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The Australo-Papuan Genus *Syconycteris* (Chiroptera: Pteropodidae) With the Description of a New Papua New Guinea Species

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INTRODUCTION

SYCONYCTERIS WAS ORIGINALLY proposed as a subgenus of *Macroglossus* F. Cuvier by Matschie (1899:94-101), with *Macroglossus australis* Peters (originally *Macroglossus minimus* var. *australis* Peters) as type species, and *M. crassus* (Thomas) as a second member. At this time, Matschie also named 2 new species of the subgenus: *papuanus* and *finschi*. In 1911, K. Andersen elevated *Syconycteris* to full generic rank, arranging in it only 3 species: *australis, crassa* (with *crassa, papuana,* and *finschi,* as well as his new forms *keyensis* and *major,* as subspecies), and a new species *naias*. The classification of Laurie and Hill (1954:44-45) repeated Andersen's 1911 (and 1912) arrangement of the genus, except for questionably placing *finschi* in the species *crassa*. Their listing, which conveniently includes type localities and general geographic ranges, is reproduced immediately below.

Genus **SYCONYCTERIS** Matschie

1899. *Syconycteris* Matschie, Megachiroptera Berlin Mus. 94, 95, 98 (described as a subgenus). Type *Macroglossus australis* Peters.

Syconycteris crassa (Thomas)
Syconycteris crassa crassa (Thomas)
1895. *Carponycteris crassa* Thomas, Novit. Zool. 2: 163. Fergusson Island, D'Entrecasteaux Archipelago. Range: Trobriand Islands: Kiriwina; D'Entrecasteaux Islands: Fergusson.

Syconycteris crassa papuana (Matschie)
1899. *Macroglossus* (*Syconycteris*) *papuanus* Matschie, Megachiroptera Berlin Mus. 95, 99. Andai, north-west Netherlands New Guinea. Range: New Guinea; Aru Islands.

[Syconycteris crassa finschi (Matschie)]
1899. *Macroglossus* (*Syconycteris*) *finschi* Matschie, Megachiroptera Berlin Mus. 95, 100. New Pomerania (= New Britain), Bismarck Archipelago. Range: Bismarck Archipelago.

Syconycteris crassa keyensis K. Andersen
1911. *Syconycteris crassa keyensis* K. Andersen, Ann. Mag. N.H. 7:643. Kei Islands. Range: Kei Islands.

Syconycteris crassa major K. Andersen
1911. *Syconycteris crassa major* K. Andersen, Ann. Mag. N.H. 7:643. Amboina. Range: Amboina group: Amboina; Ceram; range probably includes Buru and other small islands near Amboina.

Syconycteris naias K. Andersen
1911. *Syconycteris naias* K. Andersen, Ann. Mag. N.H. 7:643. Woodlark Island, Trobriand Islands.

Syconycteris australis (Peters)
1867. *Macroglossus minimus* var. *australis* Peters, M.B. Preuss. Akad. Wiss. Berlin, 13. Rockhampton, Queensland. Range: Papua; also extralimital.

Andersen (1911:642-643; 1912:775, 781) noted that the only character distinguishing all subspecies of *Syconycteris crassa* from *S. australis* was the broader, less linear, form of the premolars and molars in *crassa*. *Syconycteris naias* was differentiated morphologically from *australis* solely by the former's lack of M2/ and M/3, and Andersen (1912:785) stated that except for the absence of these teeth "this form would be difficult to distinguish from *S. australis*."

Tate (1941:346-347) examined the 23 New Guinea and Australia *Syconycteris* specimens available to him at the time, and reaffirmed Andersen's conclusion that *crassa* and *australis* were valid species. Tate found them "readily distinguished" on the basis of difference in cheek-tooth width, and stated that he had found them sympatric in the Port Moresby area of Papua New Guinea. Tate made no reference to *naias*. Lidicker and Ziegler (1968:33-34) examined a series of *Syconycteris* from Woodlark Island (type locality of *naias*) as well as from 4 other southeast Papua New Guinea islands, and found the presence or absence of cheek teeth, including M2/ and M/3, apparently individually and randomly variable in these island specimens. They concluded *naias* could not be considered more than subspecifically distinct from *australis*.

More recently, Hill (in Grieg-Smith, 1975:119) and Koopman (1979:8) examined the alleged tooth-width difference between *S. australis* and *crassa*, and both concluded that the 2 taxa are conspecific. I have examined 6 of the New Guinea *Syconycteris* specimens assigned to *australis* and to *crassa* by Tate in his 1941 study cited above and, like Hill and Koopman, am unable to find consistent differences in tooth dimensions by which to differentiate the 2 named forms. Supporting this judgment is the further examination of 735 Bishop Museum *Syconycteris* specimens from New Guinea (255 with cleaned skulls), in which I have likewise not been able to find any dental, cranial, or external characters suggestive of specific distinctness of these 2 putative species.

Thus, it appears that all previously named *Syconycteris* may best be arranged under a single species; the earliest name for this taxon being *Syconycteris australis* Peters (Common Blossom Bat). I have not had an opportunity to examine enough comparative material, especially representing the islands off the eastern half of New Guinea, and from Irian Jaya and Australia, to be qualified to propose meaningful subspecific groupings within this species.

During the study of the present Bishop Museum collection of Megachiroptera, taken at a great variety of, primarily, mainland New Guinea localities between 1959 and 1977, several specimens of a high-elevation macroglossine were found that seem best referred to *Syconycteris* but that differ from the sympatric *S. australis* in several external, cranial, and dental characters. These specimens are considered to represent a previously unnamed species, which is described here.

METHODS

Measurements of Bishop Museum specimens cited herein were obtained as follows. The head-and-body lengths (which it was felt could not accurately be remeasured on study skins and many alcoholic specimens) are those appearing on the collector's field label. The hind-foot and forearm lengths, however, were remeasured by the author to the nearest mm with a straight rule, and these figures are used here. The cranial and dental measurements of dermestid-cleaned skulls were made under 1.75x magnification with needle-point dial calipers calibrated to 0.1 mm. Alizarin-stained bacula were examined and measured with the same calipers under various powers of a binocular dissecting microscope.

Bishop Museum specimens were assigned to one of 2 general age classes on the basis of degree of fusion of the distal metacarpal epiphysis of the third digit: subadult if a gap indicating a cartilaginous area between shaft and epiphysis of the bone was visible macroscopically; adult if no such gap was present. Within the subadult category, it was often possible to further subjectively judge individuals as relatively younger or older by variation in the proximodistal extent of the cartilaginous section. All specimens used are listed in this paper under Comparative Material Examined, and some of these are described in more detail in appropriate portions of the Discussion section.

For purposes of this paper, the normal complete dental formula of *Syconycteris* (and *Macroglossus*) is considered to be:

I1/1 I2/2 – C1/1 – P2/2 P3/3 P4/4 M1/1 M2/2 M-/3, with M2/ and M/3 being the teeth lacking in the holotype of *Syconycteris naias* and, occasionally, other specimens of the genus.

Capitalized color terms used here are those of Ridgway (1912). Statistical procedures and terminology follow Simpson, Roe, and Lewontin (1960).

The abbreviations used in text, figures, and tables are explained as follows:

AMNH	American Museum of Natural History, New York.
BBM-NG	Bernice P. Bishop Museum, Honolulu.
BM(NH)	British Museum (Natural History), London.
BW	Braincase width: least distance across cranium immediately posterior to squamosal roots of zygomatic arches.
BZM	Zoologisches Museum, Berlin.
C1/-C1/	Upper canine breadth: greatest outside distance across upper canine crowns.
C1/-M2/	Upper canine-to-second-molar length: greatest distance from anteriormost extent of upper canine crown to posteriormost extent of upper second (=terminal) molar crown.
C/1-M/3	Lower canine-to-third-molar length: greatest distance from anteriormost extent of lower canine crown to posteriormost extent of lower third (=terminal) molar crown.
CB	Condylobasal length: greatest distance from posteriormost extent of occipital condyles to anteriormost extent of premaxillae, not including upper incisors.
(ch)	Chord: signifying straight-line, rather than curvature, measurements, as of forearm and fore-digits.
(cu)	*Cum unguis*: signifying measurements including claw, as of hind foot and fore-digits.
D I, II	Chord lengths of, respectively, first and second fore-digits.
D III 1, 2	Chord lengths of, respectively, proximal and distal phalanges of third fore-digit.
D IV 1, 2	Chord lengths of, respectively, proximal and distal phalanges of fourth fore-digit.
D V 1, 2	Chord lengths of, respectively, proximal and distal phalanges of fifth fore-digit.
E(n)	Ear length from notch: greatest distance from base of ventral notch on lateral surface of ear to distalmost point on rim of pinna.
FA	Forearm length: taken as a chord measurement, and not including carpals.

GL Greatest length of cranium: greatest distance from anteriormost extent of upper incisors to posteriormost extent of cranium.

H&B Head-and-body length: greatest distance from anteriormost extent of nose to posteriormost extent of body in midline.

HF Hind-foot length: greatest distance from distalmost extent of calcaneum to distalmost extent of claw on longest hind-digit.

LN Lachrymonasal length: distance between anterior rim of one lachrymal foramen and anteriormost extent of nasals in midline.

IW Interorbital width: least distance across frontals between postorbital processes and anterior rim of orbits.

M1/ L Upper first-molar length: greatest anteroposterior crown length.

M1/ W Upper first-molar width: greatest mediolateral crown width.

Mc III,IV,V Chord lengths of, respectively, third, fourth, and fifth metacarpals.

N Number of specimens in sample.

OR Observed range of sample measurement.

P Probability: as derived from Student's *t*-distribution ("2-sided").

P4/4-P4/4 Fourth-premolar breadth: greatest outside distance across, respectively, upper and lower fourth premolar crowns.

PL Palatal length: greatest distance from posteriormost extent of bony palate in midline to anteriormost extent of premaxillae, not including incisors.

PW Postorbital width: least distance across frontals immediately posterior to postorbital processes.

s Standard deviation of sample measurement.

$s_{\overline{X}}$ Standard error of sample mean.

$\overline{V}$ Coefficient of variation of sample measurement.

$\overline{X}$ Mean of sample measurement.

ZW Zygomatic width: greatest outside distance across zygomatic arches.

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I am indebted to Dr. Karl F. Koopman, American Museum of Natural History, New York, for the loan of New Guinea *Syconycteris* specimens; and to Dr. James Dale Smith, California State University at Fullerton, for providing information on *Syconycteris* holotypes he had examined in the Zoologisches Museum, Berlin, as well as for an indispensable copy of Matschie (1899). Dr. H. Hackethal of that museum kindly confirmed that the catalog number of the holotype of *Macroglossus* (*Syconycteris*) *finschi* is BZM 6270, not 6070 as mistakenly listed in Andersen (1912:779). Dr. Frank J. Radovsky, Bishop Museum Department of Entomology Chairman, reviewed a draft of the manuscript and offered helpful comments. Ben W. Patnoi and Jean Kuehneman of Bishop Museum aided greatly by, respectively, preparing the photographs and typing the manuscript of this paper. Christine Baer, Hawaii Institute of Marine Biology, executed the line drawings.

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For the opportunity of Bishop Museum to collect, export, and report on New Guinea mammals, I also wish to express my great appreciation to the numerous past and present officials of the Papua New Guinea Department of Lands, Surveys and Environment, especially to Navu Kwapena, current Assistant Secretary (Wildlife); and to W. L. Conroy, W. Lawrence, and J. Natera, who held the position of Conservator of Fauna at the various periods specimens used in this study were obtained.

TAXONOMIC SECTION

Syconycteris hobbit, sp. nov.
Moss-forest Blossom Bat

Holotype

Bernice P. Bishop Museum Vertebrate Zoology Catalog No. BBM-NG 96644; adult ♀; alcoholic with cleaned skull; from Papua New Guinea, Morobe Province, Bulldog Road, 19± km S of Edie Creek (town), 2400± m, (approximate coordinates 7° 31′ S, 146° 40′ E); collected 10 June 1968, by Abid Beg Mirza.

Paratypes

Five, all Bishop Museum Vertebrate Zoology Catalog Nos., as follows. Papua New Guinea, Morobe Province, Bulldog Road, 19± km S. Edie Creek (town): BBM-NG 28923, subadult ♂, study skin and skull, 2440± m, 13 August 1963, Harold W. Clissold; BBM-NG 52394, adult ♀, and 52398, subadult ♂, both study skin and skull, 2405± m, 11 July 1966, Nixon A. Wilson. Papua New Guinea, Morobe Province, Mt. Kaindi, 2300± m, (approximate coordinates 7° 21′ S, 146° 43′ E): BBM-NG 51176, subadult ♀, study skin and skull, 14 July 1967, Philip H. Colman; BBM-NG 53430, subadult ♀, entire alcoholic, 4 July 1967, Alan C. Ziegler.

Range and Habitat

Thus far known only from the type locality on the foot trail termed Bulldog Road, and the summit area of Mt. Kaindi about 15 km to the north. The predominant vegetation in both areas is moss forest: essentially unaltered along Bulldog Road; somewhat disturbed by human activities on Mt. Kaindi.

Description

A *Syconycteris* (see Andersen, 1912:771-775, for diagnosis of genus as previously known) with no trace of tail, uropatagium, or calcar; of average head-and-body length; (see Tables 1 and 2 for measurements), and above-average forearm length; index claw present; first and second fore-digits, and all remaining metacarpals, of essentially average length for genus; terminal phalanges of third (especially) and fourth fore-digits appreciably lengthened, terminal phalanx of fifth fore-digit slightly shorter than average; plagiopatagium attachment extending posteriorly to base of proximal phalanx of fifth hind-digit; ear pinna relatively short, evenly rounded distally, dark brown to blackish-brown with thickened, lighter-colored, rim all around (Fig. 1), naked internally and for distal 2/3 or 3/4 externally; hind foot of about average total length but metatarsus broad and long with plantar surface light-colored and fleshy (evident in fresh or alcoholic specimens), and hind-digits appearing relatively thick and short; tongue and soft palate (Fig. 2) generally typical for genus but tongue with about 70-75 centrally located trifid papillae, all of those of anterior area of median 3 rows about the same general size, and posteriormost palatal ridge with only 3 or 4 poorly developed, anteriorly projecting papillae; weight (see Table 3) of adults probably about 15.5-16.0 g, of subadults perhaps 14.5-15.5 g.

Dorsally, body pelage generally dark grayish-brown (varying overall from dark Olive Brown to near blackish Prout's Brown or Mummy Brown, with suffusion of Drab throughout; the coloration darkest on head, nape, and anterior back, lightening laterally and, especially, posteriorly, where color may approach Drab), the individual hairs lighter colored basally, with

Table 1
Comparison of Selected Measurements of *Syconycteris hobbit* Holotype With Holotypes of All Other Named Taxa of the Genus

Measurements of the previously named forms are those remeasured and listed by Andersen (1912:778-784). In cases where certain measurements of a holotype were not cited separately by either the describer or Andersen, Andersen's range of measurements of a series including the holotype is usually given. The holotype skull of *Macroglossus minimus* var. *australis* was not seen by Andersen, so certain holotype cranial and dental measurements appearing here were taken and supplied by James D. Smith, while the remaining, parenthesized ones represent Andersen's measurements of a second, adult Australian specimen. A number of the listed holotype measurements of *Macroglossus* (*Syconycteris*) *papuanus* were also obtained from Smith. Asterisks (*) in the *Syconycteris naias* column indicate the figures are for the measurements C1/-M1/ and C/1-M/2, respectively. All measurements are in mm, and are explained in the Methods section.

MEASUREMENT	*Syconycteris hobbit* BBM-NG 96644 ♀ ad.	*Macroglossus minimus* var. *australis* BZM 3292 ♂ subad.	*Carponycteris crassa* BM(NH) 95.5.8.2 ♂ ad.	*Macroglossus* (*Syconycteris*) *finschi* BZM 6270 ♂ ad.	*Syconycteris crassa keyensis* BM(NH) 99.12.4.2 ♂ ad.	*Syconycteris crassa major* BM(NH) 10.7.25.1 ♂ ad.	*Syconycteris naias* BM(NH) 96.11.5.29 ♀ ad.	*Macroglossus* (*Syconycteris*) *papuanus* BZM 4699 ♂ ad.
H&B	70	–	70	–	--	--	–	--
HF(cu)	12	12	12.5-13	11.5	11.5	?-15	11.5	11-13.5
E(n)	12	13	13.5	13	12.5	15	14.5	13
FA	50	39	45.5	39	42.5	49	41	43
D I(cu)	18	16	18-18.5	16.5	17	19-20	16	15-18
D II(cu)	32	29.5	31.5-34.5	29	32	35-36	29.5	29-35
Mc III	32	29.5	33.5	30.5	32	38	31.5	33
D III 1	23	22	24-24.5	22.5	24	23.5-27	23	23.4
D III 2(ch)	39	25.5	29.5-30.5	25.5	27	28.5-31	28	26.6
Mc IV	31	29	32.5-34	30.5	30.5	32-37.5	31	32.6
D IV 1	19	16.5	17.5-18.5	16.5	17	18-20	17	18.4
D IV 2(ch)	23	16.5	–	16	16.5	18-19.5	18	17.2
Mc V	34	30.5	33-35	30.5	31	33-37.5	31	34.1
D V 1	17	13.5	14-15	13	14	14.5-16	14.5	15.1
D V 2(ch)	15	14	16.5-17	13.5	15	16-18	16	15.1
GL	25.3	(25.5)	28.8	25	25.8	29.8	26.5	26.5
CB	23.5	23.6	25.8-26.7	23.2	24	?-28.2	24.8	24.1
ZW	13.7	14.2	17	15	15.2	17.3-18.2	14.8	15.7
IW	4.7	5.1	6.1	6.0	5.7	5.5-6.2	5.5	5.6
PW	5.5	(7.7)	6.9-8.2	7.0	6.7	6.5-7.5	7	6.5-7.8
BW	10.2	11.0	11.2-11.7	10.7	10.2	11.5-11.7	10.5	11.2
C1/-M2/	7.6	7.0	8.7	7.2	7.1	9.3	7.2*	8.5
C1/-C1/	4.9	4.7	5.8-6	5.2	5.2	6-6.5	5.1	5.2
M1/L	1.1	(1.1)	1.0-1.3	1.0	1.0	1.1-1.3	1.1	0.8-1.2
M1/W	0.7	(0.6)	0.9	0.7	0.7	0.8-0.9	0.6	0.7-0.9
C/1-M/3	8.4	10.1	9.8-10.5	8.3	8.8	10-11.5	8.2*	10.2

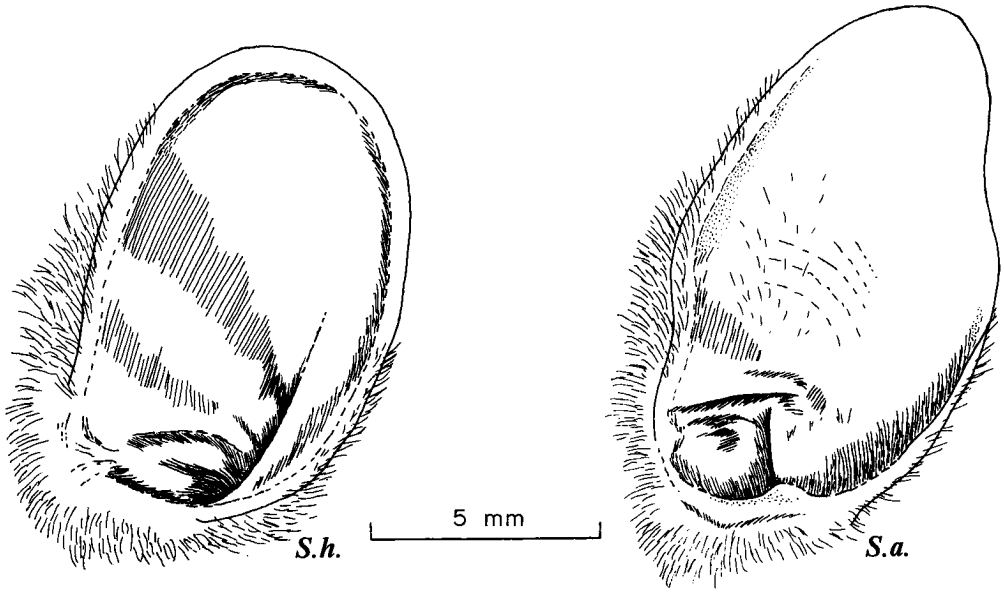

Figure 1. Comparison of ear pinnae of *Syconycteris hobbit* and *australis*. Left ears are shown in lateral view. *S. h.*: *Syconycteris hobbit*, BBM-NG 96644, adult ♀, holotype; *S. a.*: *Syconycteris australis*, BBM-NG 53431, adult ♀, from Mt. Kaindi sympatric sample.

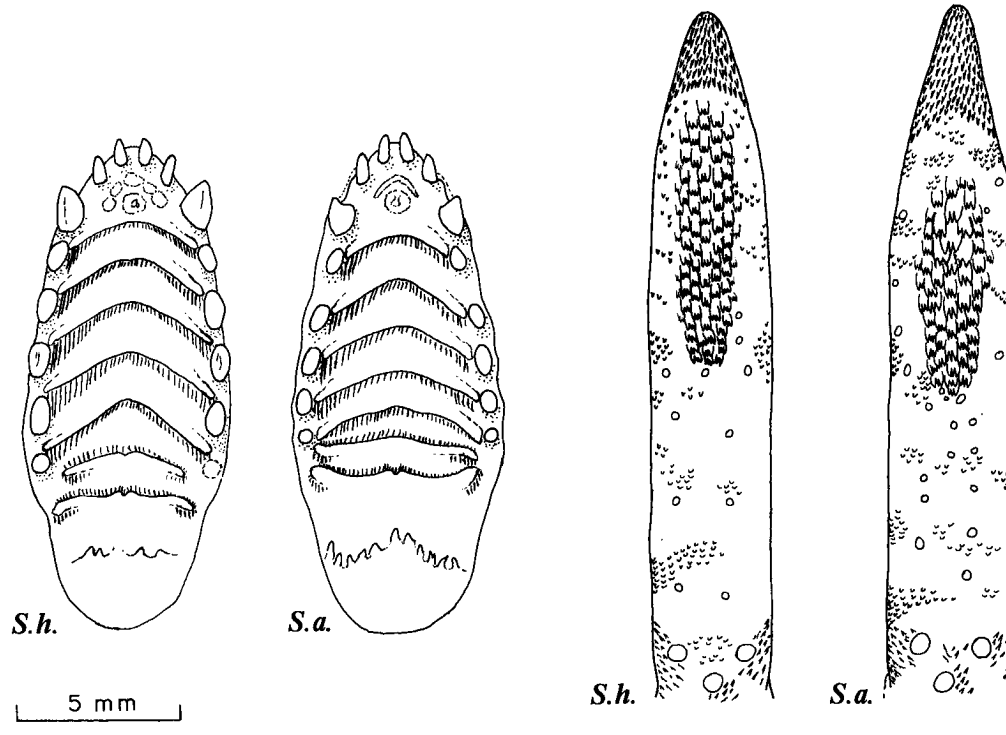

Figure 2. Comparison of soft palates and dorsal tongue surfaces of *Syconycteris hobbit* and *australis*. The upper left M2/ is missing in the *hobbit* specimen illustrated. *S. h.*: *Syconycteris hobbit*, BBM-NG 96644, adult ♀, holotype; *S. a.*: *Syconycteris australis*, BBM-NG 53431, adult ♀, from Mt. Kaindi sympatric sample.

darker, somewhat shiny tips, many longer, all-silvery hairs scattered throughout dorsal pelage enhancing the slightly glistening appearance produced by these shiny terminal portions of normal-length hairs; ventrally, pelage duller and lighter grayish-brown (varying from Drab to very light Drab-tinged Olive Brown, with Drab-Gray to Light Drab hair tips); dorsal pelage relatively dense and slightly woolly, remaining rather dense out onto hind limbs, thinning slightly on dorsal surfaces of metatarsus and hind-digits (Fig. 3).

Skull (Fig. 4; Tables 1 and 2) with cranium small, short (especially rostrally), and rather narrow for genus in most measurements, but palate relatively broad at midsection (level of P4/), mandibular ramus also bowed laterally at midsection; number and overall positioning of teeth, including lower incisors, generally typical for genus, with both M2/ and M/3 present, but postcanine teeth somewhat more closely spaced than usual, giving relatively short lower and, often, upper tooth rows; occlusal crown outlines of individual postcanine teeth more rounded or less linear than in many forms of genus.

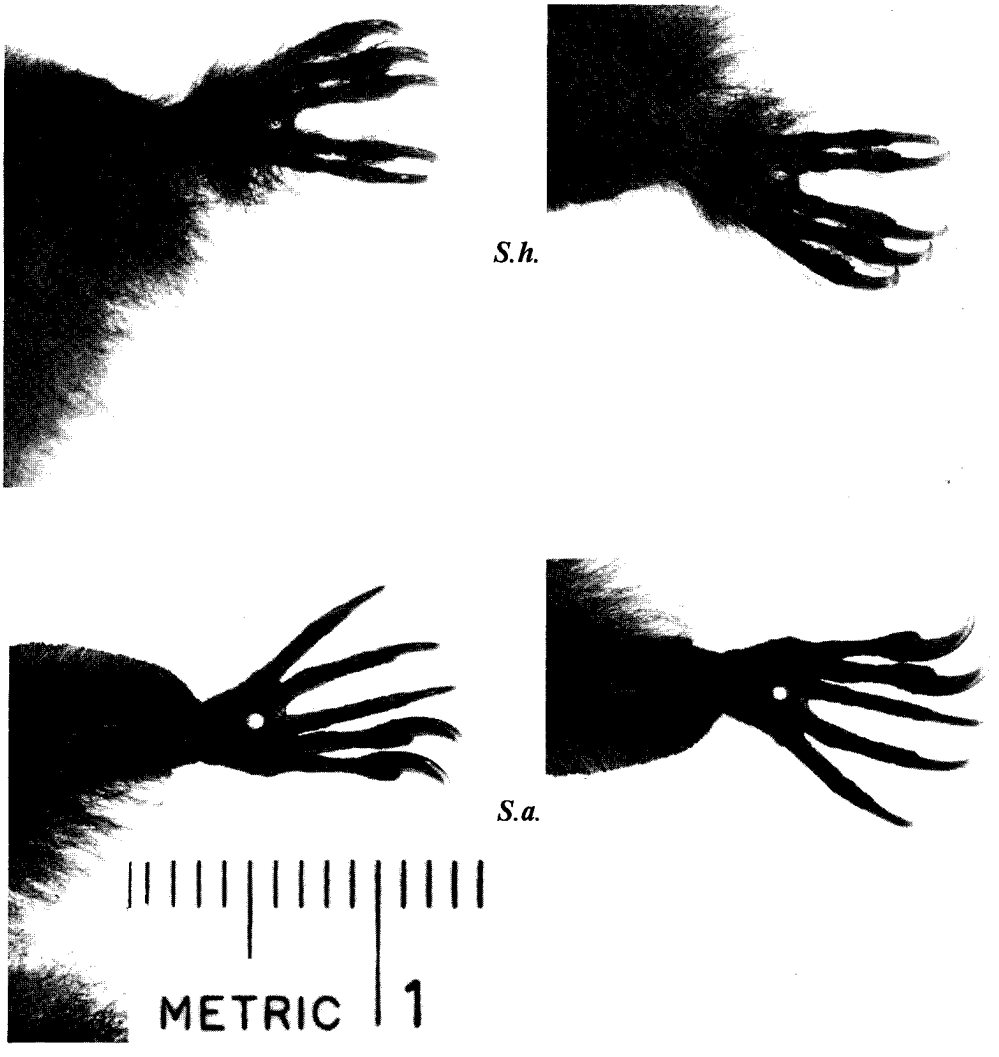

Figure 3. Comparison of dorsal (left) and plantar (right) aspects of right pes in study skins of *Syconycteris hobbit* and *australis*. *S. h.* : *Syconycteris hobbit*, BBM-NG 52398, subadult ♂, paratype; *S. a.*: *Syconycteris australis*, BBM-NG 51046, subadult ♂, from Mt. Kaindi sympatric sample.

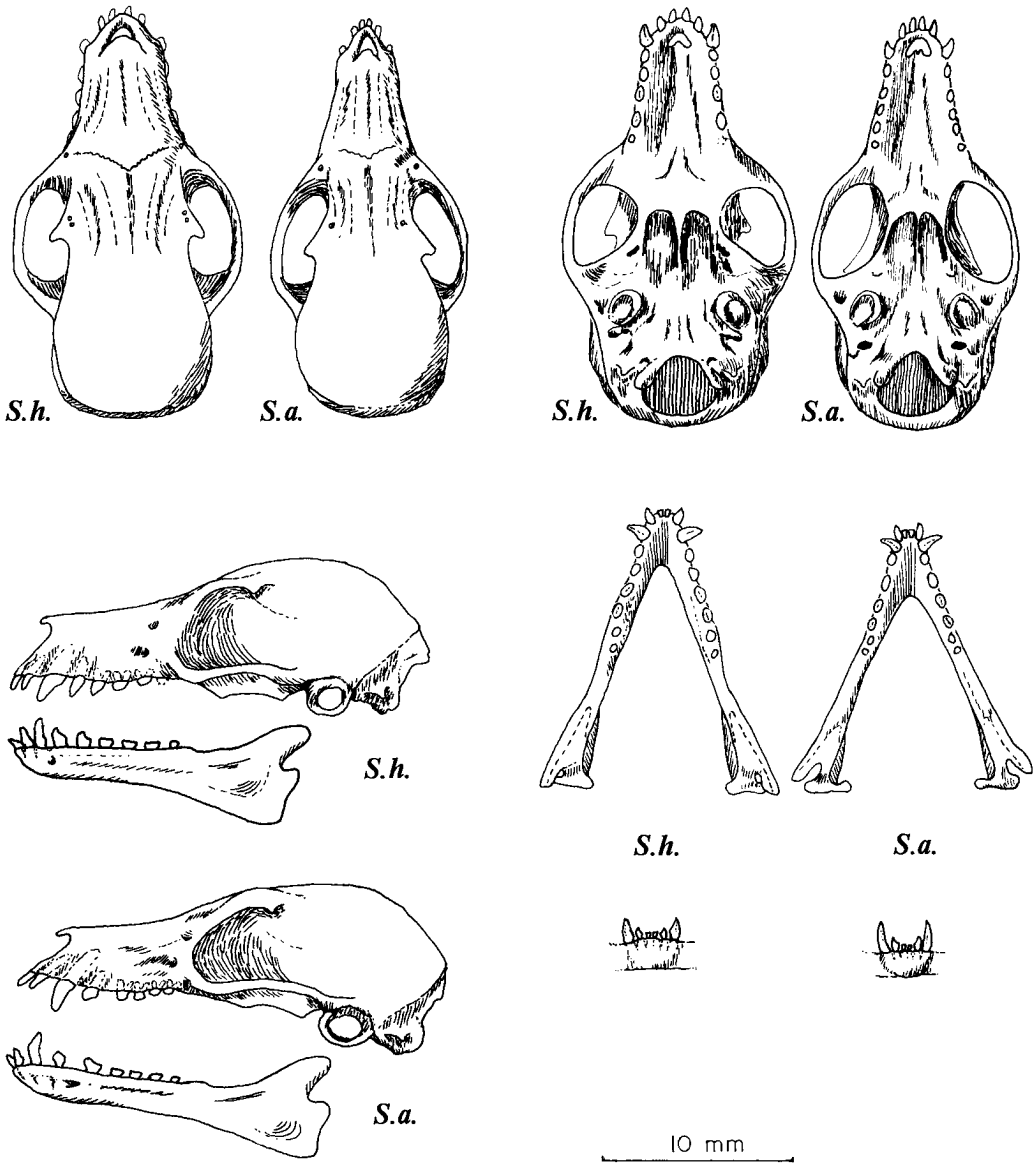

Figure 4. Comparison of skulls of *Syconycteris hobbit* and *australis*. The upper left M2/ is missing in the *hobbit* specimen illustrated. *S. h.*: *Syconycteris hobbit*, BBM-NG 96644, adult ♀, holotype; *S. a.*: *Syconycteris australis*, BBM-NG 53431, adult ♀, from Mt. Kaindi sympatric sample.

Differential Diagnosis

Syconycteris hobbit can be distinguished externally from all populations of *S. australis* primarily by the following characteristics of *australis*. Rudimentary uropatagium present and about 0.5-2.5 mm wide along medial side of femur and tibia; rudimentary calcar usually present and about 0.5-1.5 mm long; terminal phalanx of third fore-digit less than 34 mm (range probably about 20-33); ear pinna (Fig. 1) relatively long and bluntly pointed, without thickened, lighter-colored, distal rim; metatarsus relatively narrow and short, with plantar surface dark colored and not especially fleshy (even in fresh or alcoholic specimens), and hind-digits appearing rela-

tively thin and long; dorsal surfaces of metatarsus and hind-digits (Fig. 3) naked or, at most, with only a very few scattered hairs; tongue (Fig. 2) with about 50-55 centrally located trifid papillae, an anteromedian one and the 6 immediately surrounding it noticeably enlarged; posteriormost palatal ridge with 10-12, relatively well-developed, anteriorly projecting papillae (see Fig. 2).

Forearm length in *Syconycteris australis* is less than about 44 mm in all forms except *major* (from Amboina Island and vicinity, west of New Guinea; forearm reaching at least 49 mm), and, possibly, *crassa* (of islands off southeast tip of New Guinea; ranging between about 43.5 and 47.5 mm).

The dorsal pelage of *Syconycteris australis* in any area is apparently always slightly less dense, less woolly, duller (because of both lack of shiny hair-tips and presence of only a relatively small number of longer, all-silvery, intermixed hairs), and lighter in coloration than that of *S. hobbit*; but because of the difficulty in describing the sometimes rather subtle variations in color and other characteristics of pelage, direct comparison of specimens is often required to satisfactorily illustrate these differences. The pelage of *S. australis* from moss-forest habitat above about 2200 m is the darkest found in the species: the tips of the hairs (which have lighter basal portions) being some shade of dark brown (dorsally, overall color near light Prout's Brown or dark Olive Brown, with a slight Drab tinge; ventrally, between Wood Brown and Drab, with Pale Drab-Gray to Drab-Gray hair tips). Coloration in *australis* gradually lightens with decrease in elevation until, in dry, open, forest near sea level, the general coloration is usually some shade of light tan (dorsally, near Pinkish Buff or Cinnamon Buff; ventrally, near Pale Pinkish Cinnamon to Pale Pinkish Buff).

Cranially, *Syconycteris hobbit* can be distinguished from all populations of *S. australis* primarily by the long lachrymonasal length of *australis*: apparently always at least 6.0 mm, and usually 6.5 or greater (between 6.0 and 6.4 in only 5 specimens of over 250 *australis* crania examined; 6.5-8.7 in remainder). Dentally, *hobbit* can be distinguished from most, and quite possibly all, populations of *australis* by the long lower canine-to-third-molar length of *australis*: probably always at least 8.3 mm (8.3 to, possibly, 11.5 in the various *australis* holotypes of Table 1; 8.3-9.3 in sympatric *australis* sample of Table 2). The values of other individual cranial and dental measurements of *hobbit* utilized in this study can be duplicated in some specimens of almost every form of *australis*. However, the values and interrelationships of the entire suite of cranial and dental measurements characteristic of *hobbit* will seldom, if ever, be found in an individual *australis* specimen. For example, *australis* individuals will apparently essentially always agree with at least a majority of the following 5 selected measurements, while *hobbit* individuals will agree with only one or 2. Long condylobasal length (usually more than 23 mm, ranging to about 30); great zygomatic width (usually more than 13.0, ranging to about 18.5), postorbital width (usually more than 6.0, ranging to about 8.5), and upper canine breadth (usually more than 5.0, ranging to about 6.5); as well as small lower fourth-premolar breadth (usually less than 5.0, ranging to about 4.0).

More-detailed statistical comparisons between external, cranial, and dental measurements of *Syconycteris hobbit* and a sample of sympatric *S. australis* are included in the Discussion section of this paper.

The only other megachiropteran occurring in New Guinea with which *Syconycteris hobbit* needs to be compared is *Macroglossus minimus* (for use of this specific name instead of *lagochilus*, see Lekagul and McNeely, 1977:81; Long-tongued Fruit Bat) because, on superficial examination, this small macroglossine could be mistaken for a form of *Syconycteris*. *Syconycteris hobbit* may be distinguished from *Macroglossus minimus* (which is typically a lowland rain-forest species, rarely reaching 1500 m) by the following characters of *minimus*. General appearance and length of ears, forearm, terminal phalanges of third and fourth fore-digits, body pelage, pes, and cranium and mandibular ramus shape, as well as dental formula, as in almost all populations of *Syconycteris australis*.

Additionally, both *S. hobbit* and, in most cases, *S. australis* can be distinguished from *M. minimus* by the following characters of *minimus*. Short tail present and about 1.0-4.0 mm long;

narrow uropatagium present and about 1.5-3.0 mm wide along medial side of femur and tibia; short calcar present and about 1.0-3.5 mm long; lateral lower incisor subequal in size to medial one (instead of almost twice as great in diameter and height); all incisors quite small, diameter of upper and lower lateral ones each less than half that of posteriormost molar of the same tooth row (instead of subequal); and, in the cleaned skull, bases of all incisors separated from one another by diastemata at least as great as their diameters (instead of being almost or quite in contact) or, in the fresh or alcoholic skull, exposed crowns of median lower incisors separated from each other by a diastema at least twice the width of lower median incisor crown.

Etymology

The specific name is an appositive noun, alluding to certain analogies between the newly described species and another seldom-seen forest form, described by Tolkien (1937), one of whose chief distinguishing characteristics was also a thickly haired pes.

DISCUSSION

Statistical Analysis of Measurements

A number of measurements of the holotype of *Syconycteris hobbit* have been compared with those of all other holotypes of the genus in Table 1. This method of comparison of only single specimens of each taxon with each other is, of course, of quite limited value in describing the true range of variation to be expected in the various populations of the genus. However, in this case, the differences in diagnostic measurements do serve to show that the new species *hobbit* is fairly surely not represented by, at least, any of the previously named individual holotype specimens. Comparison of the present *Syconycteris hobbit* material with substantial samples of all of these other named taxa of the genus is beyond the scope of this investigation. But it seems obviously necessary to somewhat extensively describe variation within the new species, as well as to compare this variation with that of an adequate sample of a sympatric population of *S. australis.*

Thus, for comparison with the hypodigm of *Syconycteris hobbit* (4 ♀♀, including the holotype, and 2 ♂♂), a sample of 10 ♀♀ and 10 ♂♂ *Syconycteris australis* from Mt. Kaindi, and thus sympatric with *hobbit*, were selected (for collection and other data see Specimens Examined). First, to determine if either of the 2 species were sexually dimorphic with respect to any of the measurements considered, within each of the 2 samples specimens were grouped by sex, and the means of all measurements listed in Table 2 calculated for females and for males. Student's *t*-test ("2-sided") was used to compare these sample means within each species. Under the assumptions of the null hypothesis, none of the *hobbit* means proved to differ between the sexes at the $\leqslant .05$ level of significance; the probabilities ranging from $\sim .09$ to ~ 1.00. Among the *australis* means, only the lower fourth-premolar breadth differed between male and female ($♀♀\bar{X} = 4.40$, $♂♂\bar{X} = 4.23$; $P \cong .005$); the remaining probabilities ranging from $\sim .1$ to $> .9$. Therefore, with the exception of this single *australis* measurement, it was concluded that neither species was sexually dimorphic with respect to the measurements considered, and that it was justifiable to group measurements of females and males within each species sample for further testing. The difference in linear measurements between individuals assessed as either adult or subadult did not appear to be great, so to avoid an excessive amount of statistical computation as well as to simplify presentation of the findings regarding the numerous measurements, the samples of the 2 species were not subdivided by age for these particular comparisons.

Combined means for each of the 2 species were then calculated and compared, using the same statistical test, to determine which of the measurements apparently differed significantly between *Syconycteris hobbit* and sympatric *S. australis*. The resultant probabilities that the sample means for the various measurements could have been obtained from populations of the 2 species that were essentially identical with respect to a particular measurement ranged from a highly significant $< .001$, to a nonsignificant $> .8$, as listed in Table 2. (The lower fourth-

Table 2

Statistical Comparison of Measurements of *Syconycteris hobbit* Hypodigm And *S. australis* Sympatric Sample from Mt. Kaindi

The extreme right-hand column contains the probabilities (Student's *t*-test, "2-sided") that the *S. hobbit* sample could have been drawn from a population with the same parameters for the corresponding measurements as those of the *S. australis* population. The asterisk in the D III 2(ch) column for *S. hobbit* indicates the figure is probably several mm too low, compared to those for other individuals, because of apparently abnormal curvature of the phalanx in drying. All measurements are in mm and, along with the statistical abbreviations, are explained in the Methods section.

	SYCONYCTERIS HOBBIT						*SYCONYCTERIS AUSTRALIS*						P
MEASUREMENT	**N**	$\bar{X}$	± $s_{\bar{X}}$	**OR**	**s**	**V**	**N**	$\bar{X}$	± $s_{\bar{X}}$	**OR**	**s**	**V**	
H&B	6	67.7	± 2.25	59-75	5.50	8.13	20	66.5	± 0.96	61-78	4.29	6.45	>.5
HF(cu)	6	12.3	± 0.21	12-13	0.52	4.18	20	12.1	± 0.09	11-13	0.39	3.27	>.1
E(n)	5	12.0	± 0.32	11-13	0.71	5.89	20	15.4	± 0.11	15-16	0.49	3.19	<.001
FA	6	47.2	± 0.75	45-50	1.84	3.89	20	40.4	± 0.20	39-42	0.88	2.18	<.001
D I(cu)	6	16.7	± 0.33	16-18	0.82	4.90	20	16.4	± 0.11	16-17	0.49	2.99	>.2
D II(cu)	6	30.0	± 0.58	28-32	1.41	4.71	20	30.2	± 0.29	28-33	1.31	4.34	>.8
Mc III	6	30.2	± 0.54	28-32	1.33	4.41	20	30.1	± 0.18	29-32	0.79	2.62	>.8
D III 1	6	21.5	± 0.43	20-23	1.05	4.88	20	22.1	± 0.18	21-23	0.79	3.57	>.1
D III 2(ch)	6	34.5	± 1.23	30*-39	3.02	8.74	20	23.9	± 0.24	22-26	1.07	4.48	<.001
Mc IV	6	29.3	± 0.56	27-31	1.37	4.66	20	28.8	± 0.24	27-31	1.06	3.67	>.3
D IV 1	6	18.5	± 0.22	18-19	0.55	2.96	20	16.7	± 0.16	16-18	0.73	4.39	<.001
D IV 2(ch)	6	20.5	± 0.56	19-23	1.38	6.72	20	15.8	± 0.23	14-18	1.01	6.36	<.001
Mc V	6	31.8	± 0.79	29-34	1.94	6.10	20	28.8	± 0.20	27-30	0.91	3.17	<.001
D V 1	6	16.0	± 0.37	15-17	0.89	5.59	20	13.7	± 0.13	13-15	0.59	4.30	<.001
D V 2(ch)	6	13.2	± 0.48	12-15	1.17	8.88	20	14.9	± 0.20	13-16	0.88	5.89	<.001
GL	5	24.90	± 0.25	24.2-25.4	0.56	2.24	19	25.36	± 0.11	24.6-26.3	0.48	1.90	~.08
CB	4	23.15	± 0.36	22.1-23.7	0.72	3.11	19	23.48	± 0.13	22.4-24.4	0.57	2.41	>.3
LN	5	5.74	± 0.14	5.3-6.1	0.32	5.59	20	7.08	± 0.06	6.4-7.5	0.25	3.57	<.001
PL	5	11.48	± 0.15	11.0-11.8	0.34	2.98	19	12.08	± 0.05	11.7-12.4	0.21	1.77	<.001
ZW	5	13.06	± 0.19	12.7-13.7	0.42	3.19	19	13.35	± 0.11	12.6-14.3	0.48	3.62	>.2
IW	5	4.56	± 0.13	4.3-5.0	0.29	6.32	20	4.36	± 0.07	4.0-5.1	0.30	6.98	>.1
PW	5	5.52	± 0.25	4.6-6.1	0.56	10.13	20	6.61	± 0.09	5.9-7.3	0.39	5.85	<.001
BW	5	10.34	± 0.08	10.2-10.6	0.17	1.62	20	10.71	± 0.05	10.3-11.1	0.24	2.25	<.01
C1/-M2/	5	7.36	± 0.13	7.0-7.7	0.29	3.91	20	7.33	± 0.06	6.8-7.9	0.27	3.71	>.8
C1/-C1/	5	4.76	± 0.07	4.6-4.9	0.15	3.19	20	4.72	± 0.05	4.3-5.3	0.23	4.84	>.6
P4/-P4/	5	5.94	± 0.04	5.9-6.1	0.09	1.50	20	5.31	± 0.05	4.8-5.7	0.22	4.22	<.001
M1/L	5	1.04	± 0.03	1.0-1.1	0.06	5.29	20	0.76	± 0.02	0.6-1.0	0.09	11.79	<.001
M1/W	5	0.72	± 0.02	0.7-0.8	0.05	6.25	20	0.57	± 0.01	0.5-0.7	0.06	11.05	<.001
C/1-M/3	5	8.16	± 0.11	7.8-8.4	0.25	3.08	20	8.67	± 0.06	8.3-9.3	0.25	2.90	<.001
P/4-P/4	5	5.26	± 0.06	5.1-5.4	0.13	2.55	20	4.32	± 0.03	4.1-4.5	0.14	3.20	<.001

premolar breadth means of *australis* females and males were compared separately with the *hobbit* combined sample mean, and in both cases P<.001.)

Weight

Only 2 body weights are recorded for *Syconycteris hobbit*: 15.7 g for BBM-NG 52394, adult ♀, and 15.1 g for BBM-NG 52398, subadult ♂; both taken at 2405± m on Bulldog Road, 11 July 1966. No weights are recorded for the sample of 20 Mt. Kaindi *Syconycteris australis* used in the preceding statistical comparisons with *hobbit*. However, 3 other samples of *australis*, all from Morobe Province, Papua New Guinea, with weights recorded by the field collectors are available: 6 adults (all ♀♀), 10 subadults (1♂, 9♀♀), from Bulldog Road, 2405± m, 8-14 July 1966; 3 adults (all ♀♀), one subadult (♂), from 24 km SW Kabwum, 2550± m, (approximate coordinates: 6° 20′ S, 146° 55′ E), 14 August 1966; and 14 adults (10 ♂♂, 4 ♀♀), 9 subadults (4 ♂♂, 5 ♀♀), from Kalalo, 750± m, (approximate coordinates: 6° 4′ S, 147° 11′ E), 19-30 August 1966.

The size of the *Syconycteris hobbit* sample obviously is quite small, as is also that of some of the *australis* samples or age subsamples; also, only the months of July and August are represented by weighed specimens. Thus, statistical conclusions drawn here are tentative, with different results possible if sample sizes were larger and the range of collection dates greater. Means and other weight data obtained for the 2 species of *Syconycteris* appear in Table 3. To determine if body weight in the genus might vary with sex and age, weights of males and females within each of the 2 age classes of *australis* in the largest sample (Kalalo) were compared by means of Student's *t*-test ("2 sided") with a P≤.05 considered significant. No sexual dimorphism in weight was evident in either age group (P>.7 in the case of both adults and subadults), but the mean weight of Kalalo adults proved to be significantly different from that of subadults (P<.01). Thus, for further comparison using the same statistical test, the 2 age groupings for all samples were retained but sexes were pooled within each group.

Table 3

Statistical Comparison of Body-weight Data for *Syconycteris hobbit* and *australis* From Morobe Province, Papua New Guinea

The right-hand column contains the probabilities (Student's *t*-test, "2-sided") that the adult and subadult *S. hobbit* individuals could have been drawn from populations with the same weight parameters as the various *S. australis* populations of corresponding age. All weights are in g, and the statistical abbreviations are explained in the Methods section.

	N	$\bar{X}$	±	$s_{\bar{X}}$	OR	s	V	P
S. hobbit								
Bulldog, 2405± m								
adult	1	15.7						
subadult	1	15.1						
S. australis								
Bulldog, 2405± m								
adults	6	14.70	±	0.29	14.0-15.7	0.713	4.85	>.2
subadults	10	10.80	±	0.40	9.6-13.5	1.25	11.57	<.01
Kabwum, 2550± m								
adults	3	15.13	±	0.30	14.7-15.7	0.515	3.40	>.4
subadult	1	13.2						
Kalalo, 750± m								
adults	14	18.99	±	0.58	16.1-24.6	2.17	11.43	>.1
subadults	9	16.23	±	0.53	13.0-17.9	1.60	9.86	>.5

The means shown in Table 3 suggest that the weights of both adult and subadult *Syconycteris hobbit* may be greater than those of equivalent-aged *australis* from similarly high elevations, but less than those of *australis* from an elevation below 1000 m. However, in the case of the present relatively limited sampling, this apparent difference is not statistically significant except in the case of Bulldog Road subadults (*hobbit* heavier than sympatric *australis*). The possible significance of the observed differences in weight between the single adult and subadult *hobbit* specimens, as well as between the latter individual and the single subadult Kabwum *australis* specimen, could not be investigated with Student's *t*-test, and thus remains uncertain.

The *Syconycteris australis* data alone allow certain other tentative inferences not directly indicated in Table 3 regarding weight relationships within and among the 3 sampled populations of the species. It seems, in Morobe Province of northeastern Papua New Guinea, July-August *australis* adults are generally heavier than subadults of the same population; and all individuals above about 2200 m are generally similar in weight to other individuals of equivalent age from approximately equal elevations, but are lighter in weight than animals of populations below 1000 m. Specifically, within each of the 3 *australis* samples, adult weight differed significantly from that of subadults at Kalalo (750± m; $P<.01$) as mentioned earlier, and also at Bulldog Road (2405± m; $P<.001$) although not at Kabwum (2550± m; $P\cong.09$). Also, Bulldog Road and Kabwum adult weights did not differ significantly from each other ($P>.3$), but both differed from that of Kalalo adults ($P<.001$ and $<.01$, respectively). Similarly, weights of Bulldog Road and Kabwum subadults did not differ from each other ($P>.1$), but Bulldog Road subadults were lighter than Kalalo subadults ($P<.001$) although the weight of the single Kabwum subadult did not differ from that of the low-elevation specimens ($P>.1$).

Flight Characteristics

Two specimens of the *Syconycteris hobbit* hypodigm were preserved as alcoholics, and thus measurements of the area of the flight membrane or plagiopatagium could be obtained. For comparison with these, the plagiopatagia of the 2 alcoholic specimens in the sample of 20 Mt. Kaindi sympatric *S. australis* were similarly examined. The procedure of Struhsaker (1961:153-154) was followed except that, because of the small size of the sample, both wings (instead of only one) of each of the 4 specimens were measured, and the mean for each character calculated and used for each individual. The area of the rudimentary uropatagium of *australis* was

Table 4
Plagiopatagium Measurements and Flight-characteristics Data
For *Syconycteris hobbit* and *australis*

	Wing Len. (average, cm)	Wing Area (average, cm^2)	Aspect Ratio (Struhsaker, 1961)	Wing Span (cm)	Aspect Ratio (Dwyer, 1965)	Wing Load (lb/ft^2)
S. hobbit						
BBM-NG 96644 ♀ ad.	13.8	65.27	2.92	27.6	5.84	0.25
BBM-NG 53430 ♀ subad.	13.0	56.46	2.99	26.0	5.99	0.27
S. australis						
BBM-NG 53431 ♀ ad.	11.50	45.85	2.88	23.0	5.77	0.33
BBM-NG 53440 ♂ subad.	11.55	44.16	3.02	23.1	6.04	0.25

ignored, as it would have added only a small fraction of a cm^2 to the total flight membrane surface. A summary of these measurements and calculation results is included in Table 4.

Aspect ratio, as used by Struhsaker (1961:154) in a study of flight in New World bats, is the area of one wing plus half the uropatagium in cm^2, divided by the square of the length of that wing in cm; with a low resultant figure ("short, wide wings") indicating great ability to sustain slow, maneuverable flight. Hovering while feeding would be a typical manifestation of this general type of flight and, at least during nocturnal visits at fruiting or flowering vegetation, New Guinea *Syconycteris australis* is particularly adept at this type of aerial locomotion (pers. obs.). Struhsaker covered only microchiropteran species, but the relatively low aspect ratio values obtained here for both species of *Syconycteris* (between 2.88 and 3.02) fall between those of the 2 most skillful hoverers of his list: the vespertillionids *Antrozous pallidus* (Pallid Bat) at 2.44 and *Myotis lucifugus* (Little Brown Myotis) at 3.35. In contrast, the swift, generally direct-flying, molossids *Molossus nigricans* (= *M. rufus nigricans*; Red Mastiff Bat) have listed aspect ratio means of 5.97 and 6.57, respectively.

Dwyer (1965) also investigated flight characteristics of bats but included only one megachiropteran among the 17 species of Australo-Papuan species he studied. Dwyer's method of calculating wing aspect ratio differed from that of Struhsaker in that he used the square of the distance in cm from wing tip to wing tip (wing span) to divide into the total plagiopatagium plus uropatagium area in cm^2. This alternative, more usual, method of calculating aspect ratio was also applied to the 2 present *Syconycteris* samples to allow direct comparison of results (shown in Table 4) with Dwyer's figures. *Syconycteris* aspect ratios of from 5.84 to 6.04 are slightly lower than those of the presumed most-accomplished hoverer of the Dwyer list: the rhinolophid *Rhinolophus megaphyllus* (Southern Leaf-nosed Bat) at 6.4, or 6.7 without uropatagium included. As might be expected, the highest aspect ratio obtained by Dwyer is for a molossid, *Tadarida australis* (Southern Mastiff Bat): 11.6, or 12.4 without uropatagium included.

In this 1965 study, Dwyer also included the concept of wing loading, which he calculated as the bat's weight in lb per ft^2 of total plagiopatagium area. He considered low loading figures allowed more maneuverable flight than high ratios, and found wing loads ranging from 0.14 to 0.33 lb/ft^2 for 13 species of Vespertillionidae; 0.18, 0.36, and 0.48, for single species of Rhinolophidae, Emballonuridae, and Molossidae, respectively; and 0.77 for the single megachiropteran *Pteropus scapulatus* (Red Flying Fox; a member of a genus generally notorious for lack of agile flight ability in confined or crowded air space).

It is of interest to compare wing loads of *Syconycteris* with Dwyer's data, but no weights for the 4 alcoholic *Syconycteris* specimens whose wings were measured in the present investigation were available. However, to obtain at least approximate figures for wing loading in *S. hobbit* and *australis*, the mean weights by species and age class previously determined for Bulldog Road *Syconycteris* (see Table 3) were assigned to each of the appropriate 4 alcoholic *Syconycteris* specimens. As the results in Table 4 show, wing loads in the general range of about 0.25-0.35 lb/ft^2 (0.12-0.17 gm/cm^2) might be expected in *Syconycteris*, presumably allowing members of this genus at least the moderate flight maneuverability of several of the vespertillionids studied by Dwyer, although not the relatively great, often-observed maneuverability of his one rhinolophid.

To consider the direct comparison of flight characteristics of *Syconycteris hobbit* and *australis*, the figures appearing in Table 4 suggest that *australis* generally has an absolutely shorter wing than *hobbit*, but that the aspect ratios and wing loads of the 2 species are very similar. Because of the limited size of the sample, only aspect ratios among the several flight characteristics were treated statistically, with sexes and ages combined within each species. As shown in Table 5, the aspect ratio means of the 2 congeners are remarkably similar: analysis by Student's *t*-test ("2 sided") indicating $P>.9$ for the null hypothesis. Thus, the flight characteristics and related locomotor activities such as aerial feeding of *Syconycteris hobbit* are inferred to be almost identical with those of *australis*, and it is quite possible that even the type and positioning in vegetation of blossoms or fruit utilized by the 2 are also very similar if not largely the same.

Table 5
Statistical Comparison of Aspect Ratios
(Of Struhsaker, 1961)
For *Syconycteris hobbit* and *australis*

The right-hand column contains the probability (Student's *t*-test, "2-sided") that the 2 *S. hobbit* individuals could have drawn from a population with the same aspect-ratio parameters as the population of the 2 *S. australis* individuals. Statistical abbreviations are explained in the Methods section.

	N	$\bar{X}$	±	$s_{\bar{X}}$	OR	s	V	P
S. hobbit BBM-NG 96644 ♀ ad. & 53430 ♀ subad.	2	2.955	±	0.032	2.92-2.99	0.045	1.52	
S. australis BBM-NG 53431 ♀ ad. & 53440 ♂ subad.	2	2.950	±	0.067	2.88-3.02	0.095	3.22	>.9

Baculum

The penis had been preserved on only one of the 2 male *Syconycteris hobbit* specimens: BBM-NG 52398, a subadult. This organ was removed from the study skin for clearing and staining in a 5% Potassium Hydroxide-.005% Alizarin Red S aqueous solution for 5 days, then transferred to 100% Glycerol for examination and storage. The Alizarin-stained baculum separated from the fragmentary glans during the processing so its orientation in Fig. 5 is conjectural (that is, the distal and proximal ends and/or the dorsal and ventral surfaces may be reversed in the illustration). The bone is generally short, wide, and notably flattened dorsoventrally; measuring approximately 1.7 mm long, 0.7 mm wide (maximum), and varying from about 0.1 to 0.2 mm thick. It does not appear to be hollow, and no cartilaginous processes were found attached to either end of the bone although these structures, if originally present, could have separated and been lost during processing.

For comparison, the penes of 3 of the 10 male *Syconycteris australis* specimens of the Mt. Kaindi sympatric sample were similarly removed, processed, and examined. The smallest baculum among these 3 (BBM-NG 53368, see Fig. 5), that of a subadult judged relatively young from the amount of metacarpal epiphyseal cartilage still present, is slightly larger overall than that of the subadult *S. hobbit*, but is relatively more slender at mid-shaft, and less flattened dorsoventrally. Also, it is hollow, and possesses paired distal cartilaginous processes. It is 2.3 mm long (including the 0.5-mm cartilaginous processes), 0.6 mm wide (maximum), and from 0.2 to 0.4 mm thick. The baculum of an obviously adult individual (BBM-NG 53539, see Fig. 5) is generally similar in shape and other characteristics to that of the young subadult but is larger overall with lateral swellings of the distal and, especially, proximal ends more greatly expanded laterally and ventrally. This adult bone is 5.3 mm long (including the 0.9-mm cartilaginous processes), 1.9 mm wide (maximum), and from 0.4 to 1.0 mm thick. The baculum of a relatively old subadult (BBM-NG 51046, not figured), examined as a check on the 2 foregoing specimens, is quite similar to that of the adult but is slightly smaller overall, with the proximal and distal projections of the shaft a little less expanded. It is 4.7 mm long (including the 0.7-mm cartilaginous processes), 1.7 mm wide (maximum), and from 0.3 to 1.0 mm thick.

Because the single available baculum of *Syconycteris hobbit* is subadult, the exact shape and dimensions of the adult structure are unknown. However, by analogy with the age changes

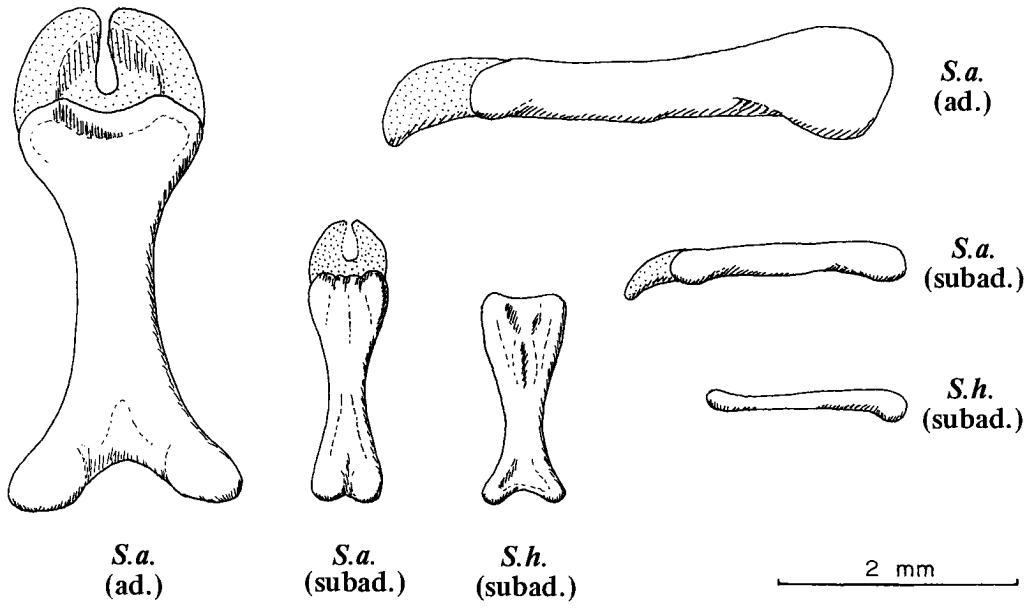

Figure 5. Comparison of ventral (left) and lateral (right) aspects of bacula of *Syconycteris hobbit* and *australis*. *S. h.* (subad.): *Syconycteris hobbit,* BBM-NG 52398, paratype; *S. a.* (subad.): *Syconycteris australis,* BBM-NG 53368; and *S. a.* (ad.): *Syconycteris australis,* BBM-NG 53539; the latter 2 both from Mt. Kaindi sympatric sample. Stippling indicates cartilaginous areas. In the case of the *hobbit* specimen illustrated, the lack of cartilage and, in part, the orientation are uncertain; see text for further explanation.

apparent in *australis*, the fully mature baculum in *hobbit* might be expected to increase in size to a maximum of about 3.5 mm in length, 2.0 mm in greatest width, and from approximately 0.2 to 0.4 mm in thickness. It would still retain a relatively more dorsoventrally flattened shape than that in *australis*. Also, it would undoubtedly be a solid rather than a hollow structure and, possibly, might lack the distal cartilaginous processes. Interestingly, in many respects, this theoretical adult baculum of *Syconycteris hobbit* would tend to more closely resemble that of various taxa of the presumed closely related genus *Macroglossus* than that of *Syconycteris australis*. The baculum in *Macroglossus* is described by Krutzsch (1959:391, Fig. 1:M,N; 1962: 41, Fig. 1:X,Y) as being generally rectangular in ventral aspect; that is, relatively short (1-4 mm) and broad compared to the longer and narrower baculum of adult *Syconycteris australis*. Krutzsch does not mention distal cartilaginous processes in *Macroglossus*, so presumably these structures characteristic of *S. australis* are absent in the genus. Neither absolute nor relative thickness of the baculum in *Macroglossus* is noted, nor whether the bone is hollow.

Krutzsch also describes and figures the bacula of 2 specimens of *Syconycteris australis* ("*Saconycteris* [*sic*] *crassa papuana*", 1959:391, Fig. 1:O; "*Syconycteris australis*", 1962:41, Fig. 1:Z). Judging from the adult *australis* baculum described above, these 2 specimens of Krutzsch seem to represent fully mature individuals also. And, although it is not stated whether the bones are hollow, they are quite similar in size and other respects to the present adult *australis* baculum. Krutzsch, however, additionally describes the baculum of a third specimen of the genus ("*Saconycteris* sp.", 1959:391, Fig. 1:P), AMNH 157379 from "Top Camp, elevation 2,230 meters, north slopes Mt. Dayman, Maneau Range, Papua, New Guinea" which "differs from the bacula of *S. c. papuana*." This problematical baculum is only 2.0 mm long and lacks the distal cartilaginous processes, although the general shape of the structure is stated to be "typical of the genus." I have not yet had an opportunity to examine this museum specimen and its baculum but the apparent general outline and seemingly nonflattened condition of the bone make it seem most likely a baculum (with distal cartilaginous processes either not yet developed or lost in preparation) of a relatively quite young *Syconycteris australis*, rather than

one of *Syconycteris hobbit*. Still, because of the current lack of knowledge of variation in the baculum of *hobbit*, as well as the relatively high elevation and general vegetation type of the collecting locality of the AMNH specimen (apparently mixed grassland and moss forest, see Brass, 1956:110-111, 126 *ff.*; near the northwest border of Milne Bay Province, Papua New Guinea, approximate coordinates: 9° 49′ S, 149° 16′ E), the possibility that this specimen might represent *Syconycteris hobbit* cannot presently be excluded.

Breeding Biology

Little can be reported for certain concerning the annual reproductive cycle of *Syconycteris hobbit*. The known specimens represent the restricted period of June through August; and only 2 of the 6 specimens have reproductive data other than sex recorded on the collector labels: BBM-NG 51176, a subadult ♀ taken 14 July 1967, was noted as having no embryos (nor placental scars), but BBM-NG 53430, a subadult ♀ taken 4 July 1967 had a 3-mm swelling of the left uterine horn that could have indicated the presence of an early stage embryo. However, enlarged mammae are evident on the alcoholic holotype, BBM-NG 96644, an adult ♀ taken 10 June 1968, as well as on the study skin of BBM-NG 52394, an essentially adult ♀ taken 11 July 1966, indicating the 2 individuals were apparently actively nursing or had only recently ceased nursing when collected.

None of the 10 female *Syconycteris australis* (5 adult and 5 subadult) of the Mt. Kaindi sympatric sample collected in June and July of 1967 possessed obvious embryos or placental scars. At least one, however, alcoholic BBM-NG 53431, an adult ♀ taken 4 July 1967, had somewhat enlarged mammae, apparently indicating it had been nursing during a period not long before capture. Of the 9 males for which reproductive data were recorded, 5 subadults had testes ranging in size from 1 x 2 mm to 5 x 6 mm, and none had epididymal tubules macroscopically visible; while 4 adults had testes ranging from 5 x 5 mm to 6 x 7 mm, and the epididymal tubules were evident in 3 of these.

Elevational and Geographic Distribution

The Bishop Museum *Syconycteris* collection examined in preparing this report represents the years 1959 through 1977, and the specimens were taken almost entirely by mist-netting. As far as known, there was no preferential preservation of one particular real or imagined form of captured *Syconycteris* over another by any of the numerous collectors. Thus, if it is assumed that *hobbit* and *australis* have generally similar flight habits and at least approximately equal susceptibility to capture in mist nets, the proportions of the 2 species in the collection studied can be considered an unbiased estimate of the true ratio of numbers of the 2 in nature.

This sample, taken as a whole, indicates that *Syconycteris australis* ranges in elevation from essentially sea level to at least 3000 m, and is distributed widely throughout New Guinea including islands off the coast. The species is relatively abundant in the eastern half of the mainland, at least, with specimens representing all Papua New Guinea provinces except Gulf (in which no vertebrate collecting has been undertaken by the Bishop Museum and Wau Ecology Institute). *Syconycteris hobbit*, however, appears to be restricted to elevations above about 2200 m for, as shown by Table 6, this species does not appear among well over 500 specimens of the genus taken below this elevation during all months of the year. Even above 2200 m, it seems scarce, being represented by only 6 out of 192 specimens. Whether or not *hobbit* is geographically restricted to the Bulldog Road-Mt. Kaindi area of central Morobe Province cannot be confidently predicted from the present data, for Table 6 shows that there are undoubtedly too few *Syconycteris* specimens present in the collection from above 2200 m outside of Morobe Province to be expected to reliably indicate either presence or absence of *hobbit* in other high-elevation areas.

Syconycteris australis specimens were taken on Bulldog Road and Mt. Kaindi in 6 months of the year, distributed between April and November; while *S. hobbit* was taken (along with *australis*) during only 3 of these: June, July, and August. Failure to take *hobbit* there in other than these 3 months between April and November is believed due to chance in sampling such an apparently rare species, rather than to possible seasonal migration (elevational or geographic)

Table 6
Summary of 1959-1977 Bishop Museum *Syconycteris hobbit* and *australis* Specimen Collections Grouped by Division or Province, Month, and General Elevation of Capture

SPECIES	DIVISION OR PROVINCE	MONTHS FOR < 2200 m	NO. SPEC.	MONTHS FOR > 2200 m	NO. SPEC.	TOTALS
S. australis						
	IRIAN JAYA:					
	Paniai	Aug.	3			3
	Tjenderawasih	Sep.-Feb.	30			30
	PAPUA NEW GUINEA:					
	Central	Oct., Nov.	14	Jul., Aug.	5	19
	E. New Britain	Nov., Dec.	3			3
	E. Sepik	Oct.	2			2
	E. Highlands	Aug., Nov.	7			7
	Madang	Jan.-Mar.	54			54
	Milne Bay	Aug.	4			4
	Morobe	Jan.-Dec.	339	Apr., Jun.-Sep., Nov.	158	497
	Northern	May, Jul., Sep.	35			35
	Simbu	Jul., Oct.	6	Nov.	1	7
	S. Highlands			Sep.	17	17
	W. Sepik	Feb., Mar., May, Jun., Nov.	32	Feb.	2	34
	Western	Feb.	2			2
	W. Highlands	Jun., Sep., Nov.	12	Sep., Oct.	3	15
Subtotals:		Jan.-Dec.	543	Feb., Apr., Jun.-Nov.	186	729
S. hobbit						
	PAPUA NEW GUINEA:					
	Morobe			Jun.-Aug.	6	6
TOTALS:		Jan.-Dec.	543	Feb., Apr., Jun.-Nov.	192	735

out of the higher Morobe Province elevations. Apparently, nothing is known concerning possible migration in *Syconycteris* and related macroglossine bats but, as indicated by the specimen numbers and months of collection of the 2 species in Table 6, *hobbit* obviously does not seem to undertake any downward elevational movements any time during the year in the Morobe Province or, probably, any other area of eastern New Guinea. As mentioned earlier, the present data are not extensive enough to rule out the slight—but unexpected—possibility that *Syconycteris hobbit* may migrate seasonally from the mountains of Morobe Province to equally high elevations in other parts of New Guinea.

Possible Adaptive Significance of Selected Characters

It has been shown above that *Syconycteris hobbit* is apparently restricted to high-elevation moss forest while *S. australis* is found from very low-elevation, dry, open forest up into the same high-elevation moss forest. The latter species seems generally more abundant below 2200 m than above but, judging from population density above 2200 m, is still relatively successful at these high elevations. It has been noted that, compared to *australis, hobbit* has woolly body pelage, thickly haired pes, relatively shorter ear, and no trace of uropatagium. All of these characteristics of *hobbit* can logically be interpreted as adaptations to reduce heat loss in the generally quite cold and wet conditions of its apparently obligatory moss-forest habitat. Pre-

sumably, these characters result in some degree of selective advantage over *australis* in moss forest, but why members of at least the sympatric *australis* population should not be similarly modified is unknown. Possibly, high-elevation specimens of *australis* represent individuals from lower areas that are constantly being forced by population pressure into habitat that is marginal for the species and, thus, are not morphologically adapted in the same manner as is *hobbit*. Intuitively, however, the relatively high number of *australis* previously mentioned as encountered in high-elevation moss forest seems to argue against this hypothesis. Or, perhaps gene flow from lower-altitude populations prevents full adaptation to high-altitude conditions in *australis* of moss forest.

The dark coloration of *Syconycteris hobbit*, as well as of sympatric *S. australis*, suggests protective coloration of selective advantage in mitigating the effects of visually orienting predators, although these presumed predators are still undetermined.

Just as in the case of the very similar body weights, flight aspect ratios, and wing loads of the 2 New Guinea *Syconycteris* species, the close correspondence in structure of the tongue and soft palate of *hobbit* and *australis* suggest generally similar types of feeding areas and diet in the 2 forms. However, the shorter rostrum, broader hard palate, generally larger postcanine teeth, and shorter mandibular tooth row of *hobbit* may possibly indicate that its dietary ratio of fruit to flowers is greater than that of *australis*. The reason for the notable elongation of the terminal phalanges of the third and fourth fore-digits, and slight shortening of that of the fifth, of *hobbit* over those of sympatric *australis* is not apparent.

SUMMARY

The range of the macroglossine genus *Syconycteris* is limited to northern and eastern Australia, and the island of New Guinea including some smaller islands to both east and west. The group had long been considered to comprise at least 3 species, but recently various workers have progressively reduced all of the several previously named taxa to forms of a single geographically, altitudinally, and individually (but not sexually), somewhat variable species, for which the earliest name is *australis*. This arrangement is supported in the present investigation. However, a second valid species, presently known only from moss-forest habitat above about 2200 m (where it is sympatric with *australis*) in Morobe Province of northeastern Papua New Guinea, is described here.

This apparently rare species, *Syconycteris hobbit*, is characterized primarily by lack of tail, uropatagium, and calcar; by possession of a short rounded ear pinna with thickened, light-colored, rim; and by very dark, rather woolly, somewhat glistening, dorsal pelage, as well as thickly furred dorsal surfaces of metatarsus and hind-digits. Sexual dimorphism is not evident in any of the external characteristics or measurements considered in this study. Major statistically significant mensural differences from *S. australis* populations (especially sympatric and other mainland New Guinea ones) include the longer forearm and terminal phalanges of the third and fourth fore-digits; shorter rostrum, palate, and mandibular (but not maxillary) tooth row; and broader palate, of *hobbit*. All forms of *Syconycteris* are distinguished morphologically from *Macroglossus minimus*, the only Australo-Papuan species of this relatively closely related genus, primarily by the greater development of tail, uropatagium, and calcar in *M. minimus*, as well as by the latter's relatively small, widely separated incisors of both upper and lower jaws, and the relatively small size of the lateral member of the incisor pair in each jaw quadrant.

Body weight of older subadult and adult *Syconycteris hobbit* is between about 15 and 16 g, which is generally the same as that of *australis* from similarly high elevations but possibly slightly lighter than that of *australis* from substantially lower areas. Aerially, *hobbit* is undoubtedly able to maintain as slow and maneuverable a flight as that known in *australis*, because the aspect ratios and wing loads of the 2 are almost identical. Values for these flight characteristics of these 2 small blossom- and fruit-feeding megachiropteran species compare favorably with those

published for more accomplished hoverers among a variety of insect-eating microchiropterans.

The baculum of *Syconycteris hobbit* is relatively short, broad, and quite flattened dorsoventrally; is not hollow; and apparently lacks distal cartilaginous processes. Thus, in many respects this bone resembles that of *Macroglossus* at least as much as it does that of the congeneric *S. australis*. Specifics of breeding biology in *S. hobbit* are still unknown, except that adult and essentially adult females were apparently nursing young about June or July (as were, apparently, at least some sympatric adult *australis*). *Syconycteris hobbit* appears not to undergo seasonal altitudinal movements but insufficient data are available to assess the possible existence of geographic migration in the species.

In *Syconycteris hobbit*, woolly dorsal pelage, as well as shortened ear, furred pes, and lack of uropatagium, are theorized to be of selective advantage in minimizing heat loss in the apparently obligatory cold and wet moss-forest habitat. The number of major similarities between *S. hobbit* and *S. australis* in external gross morphology, weight, and flight characteristics, however, as well as only minor differences in such internal characters as structure of tongue, soft palate, and most cranial and dental measurements, do not suggest markedly divergent diets, activity patterns, or other ecological characteristics, in at least the sympatric populations of these 2 species.

COMPARATIVE MATERIAL EXAMINED

Syconycteris australis

Statistical sample: 20, as follows: PAPUA NEW GUINEA. *Morobe Province*, Mt. Kaindi: BBM-NG 51046, subad. ♂, study skin and skull, 2300± m, 25 June 1967, P.H. Colman; BBM-NG 51050, subad. ♂, study skin and skull, 2250± m, 26 June 1967, P. H. Colman; BBM-NG 51072, subad. ♀, study skin and skull, 2350± m (=summit), 28 June 1967, P.H. Colman; BBM-NG 51074, subad. ♀, study skin and skull, 2300± m, 28 June 1967, P.H. Colman; BBM-NG 51083, ad. ♀, study skin and skull, 2300± m, 29 June 1967, P.H. Colman; BBM-NG 51084, subad. ♂, study skin and skull, 2300± m, 29 June 1967, P.H. Colman; BBM-NG 51126, ad. ♀, study skin and skull, 2300± m, 7 July 1967, P.H. Colman; BBM-NG 51144, ?subad. ♀, study skin and skull, 2300± m, 9 July 1967, P.H. Colman; BBM-NG 51175, ?ad. ♂, study skin and skull, 2250± m, 14 July 1967, P.H. Colman; BBM-NG 51194, ad. ♂, complete skeleton only, 2300± m, 15 July 1967, P.H. Colman; BBM-NG 51207, ad. ♀, study skin and skull, 2300± m, 15 July 1967, P.H. Colman; BBM-NG 53305, ad. ♂, study skin and skull, 2250± m, 26 June 1967, A.C. Ziegler; BBM-NG 53367, subad. ♂, study skin and skull, 2300± m, 1 July 1967, A.C. Ziegler; BBM-NG 53368, subad. ♂, study skin and skull, 2300±m, 1 July 1967, A.C. Ziegler; BBM-NG 53369, subad. ♀, study skin and skull, 2300± m, 1 July 1967, A.C. Ziegler; BBM-NG 53370, subad. ♀, complete skeleton only, 2300± m, 1 July 1967, A.C. Ziegler; BBM-NG 53429, ?ad. ♀, complete skeleton only, 2300± m, 4 July 1967, A.C. Ziegler; BBM-NG 53431, ad. ♀, alcoholic with cleaned skull, 2300± m, 4 July 1967, A.C. Ziegler; BBM-NG 53440, subad. ♂, alcoholic with cleaned skull, 2300± m, 4 July 1967, A.C. Ziegler; BBM-NG 53539, ad. ♂, study skin and skull, 2250± m, 13 July 1967, A.C. Ziegler.

Also, 709 additional Bishop Museum specimens, with general localities and elevations, and months of collection, as listed in Table 6.

American Museum sample: 6, as follow. "*Syconycteris australis*": PAPUA NEW GUINEA. *Western Province*, Fly River, 8± km below Palmer Junction, 80 m: AMNH 105076, ♀, study skin and skull, 26 May 1936, Archbold Expeditions; AMNH 105077, ♂, study skin and skull, 28 May 1936, Archbold Expeditions; AMNH 105078, ♂, study skin and skull, 30 May 1936, Archbold Expeditions. "*Syconycteris crassa*": IRIAN JAYA. *Djajawidjaja Division*, Balim River, 1600 m: AMNH 109954, ♀, study skin and skull (latter numbered AMNH 151781), 13 December 1938, Archbold Expeditions. *Paniai Division*, Gebroeders (Mountains, in Weyland Range), 1525± m: AMNH 101947, ♂, study skin and skull, 8 July 1930, F. Shaw Mayer. PAPUA NEW GUINEA. *Central Province*, Mafulu, 1253 m: AMNH 104025, ♀, study skin and skull, 16 October 1933, Archbold Expeditions.

Macroglossus minimus

A total of 110 Bishop Museum New Guinea and Solomon Island specimens, as follows. IRIAN JAYA. *Manokwari Division*: 1. *Paniai Division*: 2. PAPUA NEW GUINEA. *Bougainville Province*: 10. *Central Province*: 2. *East New Britain Province*: 2. *East Sepik Province*: 2. *Madang Province:* 5. *Morobe Province:* 23. *New Ireland Province:* 1. *Northern Province:* 28. *Simbu Province:* 1. SOLOMON ISLANDS. *Choiseul Island:* 14. *Fauro Island:* 1. *Guadalcanal Island:* 3. *Kolombangara Island*: 7. *Malaita Island*: 2. *Santa Isabel Island*: 1. *Vella Lavella Island*: 5.

LITERATURE CITED

Andersen, K. 1911. Six new fruit-bats of the genera *Macroglossus* and *Syconycteris. Ann. Mag. Nat. Hist.* 7:641-643.

Andersen, K. 1912. *Catalogue of the Chiroptera in the collection of the British Museum* (Second Ed.). *Vol. 1: Megachiroptera.* London: British Mus. (Nat. Hist.). 854 pp.

Brass, L.J. 1956. Summary of the Fourth Archbold Expedition to New Guinea (1953). *Bull. Am. Mus. Nat. Hist.* 111:77-152.

Dwyer, P.D. 1965. Flight patterns of some eastern Australian bats. *Victorian Nat.* 82:36-41.

Grieg-Smith, P.W. 1975. Notes on a collection of bats and their ectoparasites from the Sepik District, Papua New Guinea. *Science in New Guinea* 3:117-122.

Koopman, K.F. 1979. Zoogeography of mammals from islands off the northeastern coast of New Guinea. *Am. Mus. Novit.* 2690:1-17.

Krutzsch, P.H. 1959. Variation in the os penis of tropical fruit bats. *J. Mammal.* 40:387-392.

Krutzsch, P.H. 1962. Additional data on the os penis of Megachiroptera *J. Mammal.* 43:34-42.

Laurie, E.M.O., and J.E. Hill. 1954. *List of land mammals of New Guinea, Celebes and adjacent islands: 1758-1952.* London: British Mus. (Nat. Hist.). 175 pp.

Lekagul, B., and J.A. McNeely. 1977. *Mammals of Thailand.* Bangkok: Kurusapha Ladprao Press. 758 pp.

Lidicker, W.Z., Jr., and A.C. Ziegler. 1968. Report on a collection of mammals from eastern New Guinea, including species keys for fourteen genera. *Univ. Calif. Publ. Zool.* 87:1-64.

Matschie, P. 1899. *Die Fledermause des Berliner Museums fur Naturkunde, 1, Die Megachiroptera.* Berlin: G. Reimer. 103 pp.

Ridgway, R. 1912. *Color standards and color nomenclature.* Washington: published by the author. 44 pp.

Simpson, G.G., A. Roe, and R.C. Lewontin. 1960. *Quantitative zoology* (Revised Ed.). New York: Harcourt, Brace and Co. 440 pp.

Struhsaker, T.T. 1961. Morphological factors regulating flight in bats. *J. Mammal.* 42:152-159.

Tate, G.H.H. 1941. Pteropodidae (Chiroptera) of the Archbold Collections. *Bull. Am. Mus. Nat. Hist.* 80:331-347.

Tolkien, J.R.R. 1937. *The Hobbit; or, there and back again.* London: G. Allen & Unwin. 310 pp.