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## Observations on *Pygoderma bilabiatum* (Wagner)

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### Abstract

Studied aspects of the biology of *Pygoderma bilabiatum* (Wagner). The capture of 98 individuals at localities in Paraguay demonstrates that the habitat of this species is tropical forest, that reproduction occurs during the fall and winter (March, July, and August), and that the preferred food is a rapidly digested substance that leaves neither fiber nor seeds in the digestive tract. Karyotypes were obtained from 13 individuals and show  $2N = 30,31$  and  $FN = 56$ . Measurements of the crania of 18 males and 31 females, and the skins of 12 males and 22 females, demonstrate striking sexual dimorphism ( $p < .02$  for all characters measured and  $< .001$  for most) with females larger. The possibility that *Stenoderma* (*Pygoderma*) *microdon* Peters is based on male *P. bilabiatum* is discussed. Finally, sexual dimorphism in soft anatomical structures of the face, neck, and thorax is noted.

### Introduction

*Pygoderma bilabiatum* is a rare bat inhabiting Amazon and Paraná rainforests in South America. It usually is grouped with seven other stenodermine genera with white shoulder patches and shortened rostra: *Ametrida*, *Ardops*, *Ariteus*, *Phyllops*, *Stenoderma*, *Sphaeronycteris*, and *Centurio* (the white-shouldered bats; GREENBAUM et al. 1975; GARDNER 1977a). Almost nothing is known of its natural history; its morphology is known primarily from skin and skull; and it is the only stenodermine genus for which the karyotype is unreported (GREENBAUM et al. 1975). Recent field work in Paraguay has resulted in the capture of 98 *Pygoderma*, and permits a few observations on its natural history and morphology.

## Results

### Habitat

All specimens were captured in mist nets hung in mature tropical forest or second growth bordering forest. Nets were placed in trails, at the edges of clearings, and over streams. Bats entered the nets at heights ranging from within 1 m of the ground to roughly 10 m above ground, the highest level at which nets were set. The first bats each evening were captured well after dark, and bats generally continued to be captured until nets were closed at about midnight.

### Karyotype

Fourteen individuals (11 females and 3 males) were successfully karyotyped using mitotic material obtained from in vivo treatment of bone marrow (Fig. 1). The karyotype has  $2N = 30,31$  and  $FN = 56$ . It appears identical to that of *Ametrida*, *Ardops*, *Arriteus*,

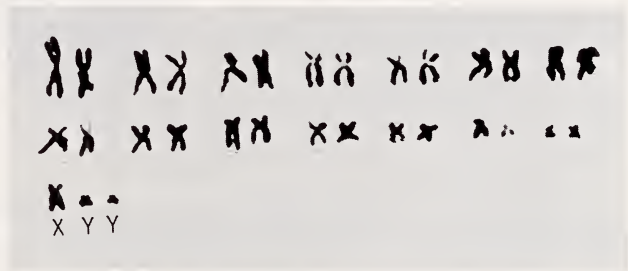


Fig. 1. Karyotype of a male *Pygoderma bilabiatum*

*Phyllops*, and *Stenoderma*, (GREENBAUM et al. 1975, fig. 1) and lacks the extra pair of small metacentrics seen in *Centurio* and *Sphaeronycteris*. The X chromosome is a medium-sized metacentric; the two Y's are small submetacentrics or subtelocentrics. The  $2N = 30,31$ ,  $FN = 56$  karyotype is common among stenodermines, and may represent a shared primitive character. The karyotype of *Pygoderma* is thus consonant with the cladograms presented by both BAKER (1973) and GARDNER (1977a).

### Reproduction

A single female captured in March was pregnant. Two captured in June were neither pregnant nor lactating. In July, 11 of 21 were pregnant; in August, 47 of 54. Embryos of all sizes were observed in both the July and August samples, implying an extended breeding season. Females invariably carried as single young. Oddly, while females with enlarged nipples were common, we observed none from which milk could be expressed. Further, only one bat with unfused epiphyses was captured (16 July). This pattern of winter pregnancy contrasts with the winter hiatus in breeding reported for four species of vespertilionid bats by MYERS (1977).

### Sexual dimorphism

*Pygoderma* females are larger than males, to a degree unusual among phyllostomatid bats (though exceeded by another white-shouldered bat species, *Ametrida centurio* [PETERSON 1965], and approached by *Ardops* [JONES and SCHWARTZ 1967] and *Stenoderma* [JONES et al. 1971]). Twelve cranial and two wing characters were measured for 17 males and 31 females from two localities in eastern Paraguay (vicinity of Curuguaty, Dept. Canendiyu, 20 females and 13 males; vicinity of San Rafael, Dept. Itapua, 11 females and 5 males)

(table). No significant variation between localities was detected, and the samples were combined. Females differed significantly from males in all characters, with the strongest differences found in wing and dental characteristics. Ranges of measurements for males and females do not overlap in length of forearm or third metacarpal, length of maxillary toothrow, width of palate measured from the labial edge of one  $M^2$  to the labial side of the other, or across  $P^4$ s.

Males further differ from females in the extreme development of a doughnut-shaped mass of glandular tissue surrounding each eye (Fig. 2). Similar swellings are seen in *A. centurio* (PETERSON 1965), though that shown in PETERSON's figure and in a single specimen (female) at the Museum of Zoology of the University of Michigan is comparatively slight. The gland is present in female *Pygoderma* but never developed to the same extent as in males. The fur on the anterior chest and shoulders of males is also unusual, appearing to have been worn away leaving much exposed skin. Females also show a similar but lesser loss. Males and females share with *Centurio* a T-shaped glandular swelling on the ventral surface of the lower jaw. Finally, both sexes possess a swollen, glandular mass lateral to the noseleaf, marked by a distinctive set of five or six vibrissae on each side, apparently homologous with the flap in that position remarked by PETERSON (1965) in *Ametrida*. A ridge lateral to the noseleaf is not unique to the white-shouldered bats, however, but is found in many phyllostomatids. It appears unusually flap-like in *Ametrida* and *Phyllops haitiensis*, and larger than average for stenodermines in *Pygoderma*. Both this ridge and the structure on the lower jaw appear slightly larger in male *Pygoderma* than in females.

PARADISO (1967) noted that the fleshy protruberances on the faces of *Centurio* males

#### Sexual dimorphism in *Pygoderma bilabiatum*<sup>1</sup>

Character	female	Means and ranges male	F <sup>2</sup>	dimorphism <sup>3</sup>
Forearm	39.79 (38.90–41.40)	36.96 (36.20–38.10)	159.81**	.071
Third metacarpal	40.96 (40.00–42.30)	37.87 (36.70–39.20)	119.77**	0.76
Greatest length skull	20.61 (20.12–21.03)	19.81 (19.36–20.28)	124.59**	.039
Condylbasal length	18.08 (17.80–18.36)	17.21 (16.81–17.64)	227.77**	.048
Mastoid breadth	12.50 (12.13–13.04)	12.16 (11.62–12.56)	26.05**	.028
Zygomatic width	14.31 (13.77–15.35)	13.72 (13.42–14.08)	38.38**	.041
Interorbital constriction	7.66 (7.14–8.12)	7.53 (7.24–7.77)	6.04*	.018
Maxillary toothrow	6.14 (5.89–6.46)	5.55 (5.33–5.75)	230.85**	.096
Length $M^2$	.76 (.61–.94)	.56 (.43–.67)	76.55**	.269
Width $P^4$	1.70 (1.57–1.83)	1.51 (1.41–1.61)	100.16**	.115
Breadth across $M^2$ 's	6.14 (5.73–6.66)	5.18 (4.89–5.58)	271.90**	.155
Breadth across $P^4$ 's	8.24 (7.92–8.56)	7.40 (7.19–7.68)	320.21**	.102
Breadth across canines	6.53 (6.30–6.89)	6.14 (5.95–6.36)	65.65**	.059

<sup>1</sup> n = 18 males, 31 females for cranial measurements; 12 males, 22 females for wing measurements.  
<sup>2</sup> \* p = .018; \*\* p < .0001.  
<sup>3</sup> (female – male) / female



Fig. 2. Ventral and side views of the head and thorax of a male *Pygoderma bilabiatum*. The inset shows a partial dissection revealing the glandular mass of tissue surrounding the eye

were more pronounced than those on females. In a small sample he found no significant sexual dimorphism in cranial or wing measurements.

*Stenoderma (Pygoderma) microdon* Peters (1863) is described from two male bats from Surinam. PETERS does not compare his species directly with *P. bilabiatum*, the type of which is a female (WAGNER 1843; CARTER and DOLAN 1978); the distinguishing feature, however, appears to be its small size. The species is generally regarded as a synonym of *P. bilabiatum* (e.g., CABRERA 1958), though HUSSON (1978) appears to consider it as potentially distinct. The measurements and description of the type given by PETERS, as well as those recorded by CARTER and DOLAN (1978), fit well the male *P. bilabiatum* described here, and it seems most reasonable to continue to regard *P. microdon* as a junior synonym of *P. bilabiatum*. *Pygoderma* thus may provide another case, with *Ametrida centurio* and *minor* (PETERSON 1965), where males of a species of phyllostomatid have received a separate name from females due to unusual sexual dimorphism in size.

### Digestive system

Gross stomach morphology resembles closely that of *Artibeus lituratus* (FORMAN 1972; this study  $n = 7$ ). I also compared *Pygoderma* stomachs ( $n = 13$ ) to those of *Vampyrops lineatus* ( $n = 7$ ), *Centurio* ( $n = 7$ , and FORMAN 1973), and *Sturnira lilium* ( $n = 3$ , and FORMAN 1972). Considerable variation in morphology was noted within each species. In *Pygoderma* the recurved aboral portion of the stomach is long relative to that of *A. lituratus*, *V. lineatus*, and *S. lilium*. The cardiac caecum is more sharply defined than that of *A. lituratus* and *S. lilium*, but less elongate than that of *V. lineatus* or *Centurio*. In general, however, the stomachs of the stenodermines are very similar, while that of *S. lilium* differs in the manner described by FORMAN (1972). No trace of a caecum such as that seen in *Carollia* (SCHULTZ 1965) was detected.

The stomachs and intestines of the 13 *Pygoderma* dissected were entirely empty, except for a very small amount of amorphous green material at the distal end of the intestine. No fiber, seeds, or insects parts were discovered. The stomachs and intestinal contents of eight



*A. lituratus*, seven *V. lineatus*, and three *S. lilium* captured during the same period and handled in the same manner as the *Pygoderma* also were scanned. The stomachs of most bats were largely empty, though some material usually was present between gastric rugae. Considerably more material was found in the intestine of the latter three species than in *Pygoderma*. In *A. lituratus*, two tracts were empty; six contained amorphous green and white material; one had seeds; one, fiber; and two, insect parts. In *V. lineatus*, five contained amorphous material; one, fiber; and one, seeds. In *S. lilium*, one was empty and two contained fiber and seeds. The difference in contents and degree of emptiness of the digestive tract between *Pygoderma* and the other species suggests strongly that *Pygoderma* feeds on rapidly digested material that leaves no fiber or seeds, such as large pulpy or overripe fruits. A similar diet has been suggested for *Centurio* (GARDNER 1977b; BONACCORSO 1975) and *Stenoderma* (GENOWAYS and BAKER 1972).

### Specimens examined

All specimens reported here are in the Museum of Zoology, University of Michigan.

*Ametrida centurio*. – Brazil. Pará, Obidos (1 female).

*Artibeus lituratus*. – Paraguay. Dept. Canendiyu: 6.3 km by rd NE Curuguaty (3 males); Dept. Paraguari: Parque Nacional Ybycui (1 male, 4 females).

*Centurio senex*. – Costa Rica. Guanacaste: 1/2 mi E Finca Jiminez (3 males, 4 females).

*Phyllos haitiensis*. – Haiti. Dept. du Sud: Paillant, 6 km SW Miraguane (1 female).

*Pygoderma bilabiatum*. – Paraguay. Dept. Caaguazu: 24 km NNW Carayao (1 female). Dept. Canendiyu: 6.3 km by rd NE Curuguaty (4 males, 9 females); 13.3 km by rd NE Curuguaty (16 males, 41 females). Dept. Itapua: 2 km NNW San Rafael (4 males, 4 females); 3.5 km E San Rafael (6 females); 8 km N San Rafael (2 males, 6 females). Dept. San Pedro: 1.2 km by road N Rio Aguaray-Guazu (2 males, 3 females).

*Sturmira lilium*. – Paraguay. Dept. Paraguari: Parque Nacional Ybycui (2 males, 1 female).

*Vampyrops lineatus*. – Paraguay. Dept. Central: Asunción, Recoleta (1 male, 4 females); Dept. Paraguari: Parque Nacional Ybycui (1 male, 1 female).

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### Zusammenfassung

#### *Beobachtungen an Pygoderma bilabiatum* (Wagner)

98 in Paraguay gefangene Fledermäuse der wenig bekannten Art *Pygoderma bilabiatum* (Wagner) bilden die Grundlage für neue Angaben zu ihrer Biologie und Taxonomie. Ihr Lebensraum ist der tropische Wald. Trächtige Weibchen wurden im Herbst und Winter (März, Juli und August) angetroffen. Ihre Nahrung muß leicht verdaulich sein und hinterläßt im Darmtrakt weder Fasern noch Samen. Die Chromosomenzahl beträgt  $2n = 30$  oder  $31$ ,  $NF = 56$  (13 Individuen untersucht). In fast allen Körper- und Schädelmaßen sind die Weibchen hoch signifikant größer als die Männchen. Die Beschreibung von *Stenoderma* (*Pygoderma*) *microdon* Peters bezieht sich vermutlich auf männliche *P. bilabiatum*. Ein Sexualdimorphismus besteht auch in Weichteilen von Gesicht, Hals und Thorax.

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## Interspecific variation in *Apodemus* from the northern Adriatic islands of Yugoslavia

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### Abstract

Reevaluated the systematic position of the endemic species *Apodemus krkensis* from the island Krk in Croatia, Yugoslavia.

Three hundred and thirty-two museum specimens of *Apodemus sylvaticus* (wood mouse) and *A. flavicollis* (yellow-necked mouse) from 10 insular, coastal, and inland localities in northwestern Yugoslavia were compared to seven specimens of the nominal species *A. krkensis* collected in 1975 near the type locality of Baška on the island of Krk. Results of a multivariate analysis of variance using 11 cranial characters showed *A. sylvaticus* could be distinguished with ease from *A. flavicollis* but that it was inseparable morphologically from *A. krkensis*. The only demonstrable difference between *A. sylvaticus* and *A. krkensis* was the gray pelage possessed by the latter. Microscopic examination of hairs from the dorsal pelage suggested that this variation in color centers around a reduction in pigment deposition and the number of melanosomes (pigment granules) synthesized by hairs of the underfur in *krkensis*. The paling effect is attributed to introduction of a mutant allele at the C (albino) locus. Inasmuch as additional collecting on northern Adriatic islands and the adjacent mainland has shown the gray form to be more widespread than previously thought, and because it occurs

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