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Pteronotus personatus (Chiroptera: Mormoopidae)

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Abstract: *Pteronotus personatus* (Wagner, 1843) is a mormoopid bat commonly called Wagner's mustached bat. A small bat, fully furred, it is 1 of 6 species in the genus *Pteronotus*. This species ranges from the most tropical regions of Mexico to South America across northern Venezuela, Guyana, Suriname, and French Guiana and through northwestern Colombia, and in a band across Ecuador, Peru, Bolivia, and Brazil, as far south as the Mato Grosso. It is frequently associated with watercourses and dense vegetation and prefers hot, humid caves and mines for roosting sites. It is considered a species of "Least Concern," but the status of many populations is uncertain. DOI: 10.1644/869.1.

Key words: bat, insectivorous bat, mormoopid, Wagner's mustached bat

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Pteronotus personatus (Wagner, 1843)
Wagner's Mustached Bat

Chilonycteris personata Wagner, 1843:367. Type locality "Mato Grosso," Brazil; restricted to St. Vicente, Mato Grosso, Brazil by Wagner (1847:186) vide Gardner 2008:384.

Chilonycteris psilotis Dobson, 1878:451 vide Gardner 2008:383. Type locality unknown; designated as "Isthmus of Tehuantepec, Mexico," by de la Torre (1955:696).

Chilonycteris torrei continentis Sanborn, 1938:1. Type locality "Laguna de Zotz, Petén, Guatemala."

Pteronotus psilotis: Burt and Stirton, 1961:26. Name combination.

P[*teronotus*]. *personatus*: Vaughan and Bateman 1970:218. First use of current name combination.

CONTEXT AND CONTENT. Order Chiroptera, family Mormoopidae. Synonymy follows Gardner (2008). Two subspecies are recognized (Simmons 2005):

P. p. personatus (Wagner, 1843:367). See above.
P. p. psilotis (Dobson, 1878:451). See above.

NOMENCLATURAL NOTES. *Pteronotus personatus* is often placed in the subgenus *Chilonycteris* proposed by Smith (1972) and recognized by Simmons and Conway (2001). This

Fig. 1.—Adult *Pteronotus personatus psilotis* from Chamela, Jalisco, Mexico. Photograph by Gerardo Ceballos used with permission.

subgenus also included the 2 insular species *P. macleayii* (MacLeay's mustached bat) and *P. quadridens* (sooty mustached bat). Recent molecular data do not support the hypothesis that *P. personatus* shared a common ancestor with *P. macleayii* and *P. quadridens* (Lewis-Oritt et al. 2001; Van Den Bussche and Weyandt 2003), and rather suggests that *P. personatus* represents an undescribed subgenus.

Smith (1972) recognized 2 subspecies for *P. personatus*, but Lewis-Oritt et al. (2001) concluded that the subspecies are unnatural assemblages. Lewis-Oritt et al. (2001) described the substantial geographic variation of *P. personatus* as being distributed in a steplike fashion, and suggested that this complex may include >1 species. Davalos (2006) suggested that the 2 subspecies of *P. personatus* (*psilotis* and *personatus*) should be considered as different species.

The generic name *Pteronotus* is derived from the combination of *pteron*, meaning wing in Greek, and the Latin *otos*, which means pertaining to (Rodríguez-Durán and Kunz 1992).

DIAGNOSIS

Pteronotus personatus is similar in general characters to *P. parnellii* (common mustached bat), but is much smaller and more delicate. The length of the forearm of *P. personatus* is <50 mm and is >50 mm in *P. parnellii* (Medellín et al. 1997). The skull of *P. personatus* is less massive than that of *P. parnellii* and has a less-inflated braincase and markedly lighter dentition as well (Smith 1972). *P. personatus* has a visibly furred dorsum that distinguishes it from *P. davyi* (Davy's naked-backed bat), which has a naked-backed appearance. Cranially, *P. personatus* resembles *P. davyi* but can be distinguished from it by its narrower, less-upturned rostrum, more-prominent mastoid flanges, and comparatively smaller braincase. The labionasal plate of *P. personatus* is simple and lacks lateral spikes in contrast to the complex labionasal plate with prominent lateral spikes of *P. macleayii* and *P. quadridens*. The shape of the braincase is ovoid in *P. personatus* and globular in *P. macleayii* and *P. quadridens* (Smith 1972).

GENERAL CHARACTERS

Pteronotus personatus (Fig. 1) is a small bat that is fully furred in either a reddish or blackish brown color phase. The reddish phase in some individuals is ochraceus tawny and reddish yellow dorsally. In this phase, the ventrum is pink-cinnamon and more reddish than the neck. Most individuals are clay-brown on the back with the neck and shoulders cinnamon colored and the ventral region ochraceus buff. The blackish brown phase is fuscous dorsally and drab gray ventrally with lighter shade variants. These 2 color phases do not appear to be functions of season, sex, or age. Males and females of both phases sometimes occupy the same roost (Villa 1966). *P. p. personatus* is reportedly slightly darker than *P. p. psilotis* (Smith 1972).

Pteronotus personatus has long, forward-pointed ears that are united by 2 low, inconspicuous ridges that fuse on top of muzzle, forming a prominent rostral tubercle. The anteriomedial edges of the pinnae have 3 or 4 (occasionally as many as 6) toothlike serrations (Smith 1972). *P. personatus* has extended lips that are ornamented with folds and small round tubercules. Mustachelike bristles also emerge from the upper lips (Villa 1966). The nose of *P. personatus* is incorporated into the folds of the upper lip. The labionasal plate is simple and lacks lateral spikes on either side of nostrils and the nostrils are not separated by a deep emargination (Smith 1972).

The wings of *P. personatus* are inserted along the sides of the body. Its uropatagium is large and hairless, and the tail emerges near the center of the dorsal surface of the uropatagium (Villa 1966). Both the uropatagium and wing membranes attach to the ankle. The tragus is spatulate; its secondary fold is moderately well developed, shelf-like, and covered with short hairs. The calcars are long and thin (Smith 1972).

In profile, the skull of *P. personatus* (Fig. 2) is flattened. Its rostrum is slightly elevated and its forehead slopes gradually onto a long, oval braincase. Upper incisors are reduced with a slight diastema between I2 and C1; I1 is distinctly bifurcated with a narrow, rounded heel. i1 and i2 are reduced and have short, rounded heels; i1 is distinctly trilobate and i2 is weakly trilobate. A small, shelf-like cuspule is present on the anterior lingual surface of the postcentrocrista on M1 and M2. The opening of the infraorbital foramen is slightly anterior to the maxillary root of the zygomatic arch (Smith 1972).

External body measurements (mm; mean with range in parentheses) for 19 individuals (sexes combined) from different localities of Mexico (Villa 1966) were: length of head and body, 65.0 (60.0–67.0); length of tail, 17.1 (16.0–18.0); length of hind foot, 10.9 (9.4–12.5); length of ear, 14.6 (10.5–17.7); length of forearm, 43.2 (41.8–46.9); length of tibia, 14.6 (14.4–17.8). Cranial measurements (mm; mean with range in parentheses) for 10 individuals (sexes combined) from the same localities (Villa 1966) were: greatest length, 14.8 (14.4–15.4); condylobasal length, 14.1 (13.8–14.5); palatal length, 6.9 (6.5–7.5); interorbital width, 3.6 (3.4–3.8); width of rostrum, 5.8 (5.4–6.2); width of zygomatic arch, 8.3 (8.2–8.5); width of mastoid, 8.2 (7.5–8.5); maximum width of braincase, 7.4 (7.1–7.7); length of maxillary toothrow, 6.0 (5.9–6.2); distance between the canines, 4.4 (4.1–4.8); distance between 3rd upper molars, 5.4 (5.3–5.9).

Pteronotus personatus personatus has a larger cranium and larger general body size than *P. p. psilotis* but geographic variation in size exists within the subspecies. Skull and body size of *P. p. personatus* increase from north

Fig. 2.—Dorsal, ventral, and lateral views of skull and lateral view of mandible of *Pteronotus personatus psilotis* from Autlán, Jalisco, Mexico (collected January 1962 by B. Villa-R. (IBUNAM [Instituto de Biología Universidad Nacional Autónoma de México] 5984). Greatest length of the skull is 15.6 mm. Photographs by A. I. Bieler.

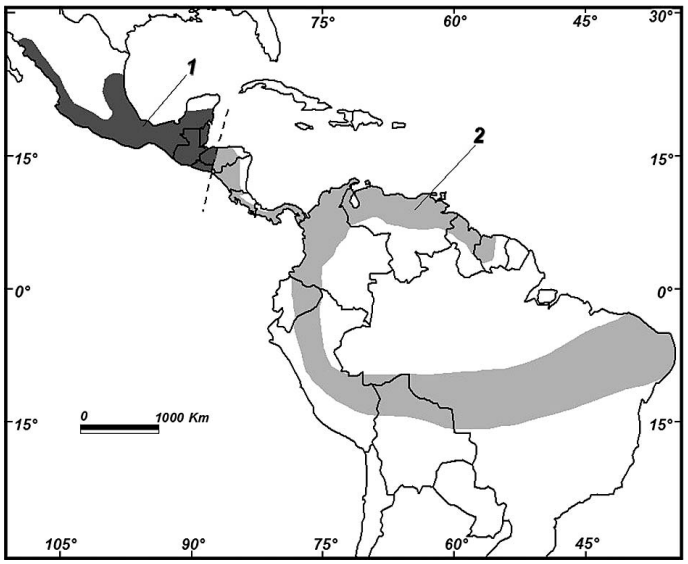

Fig. 3.—Distribution of *Pteronotus personatus*. Subspecies are: 1, *P. p. psilotis* and 2, *P. p. personatus* (modified from Eisenberg 1989; Eisenberg and Redford 1999; Koopman 1982; Medellín et al. 1997; Reid 1997).

to south between El Salvador and Colombia. Mexican and northern Middle American representatives of *P. p. psilotis* are uniformly small in size, and in southeastern Honduras and eastern El Salvador, a rather marked increase in overall size may indicate intergradations between *P. p. psilotis* and *P. p. personatus* (Smith 1972).

DISTRIBUTION

The distribution of *Pteronotus personatus* (Fig. 3) reaches its northern limits in the tropical lowlands of coastal southern Sonora and southern Tamaulipas, Mexico. The distribution extends southward along the Gulf of Mexico and Pacific coasts, through most of tropical Mexico, excluding portions of the Mexican Plateau and most of the Yucatan Peninsula (Jones et al. 1973, 1988; Smith 1972). It is found in most of Central America, excluding the eastern-most portions of Honduras, Nicaragua, Costa Rica, and northwestern Panama (Baker and Jones 1975; Burt and Stirton 1961; Reid 1997). In South America, it extends across northern and western Colombia (Bowles et al. 1979), across northern Venezuela (Ochoa and Ibanez 1985), Trinidad (Goodwin and Greenhall 1961; Koopman 1958), Guyana, northern Suriname (Simmons 2005), and into French Guiana (Brosset and Charles-Dominique 1990). *P. personatus* also is distributed through western Ecuador, central and southeastern Peru (Bowles et al. 1979), northern Bolivia (Ibáñez and Ochoa 1989), and in a band from Bolivia across Brazil, as far south as the Mato Grosso, to the Atlantic coast.

Pteronotus pteronotus psilotis occupies the northernmost extent of the species' range, from Mexico to eastern Honduras and extreme southeastern El Salvador. *P. p. personatus* occurs from these points southward through Central and South America (Fig. 3; Smith 1972).

FOSSIL RECORD

The only known fossils of *Pteronotus personatus* have been found in Robinson Crusoe Cave on the island of Tobago, which is outside the current distribution of this species. These are probably late Pleistocene deposits (Eshelman and Morgan 1985).

FORM AND FUNCTION

Form.—The dental formula is i 2/2, c 1/1, p 2/3, m 3/3, total 34. Abnormalities in teeth caused by disease or mechanical damage are rare (Phillips and Jones 1968).

The intestinal disaccharidases maltase, sucrase, isomaltase, and trehalase are all active in *P. personatus*. A significant level of trehalase is particularly important given that trehalose is a major storage form for sugar in their insect prey (Hernandez and Martinez del Rio 1992).

Function.—*Pteronotus personatus* maintains a relatively high and constant body temperature over the range of ambient temperatures encountered in roost caves and nocturnal foraging habitats. Mean body temperature of *P. personatus* is about 37.5°C, and the lowest air temperature at which a normal body temperature can be maintained is about 20°C (Bonaccorso et al. 1992; Novick 1963). Its lower critical body temperature during normothermy is about 34.0°C (Bonaccorso et al. 1992). The mean basal metabolic rate of *P. personatus* is about 1.64 (ml O_2 g^{-1} h^{-1}). There is no difference in basal metabolism of adult females and adult males. The minimal rate of thermal conductance in *P. personatus* is about 0.30 ml O_2 g^{-1} h^{-1} $°C^{-1}$ (Bonaccorso, et al. 1992).

Flight speeds of *P. personatus* range from 11 to 19.6 km/h, and do not differ between males and females. The mean of the forearm length of the specimens tested was 43.1 mm. All members of the family Mormoopidae have long and narrow wings for rapid flight, and a positive correlation between flight speed and length of the forearm was observed in these bats; small mormoopids (*P. personatus* and *P. davyi*) fly slower than larger ones (*P. parnelli* and *Mormoops megalophylla* [Peters's ghost-faced bat]—Hopkins et al. 2003).

ONTOGENY AND REPRODUCTION

Female *Pteronotus personatus* display a seasonal, monestrous reproductive pattern with births typically in June–July (Sánchez and Romero-Almaraz 1995). A female collected in June on Isla Palmito de la Virgen, Sinaloa, Mexico, contained an embryo with a crown–rump length of 17 mm (Jones et al. 1972). However, earlier pregnancies have been recorded. A female taken in Jototán, Guatemala, in March carried 1 embryo with an 11 mm crown–rump length, whereas in January, 14 specimens showed no evidence of reproductive activity (Jones 1966). Also, 2 females collected from Mamo, Venezuela, in May were pregnant (Ochoa and Ibanez 1985). Later pregnancies have been documented; this is indicated by a lactating specimen collected in Catemaco, Veracruz, Mexico, in September (Villa 1966).

Other reports of reproductive status of *P. personatus* are consistent with this interpretation of reproductive seasonality. None of 13 females collected in Jalisco, Mexico, in January, February, August, October, and December were pregnant (Watkins et al. 1972). Also, a nonpregnant female was collected in April in Quintana Roo, Mexico (Polaco et al. 1992). Births generally coincide with the onset of the rainy season, when number and availability of insects increase (Bateman and Vaughan 1974). Litter size of 1 has been reported (Cockrum 1955).

Testes length varies with time of year. Mean length for 28 specimens collected in January in Guatemala is 5.7 mm (range = 2–7 mm—Jones 1966). In late February, in Campeche, Mexico, testes of 2 specimens were 5 and 4 mm long (Jones et al. 1973). One specimen from Salitre Cave, Guerrero, Mexico, in May had testes 2 mm in length (Alvarez 1968). Single specimens from Jalisco, Mexico, in August (Watkins et al. 1972) and Tingo Mario, Peru, in late July (Bowles et al. 1979) each displayed testes that measured 3 mm.

ECOLOGY

Roosting colonies may exceed 15,000 individuals (Bateman and Vaughan 1974; Tuttle et al. 2000). In Mexico, populations in caves, their primary roost sites, generally range from 100 to 10,000 individuals (Arita 1993), although a colony that exceeded 16,000 individuals was recorded in Panuco, Sinaloa, Mexico (Bateman and Vaughan 1974). *Pteronotus personatus* is extremely susceptible to moderate temperature depressions (Novick 1963) and these large aggregations may help *P. personatus* with thermoregulation during cooler times of the year (Bateman and Vaughan 1974; Bonaccorso et al. 1992).

Pteronotus personatus has been captured at sites from sea level to an elevation of about 1,000 m in habitats that range from rain forest to dry deciduous forest. (Bateman and Vaughan 1974; Bowles et al. 1979; Brosset and Charles-Dominique 1990; Koopman 1982; Reid 1997; Smith 1972). In the El Cielo Biosphere Reserve, Tamaulipas, Mexico, *P. personatus* is associated with lowlands of the tropical semideciduous forest (Vargas-Contreras and Hernández-Huerta 2001). In Los Tuxtlas, Veracruz, Mexico, this

species also occurs in complex agroecosystems of cacao and pepper with canopy heights > 15 m (Galindo-González 2000).

Pteronotus personatus frequents watercourses associated with dense vegetation (Baker and Jones 1975; Carter and Jones 1978; Jones et al. 1962, 1972; Watkins et al. 1972). In Tamaulipas, Mexico, an individual was netted over a shallow stream that flows through a village (Choate and Clifton 1970). In Belize, *P. personatus*, identified by its echolocation calls, also was associated with streams and rivers (O'Farrell and Miller 1997). *P. personatus* is reported to maintain specific flyways in arroyos, and canyon bottoms, and may forage in areas >3.5 km from roosts (Bateman and Vaughan 1974). *Pteronotus personatus* is insectivorous (Villa 1966); however, there are no data published on specifics of diet, competition, or natural predators.

Pteronotus personatus prefers hot, humid caves and mines for roosting sites. It is reported usually in caves together with *P. davyi* at temperatures of 30.0–36.0°C (Avila-Flores and Medellín 2004). In Barra Honda and Guano caves, Venezuela, *P. personatus* selected regions of the caves with minimal ventilation and maximal temperature; individuals roosted 20 m from the cave entrance for a period of 48 h at ambient temperatures of 33.0–36.0°C. Males and females of both *P. personatus* and *P. davyi* roost in the same general areas of caves (Bonaccorso et al. 1992). In Panuco, Sinaloa, Mexico, *P. personatus* forms bachelor colonies (Bateman and Vaughan 1974).

Rabies has been reported in *P. personatus* near Tuxpan, Veracruz, Mexico (Villa 1966). *P. personatus* is host to bat mites (*Cameronieta thomasi*—Kingston et al. 1971), chiggers (*Perates monops*—Daniel and Stekol'nikov 2003), and various other ectoparasites, including ticks (*Carios setosus* [Argasidae]) and bat flies (*Nycterophilia coxata*, *N. fairchildi*, *Trichobius hoffmannae*, *T. johnsonae*, and *T. yunkeri* [Streblidae]—Whitaker and Morales-Malacara 2005).

Pteronotus personatus most frequently coexists with other bat species in roosts (Arita 1993). It shares daytime roosts with other mormoopids, such as *Mormoops megalophylla*, *P. davyi*, and *P. parnelli*, as well as with *Desmodus rotundus* (common vampire bat), *Leptonycteris curasoae* (Curaçaoan long-nosed bat), and *Natalus stramineus* (Mexican greater funnel-eared bat—Alvarez 1968; Arita 1993; Bateman and Vaughan 1974; Bonaccorso et al. 1992; Estrada-Barcenas 2005; Galicia-Castillo 2004; Graham 1988; Jones 1966; Villa 1966; Watkins et al. 1972). In a population of 400,000–800,000 bats in a mine in Panuco, Sinaloa, Mexico, only about 4% were *P. personatus*; other species in the same mine were *M. megalophylla*, *P. davyi*, and *P. parnellii* (Bateman and Vaughan 1974). *P. personatus* has been observed leaving caves during the earliest phase of emergence (Villa 1966).

In Bolivia, *P. personatus* has been collected in association with a variety of species, including *P. parnellii*, *P. davyi*, *Phyllostomus hastaus* (greater speared-nosed bat), *Carollia perspicillata* (Seba's short-tailed bat), *Uroderma bilobatum* (common tent-making bat), *Platyrrhinus* (formerly *Vampyrops*) *lineatus* (white-lined broad-nosed bat), and *Artibeus jamaicensis* (Jamaican fruit-eating bat—Ibáñez and Ochoa 1989).

BEHAVIOR

Pteronotus personatus is considered to be a generalist, short-range echolocator (Obrist et al. 1993). It forages in a complex navigational environment among tree branches using echolocation signals emitted in an initial series of constant-frequency pulses followed by frequency-modulated sweeps with a terminal, short, constant-frequency component (O'Farrell and Miller 1997; Smotherman and Guillén-Servent 2008). Different dominant spectral ranges for the frequency-modulated pulses have been reported: 45–53 kHz to 36–43 kHz (Novick 1963), 82–60 kHz (Obrist et al. 1993), 83–68 kHz (O'Farrell and Miller 1997), and 85–70 kHz (Smotherman and Guillén-Servent 2008). Additional harmonic pulse sweeps (frequency-modulated) may be emitted simultaneously with the fundamental harmonic. Obrist et al. (1993) reported 3 harmonics, Simmons et al. (1979) reported 3 harmonics, and Novick (1963) reported a 2nd harmonic that swept from 106 to 76 kHz. Different durations for the constant-frequency echolocation pulses have been reported: 2.8–8.6 ms (Novick 1963), 5–3 ms (Obrist et al. 1993), 5 to <1 ms/pulse (Simmons et al. 1979), 5.7 ms (O'Farrell and Miller 1997), and 4.8 ms (Smotherman and Guillén-Servent 2008). Characteristic frequencies of the constant-frequency component and of harmonic elements of echolocation calls emitted in natural conditions may differ from those emitted in controlled conditions (O'Farrell and Miller 1997).

Echolocation calls of *P. personatus* during prey pursuit were studied in enclosed conditions. The initial constant-frequency echolocation pulses decrease in duration (from 4 to 1 ms/pulse) as *P. personatus* progresses from the search phase of foraging, through the approach phase of pursuit, and finally to the terminal phase. Transition from the search phase to the approach phase occurs when emitted signals overlap with echos, at 400–700 mm (Novick 1965). Emission rates for echolocation pulses also vary with stage of pursuit, from 18/s during search to 170/s by the terminal stage (Novick 1965).

Doppler-shift compensatory behavior has been reported for *P. personatus*. Doppler-shift compensatory behavior is a highly specialized vocal behavior that allows *P. personatus* to adjust the frequency of its constant-frequency component to compensate for the flight-speed–induced Doppler shifts in the frequency of the returning echoes. Doppler-shift compensatory behavior is only exhibited by a select group of bats that rely upon a very skilled auditory system to discriminate fine acoustic details of their prey and to

navigate through dense foliage (Smotherman and Guillén-Servent 2008).

Sound-pressure transformations and directionality of hearing have been studied in *P. personatus* (Obrist et al. 1993). The highest interaural intensity difference occurs between 45 and 75 kHz, within the range of the frequency-modulated portion of the dominant harmonic.

GENETICS

Diploid chromosome number (2n) for *Pteronotus personatus* is 38 and fundamental number (FN) is 60. The karyotype consists of 6 large, 4 medium, and 2 small metacentric or submetacentric pairs, and 6 small acrocentric pairs of autosomes. The small Y chromosome is acrocentric and the X is a medium-sized submetacentric (Baker 1967; Baker et al. 1982). Mitochondrial and nuclear DNA analyses indicate that *P. personatus* does not share a common ancestor with *P. quadridens* and *P. macleayii* (Lewis-Oritt et al. 2001).

CONSERVATION

Pteronotus personatus is considered a ''Least Concern'' species by the International Union for Conservation of Nature and Natural Resources (2010). The status of many local populations in Mexico is unknown (Ortega 2005); however, it is not listed as threatened by the Mexican government (Secretaria de Medio Ambiente y Recursos Naturales 2002).

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