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Platyrrhinus helleri.

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Platyrrhinus Saussure, 1860

Platyrrhinus Saussure, 1860:429. Type species *Phyllostoma lineatum* Geoffroy St.-Hilaire, 1810:180, by subsequent designation (Thomas, 1900:269).

Vampyrops Peters, 1865:356. Replacement name for *Platyrrhinus* Saussure, presumed to be preoccupied by *Platyrrhinus* Clairville, 1798 (a beetle).

CONTEXT AND CONTENT. Order Chiroptera, Suborder Microchiroptera, Family Phyllostomidae, Subfamily Stenodermatinae, Genus *Platyrrhinus*. The genus *Platyrrhinus* contains eight species. A key to the species follows (measurements in mm; M. R. Willig, in litt.):

1 Length of forearm >50 2
Length of forearm <50 4
2 Pelage dark, almost black; facial and dorsal stripes distinct; conspicuous fringe of hair on interfemoral membrane 3
Pelage paler, almost buff; facial and dorsal stripes indistinct; slight fringe of hair on interfemoral membrane ..... *P. infuscus*
3 Length of forearm >55 ..... *P. vittatus*
Length of forearm <55 ..... *P. aurarius*
4 Length of forearm between 40.5 and 50 5
Length of forearm <40.5 7
5 Pelage pale or yellow brown; facial and dorsal stripes conspicuously white; conspicuous fringe of hair on interfemoral membrane 6
Pelage darker brown; facial and dorsal stripes buff-colored; slight fringe of hair on interfemoral membrane ..... *P. dorsalis*
6 Bilobed lower incisors ..... *P. lineatus*
Trilobed lower incisors ..... *P. recifinus*
7 One small accessory cusp on anterior margin of second lower premolar ..... *P. helleri*
Two small accessory cusps on anterior margin of second lower premolar ..... *P. brachycephalus*

Platyrrhinus helleri (Peters, 1866)

Heller's Broad-nosed Bat

Vampyrops helleri Peters, 1866:392. Type locality "Mexico."

Vampyrops zarhinus Allen, 1891:400. Type locality "Brazil" (corrected to Bas Obispo, Canal Zone, Panamá, by Goldman, 1920).

Vampyrops zarhinus incarum Thomas, 1912:408. Type locality "Pozuzo, Peru."

Platyrrhinus helleri: Hall and Kelson, 1959:131. First use of current name combination.

CONTEXT AND CONTENT. Context as in generic summary above. *P. helleri* is currently considered monotypic, although the name *P. h. incarum* is available for the South American populations east of the Andes, should subspecies be recognized (Jones and Carter, 1976; Koopman, 1978).

DIAGNOSIS. *Platyrrhinus helleri* can be distinguished from all other species of the genus except *P. brachycephalus* by its smaller size. *P. helleri* is further distinguished by its distinct white or cream-colored facial stripes and a conspicuous fringe of hair on the free edge of the interfemoral membrane (Gardner and Carter, 1972). *P. helleri* has more distinctive facial markings and is smaller in size and paler in color than *P. lineatus*. *P. recifinus* is larger than *P. helleri*.

Platyrrhinus helleri is most easily distinguished from *P. brachycephalus* by a single, usually weakly-developed anterior accessory cusp on the anterior edge of the second lower premolar, whereas *P. brachycephalus* has two well-developed anterior accessory cusps. Another major distinguishing feature is the shape of the skull. *P. helleri* has a relatively narrow, elongate rostrum and narrow zygoma, whereas *P. brachycephalus* has a short, broad rostrum, wider zygoma, and a slightly more inflated braincase (Rouk and Carter, 1972).

Platyrrhinus helleri is similar in external appearance to *Uroderma bilobatum* in some areas and may be difficult to distinguish in the field (Tamsitt and Valdivieso, 1963). However, the interfemoral membrane of *P. helleri* is narrow, the posterior margin is an inverted "V," and is densely furred along its free edge. The skull of *P. helleri* is similar to that of *U. bilobatum*, but the upper incisors are unequal with the inner more than twice the height of the outer. The cutting edges of the upper incisors are trifid, but cusps may be lost through wear. The crowns of the upper incisors are obliquely set and in contact at the tip. The third upper and third lower molars are present but small (Goodwin and Greenhall, 1961).

GENERAL CHARACTERS. *Platyrrhinus helleri* is a medium-sized bat with four distinct white or cream-colored facial stripes (Fig. 1). Two broad stripes extend from the nose-leaf to above the ear and two stripes extend from the corners of the mouth to the base of the ears (Goodwin, 1946). The color of the dorsal pelage has been described as pale, buffy brown to medium brown (Gardner and Carter, 1972), warm buffy brown (Hall, 1981), and snuff brown (Goodwin and Greenhall, 1961) with a white or cream-colored line extending from the top of the head down the midline of the back. The ventral pelage is usually paler than the dorsal pelage. The wing membranes are brown to blackish brown with the upper and lower surfaces furred beyond the elbow and along the proximal part of the forearm with whitish to pale buffy fur (Gardner and Carter,

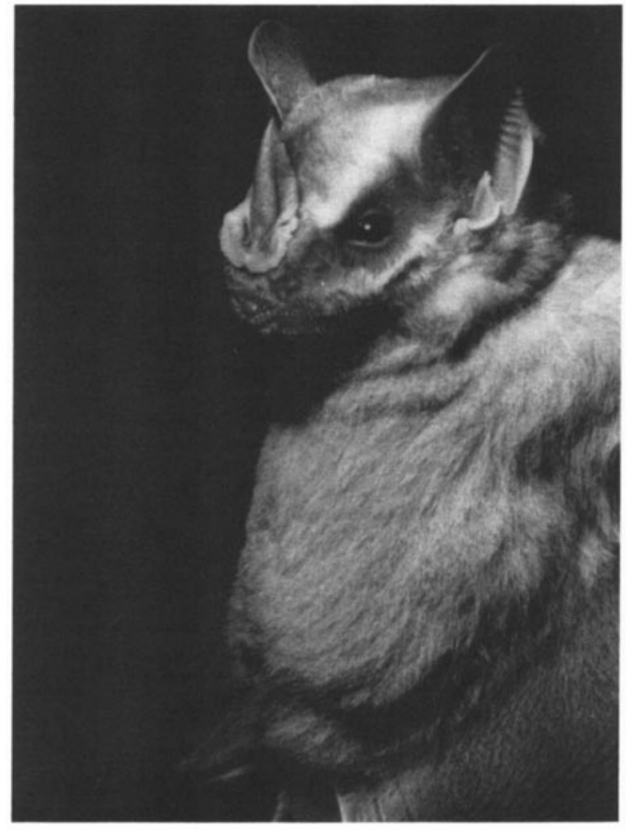

FIG. 1. *Platyrrhinus helleri* from Costa Rica. Photograph by B. L. Clauson.

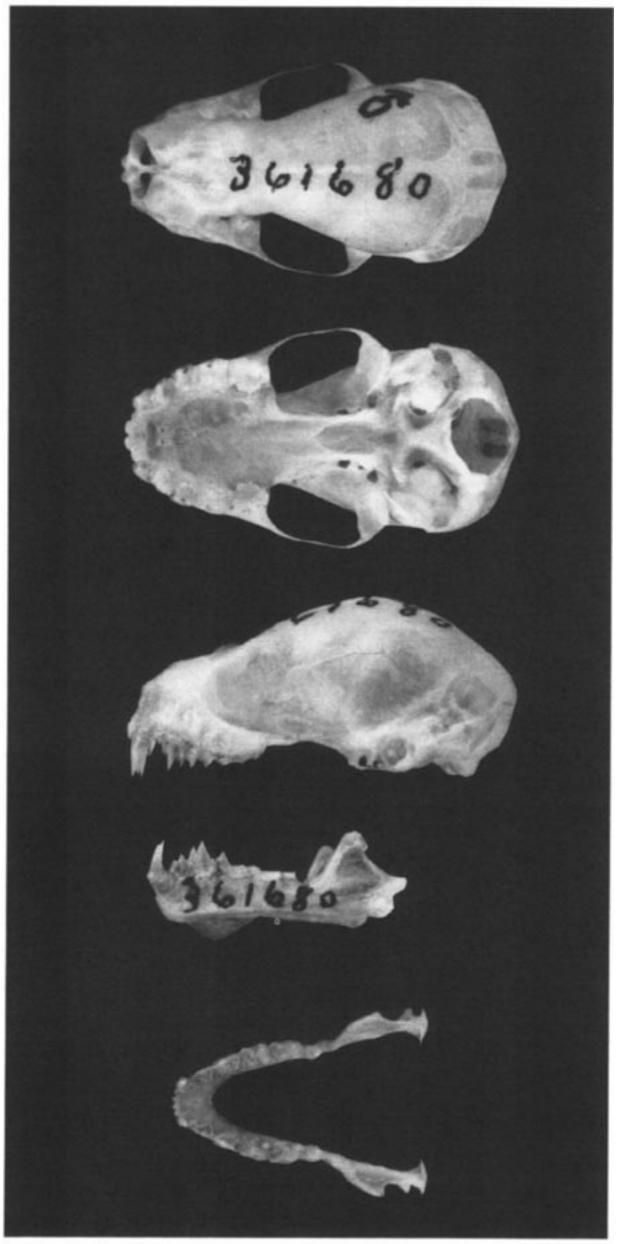

FIG. 2. Dorsal, ventral, and lateral views of cranium, and lateral and dorsal views of mandible, of a male *Platyrrhinus helleri* from Belém, Pará, Brazil (United States National Museum 361680). Greatest length of skull is 23.0 mm.

1972). The hind limbs and feet are more or less furred to the claws (Goodwin and Greenhall, 1961).

The uropatagium is short, narrow, V-shaped, and thinly haired, but the free edge has a conspicuous fringe of stiff, white hairs (Husson, 1962). The plagiopatagium attaches to the metatarsal region. There is no tail.

The dental formula of *P. helleri* is i 2/2, c 1/1, p 2/2, m 3/3, total 32 (Owen, 1987). The upper incisors are unequal in size (Fig. 2). The upper inner incisors are usually not strongly convergent and sometimes touch distally, and the cutting edges are trifid. The upper outer incisors are small and medially inclined and the cutting edges are bifid. The lower incisors have bifid cutting edges and form a straight row filling the space between canines (Husson, 1962). The second upper premolar contains a long primary cusp and two well-defined, posterior accessory cusps. The lower second premolars have a large, well-developed primary cusp and a small, weakly developed anterior accessory cusp. There also are one to three weakly to moderately developed posterior accessory cusps, which often give the posterobasal portion of the tooth a serrate appearance in lateral view (Gardner and Carter, 1972).

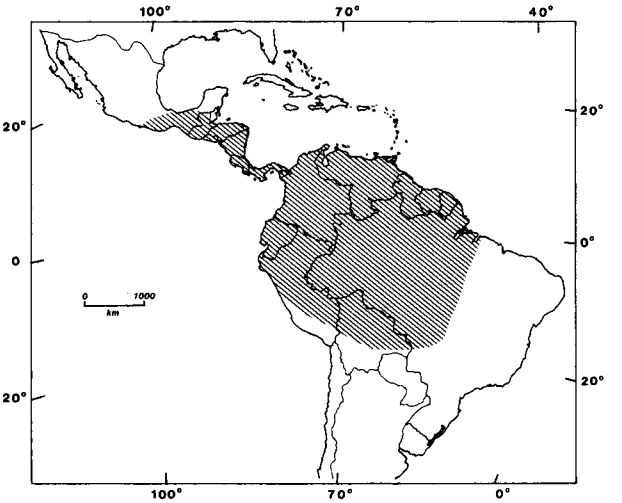

FIG. 3. Distribution of *Platyrrhinus helleri*.

Ears are rounded with pronounced indentations of the latero-posterior border of the pinna and medio-anterior border of the pinna to the point of attachment to the head (Owen, 1987). The tragus is short and triangular, and is about one-third to one-fourth of the total length of the ear (Husson, 1962). The inner edge of the tragus is thick and puffy and the thinner outer edge is dully serrated, with an almost bilobed process at the base (Peters, 1866).

The nose leaf of *P. helleri* is sharply pointed and lancet-shaped with a wide lancet-shaped medial prominence. The upper lip is finely crenate and the lower lip contains a rounded transverse prominence, which lies between two smaller ones in the middle. A row of warts forms an obtuse angle on the lower lip (Peters, 1866).

Means (calculated from specimens in the United States National Museum of Natural History) and ranges (including those published in cited literature) of external measurements (in mm) are: total length of body, 58.2 (50–66), n = 24; length of hind foot, 11.5 (9–14), n = 23; length of ear, 17.1 (15–19), n = 24; length of forearm, 38.1 (35.0–41.3), n = 14; wing spread, 304 (289–329), n = 4; weight in grams, 15.6 (13.2–18.9), n = 4 (Davis et al., 1964; Gardner and Carter, 1972; Goodwin, 1946; Goodwin and Greenhall, 1961; Hall, 1981; Husson, 1962; Linares, 1968; Rick, 1968; Robinson and Lyon, 1901; Rouk and Carter, 1972; Sanborn, 1955; Starrett and de la Torre, 1964; Swanepoel and Genoways, 1979). Means and ranges of cranial measurements (in mm) of adults are as follows: greatest length of skull, 22.2 (20.0–23.8), n = 35; condylobasal length, 19.4 (18.8–21.3), n = 33; zygomatic breadth, 12.5 (11.8–13.1), n = 33; postorbital constriction, 5.4 (5.1–5.7), n = 33; breadth of braincase, 9.2 (8.8–10.0), n = 30; length of maxillary tooth row, 7.8 (7.3–8.5), n = 37; breadth across upper molars, 9.0 (8.4–9.8), n = 35 (Goodwin, 1942; Rick, 1968; Rouk and Carter, 1972; Starrett and de la Torre, 1964; Swanepoel and Genoways, 1979).

DISTRIBUTION. *Platyrrhinus helleri* ranges from southern México (Chiapas, Oaxaca, Tabasco, Veracruz; Rámirez-Pulido et al., 1983) southward through Central America and South America to Perú (Baud, 1986), Bolivia (Anderson et al., 1982; Koopman, 1976), and Amazonian (Belém, Pará; Handley, 1967), and central (Serra do Roncador, Mato Grosso; Pine et al., 1970) Brazil. Specimens also are known from Trinidad (Goodwin and Greenhall, 1961).

Platyrrhinus helleri has been categorized as a lowland species (Koopman, 1978). Specimens collected in Venezuela were caught at elevations of 1–1,537 m; however, 99% were caught below 1,000 m (Handley, 1976). Altitudinal limits in Perú were between 150 and 850 m (Gardner and Carter, 1972). There is no fossil record of this species, although Linares (1968) reported subfossil remains from Venezuela.

FORM AND FUNCTION. Frugivorous bats reflect a generalized style of flight, with wings that are broad and roughly elliptical in outline (Smith and Starrett, 1979; Vaughan, 1970). Four specimens of *P. helleri* from Nicaragua had an average weight of 13.3 g, wing span of 27.0 cm, wing area of 112.36 cm^2, uropatagial area of 1.9 cm^2, percentage of wing area comprised by the uropa-

tagium of 1.7%, wing loading of 0.116 g/cm², and aspect ratio of 6.40 (Lawlor, 1973).

In general, brains of species of *Platyrrhinus* have large cerebral hemispheres with deep sulci and high convolutions, and a relatively complex pattern of foliation of the cerebellum. *P. helleri* has the least convoluted cerebrum and the shallowest cerebral sulci among species studied to date. In *P. helleri*, the posterior portions of the inferior colliculi are exposed dorsally rather than being covered by the cerebral hemispheres as in other species in the genus (McDaniel, 1976).

Mean cochlear height of *P. helleri* is 2 mm. Cochlear height is not correlated with body size (weight). The major component of the echolocation pulses is high (108 kc/s), with the lesser component at 72 kc/s; the pulses are of short duration. Harmonic components are present (Pye, 1967).

The stomach of *P. helleri* differs from that of *Uroderma* only slightly in that the caecum is somewhat broader. The rugae of the stomach wall are distributed diagonally within the caecum. The mucous neck cells within the upper portions of fundic gland tubules react with Hale's colloidal iron indicating the presence of gastric acid mucopolysaccharides. The pyloric valve flap is so long that the apex is directed up into the duodenum, perhaps improving the efficiency of gastric closure. This might help to delay gastric emptying and improve digestion by increasing time in these plant feeders (Forman et al., 1979).

The structure and size of the sperm head varies within the genus *Platyrrhinus*. That of *P. helleri* is unusually long and closely resembles that of *Artibeus jamaicensis*. A specimen from Trinidad had a long and narrow head, and a relatively long nucleus as compared with other species. The narrow and asymmetric acrosome appears to be slightly narrower than the nucleus and a substantial portion of it lies anterior to the apex of the nucleus. The apex of the acrosome is narrowly rounded to pointed and the posterior portion terminates midway along the length of the nucleus. The nucleus is strongly ovoid with a concave base. The apex of the nucleus is rounded. The junction of the neck and head is slightly off center, and there is a distinctive junction between the tail and the long, slender midpiece (Forman and Genoways, 1979).

Natural urine osmotic pressures ranging from 365 to 610 mOsm/kg were measured in *P. helleri* from Panamá. Urinary sodium was 53 mEq/l and urinary potassium was 47 mEq/l in one specimen (Studier and Wilson, 1983).

ONTOGENY AND REPRODUCTION. Pregnant females have been reported from México in July (Davis et al., 1964), Honduras in August (LaVal, 1969), El Salvador in June and August (LaVal, 1969), Nicaragua in March, April, June, July, and August (Jones et al., 1971), Costa Rica in March (Mares and Wilson, 1971), Panamá in January (Fleming et al., 1972), Trinidad in July and August (Carter et al., 1981), and from Perú in August (Gardner and Carter, 1972). Lactating females have been reported from México in May (Villa-R., 1966), Guatemala in May (Rick, 1968), Costa Rica in August (Starrett and de la Torre, 1964), and Trinidad in August (Carter et al., 1981). Although there are no reported fertilization or implantation data, *P. helleri* is considered bimodally polyestrous (Fleming et al., 1972) with the first birth period beginning during the second half of the dry season (March or April), and the second birth period beginning in the middle of the wet season (July or August). Weaning of the single young probably occurs after the beginning of the wet season, coinciding with the maximum abundance of food and resulting in the most energetically favorable time to rear young (Wilson, 1979).

ECOLOGY. *Platyrrhinus helleri* is most often found in humid tropical forest environments, although specimens have been caught in arid tropical vegetation at Chiapa de Corzo, Chiapas, Mexico (Davis et al., 1964), and in the semi-arid environment of the Cosiguina Peninsula in northwestern Nicaragua (Jones et al., 1971). In Venezuela, 78% of 821 specimens were mistnetted in moist habitats of primarily evergreen forests (Handley, 1976). In captivity, animals survived well at temperatures between 21.1 and 29.4°C and relative humidities between 55 and 95% (Greenhall, 1976).

Platyrrhinus helleri roosts in caves or tunnels, in culverts or bridges, in foliage or under branches, in hollow trees, in buildings, and under large leaves or palm fronds (Tuttle, 1976). Specimens have been netted in Belize along or in the proximity of waterways (McCarthy, 1987), and in Perú in disturbed, humid tropical forests

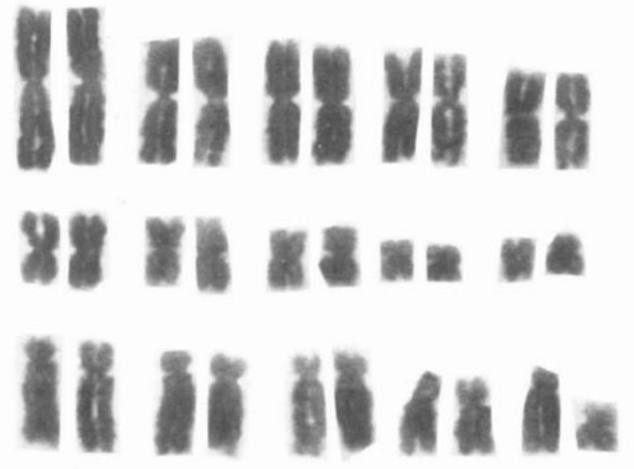

FIG. 4. Karyotype of *Platyrrhinus helleri*.

of the Amazonian drainage at elevations from 150 to 860 m (Gardner and Carter, 1972). *P. helleri* was most frequently caught in the subcanopy level of humid tropical forest in Panamá (Bonaccorso, 1978), and was collected in or near banana (*Musa paradisiaca*) groves in Veracruz (Carter et al., 1966) and in Nicaragua (Jones et al., 1971).

Platyrrhinus helleri was categorized by Bonaccorso (1978) as a canopy frugivore. It forages primarily on fruits that grow in the trees of the canopy and subcanopy level of the forest. He described *P. helleri* as a rare, fig (*Ficus*) specialist. When the stomach contents of six specimens were analyzed, 67% of the contents was *Ficus*, and the most important species consumed was *F. insipida*. *P. helleri* also eats insects. Of 10 bats from Costa Rica whose stomach contents were analyzed, two contained fruit (*Cecropia* sp.) and insects (Lepidoptera), and eight others had been feeding on fruits of *Acnistus* (Howell and Burch, 1974).

On Barro Colorado Island, Panamá, food niche overlap occurs between *P. helleri* and *Artibeus phaeotis*, which also is a fig specialist. *P. helleri* also may overlap with other fig eaters such as *Chiroderma villosum* (of similar weight), or the somewhat larger *Vampyrodes caraccioli*, *A. jamaicensis*, and *A. lituratus* (Bonaccorso, 1978).

The following ectoparasites have been recorded (Webb and Loomis, 1977) from *P. helleri*: Bat-mites—*Alabidocarpus furmani*, *A. jonesi* (Labidocarpidae), *Eutrombicula nadchatrami* (Trombiculidae), *Periglischrus iheringi* (Spinturnicidae), *Phyllostomonyssus conradyunkeri* (Gastronyssidae); batflies—*Basilia astochia* (Nycteribiidae), *Paratrichobius* sp. (Streblidae); and ticks—*Amblyomma* sp. (Ixodidae), *Ornithodoros hasei* (Argasidae). The only virus reported for this species is Itaporanga virus from Brazil (Jones, 1976).

BEHAVIOR. Based on captures in mist nets, Fenton and Kunz (1977) suggested that *P. helleri* was active from late evening to approximately 1 h before dawn. Capture rate of *P. helleri* in mist nets at a site near Iquitos, Perú, was recorded hourly. Between 1830 and 2000 h, nine bats were captured and four were captured between 2100 and 2300 h. Because of the small number of *P. helleri* caught as compared with other species in the same net, it was suspected that the numbers did not reflect the relative abundance of each species, but rather measured their susceptibility to being caught in mist nets (Davis and Dixon, 1976).

Under simulated environmental conditions, a *P. helleri* was subjected to food deprivation for 1 night. The bat went into torpor and body temperature taken at 1400 h following food deprivation was considerably lower than on days following normal feeding activity (mean body temperature after food deprivation, 29.6°C; mean body temperature after normal feedings, 37.3°C). The bat exhibited signs of lethargy, was unable to fly when approached or prodded, and made no audible noises. These data suggest that in the absence of food, darkness does not stimulate arousal (Rasweiler, 1973). The observations of estivation in *P. helleri* conflict with previous conclusions that phyllostomid bats are true homeotherms and do not exhibit torpor (Carpenter and Graham, 1967; McNab, 1969; Morrison and McNab, 1967).

GENETICS. The karyotype of *P. helleri* has a diploid number of 30 chromosomes and a fundamental number of 56 (Fig. 4). The X chromosome is subtelocentric and the Y chromosome is submetacentric (Baker et al., 1982). Baker (1967) proposed the synonymy of the subfamily Sturnirinae with Stenodermatinae because of the close similarity of karyotypes of *Sturnira lilium* and *P. helleri*. This arrangement was supported by Gerber and Leone (1971), who noted immunological similarities of *P. helleri* to *Uroderma bilobatum* as well as to *S. lilium*. Smith (1976:62) included these three along with *Vampyressa* and *Vampyrodes* as one of two clades in his "long-faced" lineage. Biochemical studies by Straney et al. (1979) did not support synonymy for the two subfamilies, but did suggest a close relationship between the genera *Platyrrhinus* and *Artibeus*.

REMARKS. Peters (1865:356, footnote) proposed the name *Vampyrops* to replace *Platyrrhinus* Saussure, 1860, which he believed to be preoccupied by *Platyrhinus* Schellenberg, 1798, an anthribid beetle (de la Torre and Starrett, 1959). Fabricius' (1801) subsequent use of *Platyrrhinus* (double-r spelling) for the beetle in a synonymy was an incorrect subsequent spelling rather than an emendation of the name *Platyrhinus* Schellenberg, 1798 (single-r spelling). Therefore the name *Platyrrhinus* Saussure, 1860 antedates the name *Vampyrops* Peters, 1866, is not antedated by any synonym or homonym, and consequently should be used for this bat genus (Hall, 1981; Hall and Kelson, 1959). Thomas (1900) fixed *Phyllostoma lineatum* Geoffroy as the type species for *Vampyrops*, which action also fixed *Phyllostoma lineatum* as the type of *Platyrrhinus* Saussure, 1860, barring any prior restriction (Gardner and Ferrell, 1990).

The record of *P. helleri* from Paraguay (Sherman, 1955) was actually based on a specimen of *Pygoderma bilabiatum*, subsequently correctly identified by K. F. Koopman.

The name *Platyrrhinus* is derived from the Greek *platys*, meaning flat, broad, or wide, and *rhinos*, meaning nose. The specific epithet is a patronym for Edmund Heller, who collected the type specimen in Mexico.

We thank T. H. Fleming, A. L. Gardner, C. O. Handley, Jr., and T. J. McCarthy for reading an earlier version of the manuscript. C. J. Angle prepared the map, R. J. Baker supplied us with the karyogram, B. L. Clauson took the photograph for Fig. 1, and R. V. Peterson provided assistance with the parasites.

LITERATURE CITED

ALLEN, H. 1891. Description of a new species of *Vampyrops*. Proceedings of the Academy of Natural Sciences of Philadelphia, 43:400–405.

ANDERSON, S., K. F. KOOPMAN, AND G. K. CREIGHTON. 1982. Bats of Bolivia: an annotated checklist. American Museum Novitates, 2750:1–24.

BAKER, R. J. 1967. Karyotypes of bats of the family Phyllostomidae and their taxonomic implications. The Southwestern Naturalist, 12:407–428.

BAKER, R. J., M. W. HAIDUK, L. W. ROBBINS, A. CADENA, AND B. F. KOOP. 1982. Chromosomal studies of South American bats and their systematic implications. Pp. 303–327, *in* Mammalian biology in South America (M. A. Mares and H. H. Genoways, eds.). Special Publication Series, Pymatuning Laboratory of Ecology, University of Pittsburgh, 6:1–539.

BAUD, F. J. 1986. Chiroptères récoltés par l'expédition de l'IRSNB au sud-est du Pérou. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique: Biologie, 56:45–49.

BONACCORSO, F. J. 1978. Foraging and reproductive ecology in a Panamanian bat community. Bulletin of the Florida State Museum, Biological Sciences, 24:359–408.

CARPENTER, R. E., AND J. B. GRAHAM. 1967. Physiological responses to temperature in the long-nosed bat, *Leptonycteris sanborni*. Comparative Biochemistry and Physiology, 22:709–722.

CARTER, C. H., H. H. GENOWAYS, R. S. LOREGNARD, AND R. J. BAKER. 1981. Observations on bats from Trinidad with a checklist of species occurring on the island. Occasional Papers, The Museum, Texas Tech University, 72:1–27.

CARTER, D. C., R. H. PINE, AND W. B. DAVIS. 1966. Notes on Middle American bats. The Southwestern Naturalist, 11:488–499.

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.

DAVIS, W. B., D. C. CARTER, AND R. H. PINE. 1964. Noteworthy records of Mexican and Central American bats. Journal of Mammalogy, 45:375–387.

DE LA TORRE, L., AND A. STARRETT. 1959. Name changes and nomenclatural stability. Natural History Miscellanea, 167:1–4.

FABRICIUS, J. C. 1801. Systema Eleutheratorum Secundum ordines, genera, species, adjectis synonomis, locis, observationibus, descriptionibus. Bibliopolii Academici Novi, Kiliae, 2:1–687.

FENTON, M. B., AND T. H. KUNZ. 1977. Movements and behavior. Pp. 351–364, *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.

FLEMING, T. H., E. T. HOOPER, AND D. E. WILSON. 1972. Three Central American bat communities: structure, reproductive cycles, and movement patterns. Ecology, 53:555–569.

FORMAN, G. L., AND H. H. GENOWAYS. 1979. Sperm morphology. Pp. 177–204, *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.

FORMAN, G. L., C. J. PHILLIPS, AND C. S. ROUK. 1979. Alimentary tract. Pp. 205–228, *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., AND C. S. FERRELL. 1990. Comments on the nomenclature of some Neotropical bats (Mammalia: Chiroptera). Proceedings of the Biological Society of Washington, 103:501–508.

GARDNER, A. L., AND D. C. CARTER. 1972. A review of the Peruvian species of *Vampyrops* (Chiroptera: Phyllostomatidae). Journal of Mammalogy, 53:72–82.

GERBER, J. D., AND C. A. LEONE. 1971. Immunologic comparisons of the sera of certain phyllostomatid bats. Systematic Zoology, 20:160–166.

GEOFFROY ST.-HILAIRE, E. 1810. Sur les Phyllostomes et les megadermes, deux genres de la famille des chauve-souris. Annales du Museum d'Histoire Naturelle, Paris, 15:157–198.

GOLDMAN, E. A. 1920. Mammals of Panama. Smithsonian Miscellaneous Collections, 69:1–309.

GOODWIN, G. G. 1942. Mammals of Honduras. Bulletin of the American Museum of Natural History, 79:107–195.

———. 1946. Mammals of Costa Rica. Bulletin of the American Museum of Natural History, 87:271–474.

GOODWIN, G. G., AND A. M. GREENHALL. 1961. A review of the bats of Trinidad and Tobago. Bulletin of the American Museum of Natural History, 122:187–302.

GREENHALL, A. M. 1976. Care in captivity. Pp. 89–132, *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.

HALL, E. R. 1981. The mammals of North America. Second edition. John Wiley and Sons, New York, 1:1–600 + *90*.

HALL, E. R., AND K. R. KELSON. 1959. The mammals of North America. The Ronald Press Company, New York, 1:1–546 + *79*.

HANDLEY, C. O., JR. 1967. Bats of the canopy of an Amazonian forest. Atas do Simpósio sôbre a Biota Amazônica, 5:211–215.

———. 1976. Mammals of the Smithsonian Venezuelan project. Brigham Young University Science Bulletin, Biological Series, 20(5):1–89.

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

HUSSON, A. M. 1962. The bats of Suriname. Zoologische Verhandelingen, Rijksmuseum Naturlijke Historie, Leiden, 58:1–282.

JONES, C. 1976. Economics and conservation. Pp. 133–146, *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.

JONES, J. K., JR., AND D. C. CARTER. 1976. Annotated checklist,

with keys to subfamilies and genera. Pp. 7–38, *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.

JONES, J. K., JR., J. D. SMITH, AND R. W. TURNER. 1971. Noteworthy records of bats from Nicaragua, with a checklist of the chiropteran fauna of the country. Occasional Papers of the Museum of Natural History, The University of Kansas, 2:1–35.

KOOPMAN, K. F. 1976. Zoogeography. Pp. 39–47, *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.

———. 1978. Zoogeography of Peruvian bats with special emphasis on the role of the Andes. American Museum Novitates, 2651:1–33.

LAVAL, R. K. 1969. Records of bats from Honduras and El Salvador. Journal of Mammalogy, 50:819–822.

LAWLOR, T. E. 1973. Aerodynamic characteristics of some Neotropical bats. Journal of Mammalogy, 54:71–78.

LINARES, O. J. 1968. Quirópteros subfósiles encontrados en las cuevas venezolanas. Parte I. Depósitos de la cueva de Quebrada Honda. Boletin de la Sociedad Venezolana de Espeleología, 1: 3–29.

MARES, M. A., AND D. E. WILSON. 1971. Bat reproduction during the Costa Rican dry season. BioScience, 21:471–477.

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

MCNAB, B. K. 1969. The economics of temperature regulation in Neotropical bats. Comparative Biochemistry and Physiology, 31:227–268.

MORRISON, P., AND B. K. MCNAB. 1967. Temperature regulation in some Brazilian phyllostomid bats. Comparative Biochemistry and Physiology, 21:207–221.

OWEN, R. D. 1987. Phylogenetic analyses of the bat subfamily Stenodermatinae (Mammalia: Chiroptera). Special Publications, The Museum, Texas Tech University, 26:1–65.

PETERS, W. 1865. Über Flederthiere (*Vespertilio soricinus* Pallas, *Choeronycteris* Lichtenst., *Rhinophylla pumilio* nov. sp., *Artibeus fallax* nov. sp., *A. concolor* nov. sp., *Dermanura quadrivillatum* nov. sp., *Nycteris grandis* n. sp.). Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, 1866:351–359.

———. 1866. Über neue oder ungenügend bekannte Flederthiere (*Vampyrops, Uroderma, Chiroderma, Ametrida, Tylostoma, Vespertilio, Vesperugo*) und Nager (*Tylomys, Lasiomys*). Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, 1867:392–411.

PINE, R. H., I. R. BISHOP, AND R. L. JACKSON. 1970. Preliminary list of mammals of the Xavantina/Cachimbo expedition (central Brazil). Transactions of the Royal Society of Tropical Medicine and Hygiene, 64:668–670.

PYE, A. 1967. The structure of the cochlea in Chiroptera, III. Microchiroptera: Phyllostomatoidea. Journal of Morphology, 121:241–251.

RÁMIREZ-PULIDO, J., R. LÓPEZ-WILCHIS, C. MÜDESPACHER ZIEHL, AND I. E. LIRA. 1983. Lista y bibliografía reciente de los mamíferos de México. Universidad Autónoma Metropolitana, Unidad Iztapalapa, México, 363 pp.

RASWEILER, J. J., IV. 1973. Care and management of the long-tongued bat, *Glossophaga soricina* (Chiroptera: Phyllostomatidae), in the laboratory, with observations on estivation induced by food deprivation. Journal of Mammalogy, 54:391–404.

RICK, A. M. 1968. Notes on bats from Tikal, Guatemala. Journal of Mammalogy, 49:516–520.

ROBINSON, W., AND M. W. LYON, JR. 1901. An annotated list of mammals collected in the vicinity of La Guaira, Venezuela. Proceedings of the United States National Museum, 24:135–162.

ROUK, C. S., AND D. C. CARTER. 1972. A new species of *Vampyrops* (Chiroptera: Phyllostomatidae) from South America. Occasional Papers, The Museum, Texas Tech University, 1: 1–7.

SANBORN, C. C. 1955. Remarks on bats of the genus *Vampyrops*. Fieldiana: Zoology, 37:403–413.

SAUSSURE, H. 1860. Note sur quelques mamiferes du Mexique. Revue et Magasin de Zoologie, serie 2, 12:425–431.

SCHELLENBERG, J. R. 1798. Helvetische entomologie; oder, Verzeichniss der schweizerischen insekten nach einer neuen methode geordnet. Mit beschreibungen und abbildungen. Fussli und compagnie, Zurich, 1:1–149.

SHERMAN, H. B. 1955. A record of *Lasiurus* and of *Vampyrops* from Paraguay. Journal of Mammalogy, 36:130.

SMITH, J. D. 1976. Chiropteran evolution. Pp. 49–70, *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.

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.

STARRETT, A., AND L. DE LA TORRE. 1964. Notes on a collection of bats from Central America, with the third record for *Cyttarops alecto* Thomas. Zoologica, 49:53–63.

STRANEY, D. O., M. H. SMITH, I. F. GREENBAUM, AND R. J. BAKER. 1979. Biochemical genetics. Pp. 157–176, *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, 75A:509–515.

SWANEPOEL, P., AND H. H. GENOWAYS. 1979. Morphometrics. Pp. 13–106, *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.

TAMSITT, J. R., AND D. VALDIVIESO. 1963. Records and observations on Colombian bats. Journal of Mammalogy, 44:168–180.

THOMAS, O. 1900. Descriptions of new Neotropical mammals. Annals and Magazine of Natural History, series 7, 5:269–274.

———. 1912. Three small mammals from South America. Annals and Magazine of Natural History, series 8, 9:408–410.

TUTTLE, M. D. 1976. Collecting techniques. Pp. 71–88, *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.

VAUGHAN, T. A. 1970. Flight patterns and aerodynamics. Pp. 195–216, *in* Biology of bats (W. A. Wimsatt, ed.). Academic Press, Inc., New York, 1:1–406.

VILLA-R., B. 1966 [1967]. Los murciélagos de México. Universidad Nacional Autónoma de México, Instituto de Biología, México, 491 pp.

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.

WILSON, D. E. 1979. Reproductive patterns. Pp. 317–378, *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.

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