of *G. commissarisi* is short, with a high aspect ratio and tip index because of its relatively short forearm, long third digit, and long second phalanx of the fifth digit (Smith and Starrett, 1979). The spear and horseshoe of the noseleaf have the same proportions as found in most phyllostomids, but they are smaller than expected given the body size of *G. commissarisi* (Arita, 1990).

The sequence of molt has not been determined in *Glossophaga commissarisi*, but it is probably similar to that of *G. longirostris* (Webster and Handley, 1986) and *G. soricina* (Jones et al., 1973). The timing of molt is broadly asynchronous in *G. commissarisi*, with individuals in the process of molt known from all months from February to September except June, and molt in females is not restricted to reproductively inactive animals (Webster, 1993). Hair from the interscapular region of *G. commissarisi* is similar in morphology to that found in other species of *Glossophaga* (Webster, 1993). The scales are petal-shaped, smooth, imbricate, and two scales surround the shaft of a hair at any given height.

The brain of *Glossophaga commissarisi* is similar in external morphology to those of *G. leachii* and *G. soricina* (McDaniel, 1976). The olfactory bulbs are small and the cerebral hemispheres are short and smooth with angular pseudotemporal lobes. There are few cerebral sulci and the cerebellar foliations are simple.

The relatively large saccular stomachs of *G. commissarisi* and *G. soricina* are similar in that each has a distinct dorsolateral sulcus that separates the fundus from the cardiac portion of the stomach; however, in *G. commissarisi*, as compared to *G. soricina*, the fundic caecum is relatively longer and narrower and the cardiac vestibule and pylorus are more distinctive (Forman et al., 1979). In the intestinal muscosa of *G. commissarisi*, Peyer's patches have relatively large germinal centers (50–70% the total volume of each lymph nodule), indicating a relatively high level of immunological activity in the small intestine (Forman, 1974). As in other phyllostomid species thus far studied, *G. commissarisi* lacks an ileocaecal valve and caecum, and the relatively short colon lacks ascending and transverse segments (Forman et al., 1979).

The urine of *G. commissarisi*, with an average (n = 2) osmotic pressure of 744 mOsm/kg, is more concentrated than that found in frugivorous phyllostomids but less concentrated than that found in sanguivorous, insectivorous, and carnivorous phyllostomids (Studier and Wilson, 1983).

REPRODUCTION. Virtually nothing is known about the reproductive biology of *G. c. bakeri*. Females collected on 28 May and 8 August each carried one embryo with crown–rump lengths of 16.2 and 12.0 mm, respectively, but another taken on 28 June was not reproductively active; a male taken on 24 October had enlarged testes (Webster and Jones, 1987). The reproductive strategy of *G. c. commissarisi* appears to be one of monotocous bimodal polyestry with a postpartum estrus (Webster, 1993), with local

reproductive patterns limited by the seasonal availability of resources (LaVal and Fitch, 1977). There are two peaks in parturition, one from January to April and another from July to November. Lactation is most prevalent in April and May. Testicle size increases from January to May and then decreases until August. The scanty information from 44 females of *G. c. hespera* is reminiscent of bimodal polyestry (Webster and Jones, 1982).

ECOLOGY. *Glossophaga commissarisi* occupies a wide variety of subtropical and tropical habitats including savanna, secondary riparian growth, xeric thorn forest, pine-oak forest, and both pristine and disturbed deciduous and evergreen rain and cloud forests (Gardner, 1962; Handley, 1966; McCarthy, 1987; Medellín, 1988; Nuñez Garduño et al., 1981; Webster and Jones, 1982, 1983, 1987). Using the life zone classification of Holdridge (1967), *G. c. commissarisi* occupies Tropical Moist and Subtropical Moist forests in El Salvador (Hellebuyck et al., 1985), and Tropical Wet, Premontane Moist, and Premontane Wet forests along the Caribbean versant and Tropical Dry Forest along the Pacific coast in Costa Rica (LaVal and Fitch, 1977). Most individuals have been collected in mist nets set across streams, arroyos, and trails in forests or around fruit groves, but others have been taken in villages, probably owing to the proximity of suitable food (Albuja, 1983; Baker and Greer, 1962; Gardner, 1962; Jones, 1964; Jones et al., 1972; McCarthy, 1987; Medellín et al., 1986; Watkins et al., 1972; Webster and Jones, 1983, 1987). Known daytime roosts include caves, culverts, houses, and hollows of living trees (Hellebuyck et al., 1985; Jones et al., 1972; McCarthy, 1987; Webster and Jones, 1982).

Stomach contents of *G. commissarisi* collected in Costa Rica in May contained lepidopterans, fruit (Solananeae, *Acnistus*), and legume (Papilionoideae, *Macuna*) and banana (Musacea, *Musa*) nectar and pollen (Howell and Burch, 1974). Apparently, this species, like its congeners, is rather catholic in diet and opportunistically consumes pollen, nectar, soft fruits, and soft-bodied insects (Gardner, 1977).

Times of capture, recorded from specimen labels of 26 individuals (Webster, 1993), indicate that *G. commissarisi* is most frequently collected before 2100 h (57.7%) or from 2100 to 0000 h (23.1%), with capture rates diminishing from midnight to 0300 h (11.5%) and from 0300 to 0600 h (7.7%). This activity pattern agrees favorably with those exhibited by other phyllostomid species (see for example, Davis and Dixon, 1976).

During a brief study in Costa Rica in which 21 *G. commissarisi* were banded, none was recaptured in 5 subsequent nights of mist-netting (LaVal, 1970). Long-term studies in that country, however, indicate that *G. commissarisi* has a relatively large home range (LaVal and Fitch, 1977). Ten of 48 bats banded at La Selva and 4 of 33 banded at Monteverde were recaptured 9–159 days (mean, 83) and 17–135 days (mean, 59) later, with individuals being recaptured 80–810 m (mean, 428) and 0–1,200 m (mean, 650) from where they were banded, respectively (LaVal and Fitch, 1977).

Trombiculid mites (*Hooperella saccopteryx, H. vesperuginis,* and *Speleocola secunda*) are known to parasitize *G. commissarisi* (Webb and Loomis, 1977).

GENETICS. Commissaris' long-tongued bat has a diploid number of 32 chromosomes that vary in size from large to small (Baker, 1979). All autosomes are biarmed, resulting in a fundamental number of 60, and vary in morphology from metacentric to subtelocentric. The X-chromosome is a medium metacentric and the Y is a minute acrocentric. The 2N = 32, FN = 60 karyotype is primitive for the entire glossophagine clade, and is characteristic of all five species of *Glossophaga* (Baker and Bass, 1979; Baker et al., 1981, 1989; Haiduk and Baker, 1982).

The biochemical genetics of 17 loci in five species of *Glossophaga* were examined (Webster, 1993) and no fixed allelic differences between *G. commissarisi* and its congeners were found. Of the 17 loci examined in four specimens of *G. commissarisi,* 17.7% were polymorphic and average heterozygosity was 0.44.

REMARKS. The generic name *Glossophaga* combines the Greek roots *glossa*, tongue, and *phage*, to eat. The specific name is a patronym honoring Larry R. Commissaris, who died while a graduate student and colleague of A. L. Gardner at the University of Arizona.

LITERATURE CITED

ALBUJA, L. 1983. Murciélagos del Ecuador. Escuela Politécnica Nacional, Quito, Ecuador, xii + 285 pp.

ARITA, H. T. 1990. Noseleaf morphology and ecological correlates in phyllostomid bats. Journal of Mammalogy, 71:36–47.

BAKER, R. H., AND J. K. GREER. 1962. Mammals of the Mexican state of Durango. Publications of The Museum, Michigan State University Biological Series, 2:25–154.

BAKER, R. J. 1979. Karyology. Pp. 107–155, *in* Biology of bats of the New World family Phyllostomatidae. Part III (R. J. Baker, J. K. Jones, Jr., and D. C. Carter, eds.). Special Publications, The Museum, Texas Tech University, 16:1–441.

BAKER, R. J., AND R. A. BASS. 1979. Evolutionary relationship of the Brachyphyllinae to the glossophagine genera *Glossophaga* and *Monophyllus*. Journal of Mammalogy, 60:364–372.

BAKER, R. J., R. L. HONEYCUTT, M. L. ARNOLD, V. M. SARICH, AND H. H. GENOWAYS. 1981. Electrophoretic and immunological studies on the relationships of the Brachyphyllinae and the Glossophaginae. Journal of Mammalogy, 62:665–672.

BAKER, R. J., C. S. HOOD, AND R. L. HONEYCUTT. 1989. Phylogenetic relationships and classification of the higher categories of the New World bat family Phyllostomidae. Systematic Zoology, 38:228–238.

DAVIS, W. B., AND J. R. DIXON. 1976. Activity of bats in a small village clearing near Iquitos, Peru. Journal of Mammalogy, 57: 747–749.

FORMAN, G. L. 1974. Structure of Peyer's patches and their associated nodules in relation to food habits of New World bats. Journal of Mammalogy, 55:738–746.

FORMAN, G. L., C. J. PHILLIPS, AND C. S. ROUK. 1979. Alimentary tract. Pp. 205–227, *in* Biology of bats of the New World family Phyllostomatidae. Part III (R. J. Baker, J. K. Jones, Jr., and D. C. Carter, eds.). Special Publications, The Museum, Texas Tech University, 16:1–441.

GARDNER, A. L. 1962. A new bat of the genus *Glossophaga* from Mexico. Los Angeles County Museum, Contributions to Science, 54:1–7.

———. 1977. Feeding habits. Pp. 293–350, *in* Biology of bats of the New World family Phyllostomatidae (R. J. Baker, J. K. Jones, Jr., and D. C. Carter, eds.). Special Publications, The Museum, Texas Tech University, 13:1–364.

HAIDUK, M. W., AND R. J. BAKER. 1982. Cladistic analysis of G-banded chromosomes of nectar feeding bats (Glossophaginae: Phyllostomidae). Systematic Zoology, 31:252–265.

HANDLEY, C. O., JR. 1966. Checklist of mammals of Panama. Pp. 753–795, *in* Ectoparasites of Panama (R. L. Wenzel and V. J. Tipton, eds.). Field Museum of Natural History, Chicago, xii + 861 pp.

HELLEBUYCK, V., J. R. TAMSITT, AND J. G. HARTMAN. 1985. Records of bats new to El Salvador. Journal of Mammalogy, 66: 783–788.

HOLDRIDGE, L. R. 1967. Life zone ecology. Tropical Sciences Center, San José, Costa Rica, 296 pp.

HOWELL, D. J., AND D. BURCH. 1974. Food habits of some Costa Rican bats. Revista de Biología Tropical, 21:281–294.

JONES, J. K., JR. 1964. Bats new to the fauna of Nicaragua. Transactions of the Kansas Academy of Science, 67:506–508.

JONES, J. K., JR., J. R. CHOATE, AND A. CADENA. 1972. Mammals from the Mexican state of Sinaloa. II. Chiroptera. Occasional Papers of the Museum of Natural History, The University of Kansas, 6:1–29.

JONES, J. K., JR., J. D. SMITH, AND H. H. GENOWAYS. 1973. Annotated checklist of mammals of the Yucatan Peninsula, Mexico. I. Chiroptera. Occasional Papers, The Museum, Texas Tech University, 13:1–31.

LAVAL, R. K. 1970. Banding returns and activity periods of some Costa Rican bats. The Southwestern Naturalist, 15:1–10.

LAVAL, R. K., AND H. S. FITCH. 1977. Structure, movements and reproduction in three Costa Rican bat communities. Occasional Papers of the Museum of Natural History, University of Kansas, 69:1–28.

MCCARTHY, T. J. 1987. Distributional records of bats from the Caribbean lowlands of Belize and adjacent Guatamala and Mexico. Pp. 137–162, *in* Studies in Neotropical mammalogy: essays in honor of Philip Hershkovitz (B. D. Patterson and R. M. Timm, eds.). Fieldana Zoology, New Series, 39:1–506.

MCDANIEL, V. R. 1976. Brain anatomy. Pp. 147–200, *in* Biology of bats of the New World family Phyllostomatidae. Part I (R. J. Baker, J. K. Jones, Jr., and D. C. Carter, eds.). Special Publications, The Museum, Texas Tech University, 10:1–218.

MEDELLÍN, R. A. 1988. Prey of *Chrotopterus auritus*, with notes on feeding behavior. Journal of Mammalogy, 69:841–844.

MEDELLÍN, R. A., G. URBANO-VIDALES, O. SÁNCHEZ-HERRERA, G. TÉLLEZ-GIRÓN, AND H. ARITA W. 1986. Notas sobre murciélagos del este de Chiapas. The Southwestern Naturalist, 31: 532–535.

NUÑEZ GARDUÑO, A., C. B. CHÁVEZ T., AND C. SÁNCHEZ H. 1981. Mamíferos silvestres de la región de el Tuito, Jalisco, México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, 51:647–668.

PHILLIPS, C. J. 1971. The dentition of glossophagine bats: development, morphological characteristics, variation, pathology, and evolution. Miscellaneous Publications of the Museum of Natural History, University of Kansas, 54:1–138.

RAMÍREZ-PULIDO, J., AND C. MÜDESPACHER. 1987. Fórmulas dentarias anormales en algunos murciélagos mexicanos. Acta Zoológica Méxicana, Nueva Serie, 23:1–54.

RIDGWAY, R. 1912. Color standards and color nomenclature. Privately published, Washington, D. C., xiii + 43 pp.

SÁNCHEZ HERNÁNDEZ, C., AND G. GAVIÑO DE LA TORRE. 1988. Registros de murciélagos para la Isla de Peña, Nayarit, México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología, 58(1987):939–940.

SMITH, J. D., AND A. STARRETT. 1979. Morphometric analysis of chiropteran wings. Pp. 229–316, *in* Biology of bats of the New World family Phyllostomatidae. Part III (R. J. Baker, J. K. Jones, Jr., and D. C. Carter, eds.). Special Publications, The Museum, Texas Tech University, 16:1–441.

STUDIER, E. H., AND D. E. WILSON. 1983. Natural urine concentrations and composition in Neotropical bats. Comparative Biochemistry and Physiology, A. Comparative Physiology, 75: 509–515.

WATKINS, L. C., J. K. JONES, JR., AND H. H. GENOWAYS. 1972. Bats of Jalisco, México. Special Publications, The Museum, Texas Tech University, 1:1–44.

WEBB, J. P., JR., AND R. B. LOOMIS. 1977. Ectoparasites. Pp. 57–119, *in* Biology of bats of the New World family Phyllostomatidae. Part II (R. J. Baker, J. K. Jones, Jr., and D. C. Carter, eds.). Special Publications, The Museum, Texas Tech University, 13:1–364.

WEBSTER, W. D. 1993. Systematics and evolution of bats of the genus Glossophaga. Special Publications, The Museum, Texas Tech University, 36:1–184.

WEBSTER, W. D., AND C. O. HANDLEY, JR. 1986. Systematics of Miller's long-tongued bat, Glossophaga longirostris, with description of two new subspecies. Occasional Papers, The Museum, Texas Tech University, 100:1–22.

WEBSTER, W. D., AND J. K. JONES, JR. 1982. A new subspecies of Glossophaga commissarisi (Chiroptera: Phyllostomidae) from western Mexico. Occasional Papers, The Museum, Texas Tech University, 76:1–6.

———. 1983. First record of *Glossophaga commissarisi* (Chiroptera: Phyllostomidae) from South America. Journal of Mammalogy, 64:150.

———. 1984. Glossophaga leachii. Mammalian Species, 226: 1–3.

———. 1987. A new subspecies of Glossophaga commissarisi (Chiroptera: Phyllostomidae) from South America. Occasional Papers, The Museum, Texas Tech University, 109:1–6.

Editors of this account were GUY N. CAMERON and KARL F. KOOPMAN. Managing editor was JOSEPH F. MERRITT.

W. D. WEBSTER, DEPARTMENT OF BIOLOGICAL SCIENCES, UNIVERSITY OF NORTH CAROLINA AT WILMINGTON, WILMINGTON 28403; J. K. JONES, JR., DEPARTMENT OF BIOLOGICAL SCIENCES AND THE MUSEUM, TEXAS TECH UNIVERSITY, LUBBOCK 79409.