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The bats of Silhouette Island, Seychelles

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Abtract.— A review of the status of the bats recorded on Silhouette island is presented. This is placed in the context of the conservation status of the bats on the granitic islands of Seychelles. Two species are present: the Seychelles fruit bat *Pteropus seychellensis* and the Seychelles sheath-tailed bat *Coleura seychellensis*. The Silhouette population of the fruit bat is estimated at approximately 2,000 (with a Seychelles total of approximately 8,500). One roost of the sheath-tailed bat is known on Silhouette, this contains 32 bats. This is the only roost to have been monitored regularly and is only one of two known in Seychelles. The fruit bat population appears to be stable, the sheath-tailed bat remains Critically Endangered.

Keywords.— Chiroptera, *Coleura seychellensis, Pteropus seychellensis*, Seychelles

INTRODUCTION

The granitic Seychelles islands support only two species of native mammal, the Seychelles fruit bat *Pteropus seychellensis* MILNE-EDWARDS, 1877 and the Seychelles sheath-tailed bat *Coleura seychellensis* PETERS, 1868, both with naturally restricted

Fig. 1 *Pteropus seychellensis* on Silhouette (photo by N. BALL).

ranges. Distributions and populations have been further reduced by human activity; the Seychelles sheath-tailed bat is classified as Critically Endangered by IUCN.

The Seychelles fruit bat (Fig. 1) was estimated to number some 10,000 in 1979 and current populations are believed to be close to this level although adequate censuses have not been completed on all islands. Fruit bat populations have been assessed by roost counts on three occasions. In 1977 a survey of Praslin and neighbouring islands counted 2,052 bats and estimated the total to be approximately 2,500 on these islands (RACEY 1979). A repeat in 1979 counted 1,399 on Praslin and La Digue (compared to 1,443 in 1977). At the same time 2,463 were counted on Mahé and the total for that island estimated at 10,000 (RACEY & NICOLL 1984). In 1996 4,557 bats were counted on Mahé (with an estimate of over 4,000) and 1,229 were reported from Praslin and neighbouring islands. 200 were estimated to be roosting on Silhouette using a different methodology.

A 1992 review of the data concluded the species was not threatened but needed regular monitoring (MICKLEBURGH *et al*. 1992). Levels of consumption and other causes of mortality have been assessed in the past (MAISELS 1979; VERSCHUREN 1985; MELLANBY *et al*. 1996). Social behaviour was described in 1979; mating has been recorded in June-July, with births in November-December (RACEY & NICOLL 1984), after which family territories are formed within the roost. In April juveniles aggregate in the centre of the roost, with the males and females separating. No data are available for the non-communal roosting population on Silhouette. The diet is known to comprise sweet soft fruits and nectar, with 23 fruits identified and 4 flower species (RACEY & NICOLL 1984).

The Seychelles sheath-tailed bat (Fig. 2) has been recorded as a resident species on the four largest islands of the Seychelles group. Two subspecies have been described*: C. s.*

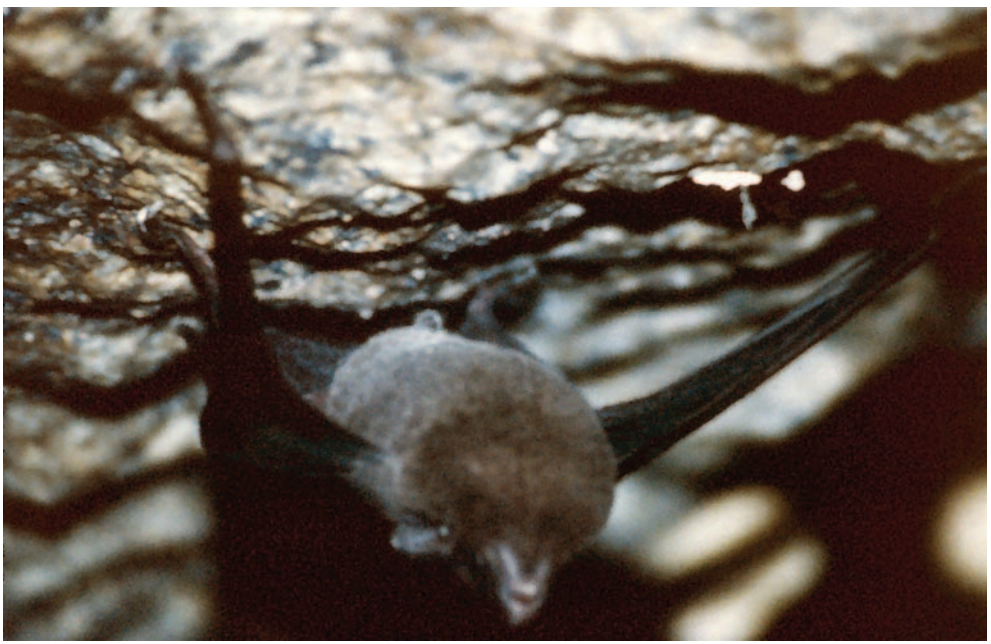

Fig. 2 *Coleura seychellensis*

seychellensis from Mahé and Praslin and *C. seychellensis silhouettae* (THOMAS, 1915) from Silhouette and La Digue (HILL 1971). The island origins are based on unsubstantiated statements and limited metric data in NICOLL & SUTTIE (1982) (Table 1). In the granitic islands roosts have been recorded on all 4 islands. The species was first recorded in 1868 when roost sites were noted to have north-facing entrances screened by palm

Table 1. *Coleura seychellensis* biometrics (from THOMAS 1915, NICOLL & SUTTIE 1982 and new data). Institutional abbreviations: BMNH – British Museum (Natural History); UMZC – University Museum of Zoology, Cambridge

Specimen or reference	sex	Origin	Forearm	Skull	Maxillary tooth row	p^4-m^3	Live weight (g)
BMNH 69.2.19.2	M	Mahé ?	56.0	15.2	7.0	5.0	
BMNH 83.8.6.1	M	Mahé ?	57.0	15.3	7.0	5.0	
BMNH 76.10.10.1	F	'Zanzibar'	56.6	15.1	6.8	5.0	
BMNH 6.3.18.2	M	Silhouette	53.0	14.4	6.5	4.7	
BMNH 6.3.18.3	M	Silhouette	52.5	14.7	6.7	4.7	
UMZC	F	Mahé	57.0	-	-	-	
NICOLL & SUTTIE 1982	M (n=6)	La Digue	53.9±0.2	-	-	-	10.2±0.1
NICOLL & SUTTIE 1982	F (n=5)	La Digue	55.6±0.3	-	-	-	11.1±0.3

Fig. 3 Female *Coleura seychellensis* collected at Cascade on Mahé in 1913 (UMZC)

leaves (WRIGHT 1868). A small number of individuals were collected in the late 1800s and early 1900s (Fig. 3) but there were no further published records until one was shot in 1908 in an attempt to locate parasites (SCOTT 1914).

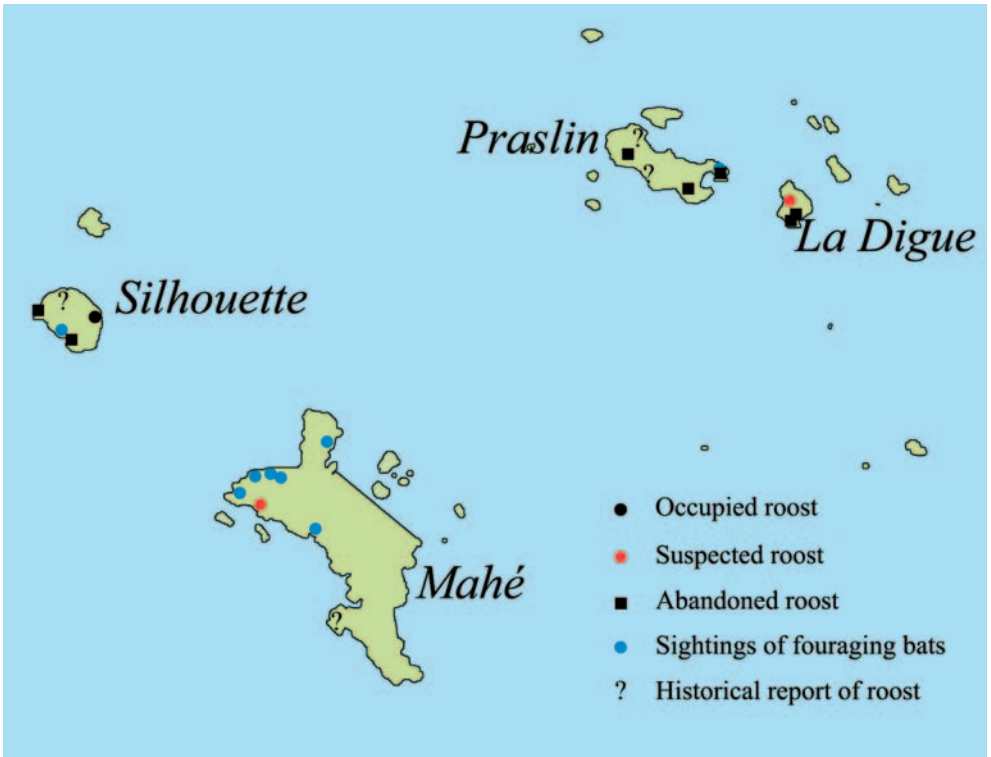

Fig. 4 Map of *Coleura seychellensis* distribution.

Research in 1973-1980 located 5 roost sites (2 occupied) and monitored occupancy (CHEKE & DAHL 1981; NICOLL & SUTTIE 1982; RACEY & NICOLL 1984). Numbers of roosting bats were low (1-6 in most roosts, rising briefly to 12 in one roost). Since 1991 (MELLANBY *et al*. 1996) all these roosts have been reported to have been abandoned for unknown reasons. These investigations provided some data on roost sites, social behaviour and reproduction. It was reported that a single male harem system existed and that pregnant bats were observed in November and flying young in December/January (NICOLL & SUTTIE 1982). The presence of juveniles in April suggests that two breeding seasons may occur. It was suggested that this species feeds in or above the forest canopy (NICOLL & SUTTIE 1982) although brief observations in 1993-4 indicate that at least some feeding is done within 2m of the ground (MATYOT 1995). In 1995 further abandoned roosts and the occupied roost on Silhouette were found. It was reported that Coleoptera and Lepidoptera were the main food items identifiable in guano, prey items were estimated to be above 5.5mm long (MATYOT 1995; JOUBERT 2004). Roosts and foraging bats have been recorded in several areas (Fig. 4). The roost on Silhouette has been monitored

since 1995 (Seychelles Division of Environment [DoE] 1995-7, The Nature Protection Trust of Seychelles [NPTS] quarterly from 1997). The location of this roost has allowed observation to be made without disturbance (BURGESS & LEE 2004), results of the monitoring for both bats species on Silhouette and the research into the sheath-tailed bat are summarised below.

METHODS

Seychelles fruit bat

4 surveys of the fruit bat populations have been published, dating from 1977 to 1996. These surveys were based on roost counts on different islands, few of the surveys have significant overlap and none visited all islands. The published results are compiled here. Only one survey included Silhouette island; this did not locate any roosts and this estimated the population at 200 bats based on causal observations.

In 2001-2004 visits were made to all of the granitic islands, bats were not counted on all islands but their presence was noted and counts made on the smaller islands. Attempts were made to refine the population estimate for Silhouette on two occasions. In July 1999 a transect method was used, recording bats 3m either side of paths in four principal habitats: coastal forest, lowland forest, palm forest and moss forest. This provided an estimate but initial calculations (NPTS 1999) were based on incorrect area calculations, these are corrected below (Table 2). In April 2004 vantage points were used to count bats at 8am in different areas. The areas that could be observed were drawn onto a map and the ground area calculated, providing density estimates of active bats in different habitats. Searches

Table 2. Fruit bat populations on Silhouette (estimates and 95% confidence limits)

		1999		2004	
Habitat	**area (ha)**	**density (per ha)**	**population**	**density**	**population**
Littoral	4	0	-	0	-
Marsh	12.1	0	-	0	-
Suburb	17.6	0	-	0	-
Casuarina	1.5	0	-	0	-
Dry coastal	5.7	2.89±1.43	16±8	0.01±0.01	0
Mixed coastal	92.2	3.10±2.91	286±268	0.11±0.05	10±5
Coffee	8.4	0	-	0	-
Hevea	7.4	0	-	0	-
Glacis	112	0	-	0.01±0	1±0
mid-altitude	351.4	1.45±0.25	510±88	0.11±0.04	38±14
Palm	1087.5	1.05±0.45	1,142±489	1.67±0.10	1,813±109
Dicranopteris	70.3	0	-	0	-
Clidemia	2.3	0	-	0	-
Cyathea	0.7	0	-	0	-
Pisonia	0.5	0	-	0	-
mist	215.3	1.42±1.40	306±301	0.10±0.05	22±11
TOTAL			2,260±1,154		1,884±139

for bats in closed forest indicated that 20% of bats were active at this time of day, enabling a total population estimate to be made.

Seychelles sheath-tailed bat

The La Passe roost is described in BURGESS & LEE (2004). The numbers of bats in roost A were recorded at least quarterly since 1997 and roost B since 2001. Both roosts A and B were entered when the bats had left the roost to forage at 19:00hrs on 8th and 14th June 2004 (BURGESS & LEE 2004). A search was made for fresh guano but only 16 faecal pellets were located in roost A. On 14th June plastic sheets measuring 30x40cm were placed over the main accumulations of decomposed guano and left for 24 hours. Fresh faeces were collected on these sheets. These were weighed fresh and stored dry until examination.

The dried faeces were moistened with water and dissected under a binocular dissecting microscope at ×10 and ×20 magnification. All arthropod remains were identified as completely as possible and counted to obtain an indication of the number of items consumed. Moth scales were present in almost all samples, these were recorded but not counted. The data were combined with a smaller set of samples collected from roost A on 13th July 1999. Searches for further roosts have been made around the coast and along mountain paths since 1997.

RESULTS

Seychelles fruit bat

Fruit bat population estimates on Silhouette are summarised in Table 2, the most recent estimate is incorporated into the overall summary (Table 3).

Table 3. Seychelles fruit bat census data. (1977-79: NICOLL & RACEY 1981; RACEY 1979, 1996: MELLANBY *et al*. 1996)

		1977-9		1996	2001-4
		Islands	**group**		
Mahé group			10,000		5,000
	Mahé	2,463		4,557	+
	St. Anne	-		0	20
	Therese	-		-	+
Silhouette & North		-	?		2,000
	Silhouette	-		200	1,884
	North	-		-	+
Praslin Group			2,500		1,400
	Praslin	1,399-1,443		800	+
	Aride	-		42	0-40
	Curieuse	0		0	+
	Round	-		-	70
	Cocos	-		-	30
	Felicite	170-500		-	50
	Marianne	-		-	10
	La Digue	439		387	+
Fregate		-		0	100
TOTAL			>12,500	>6,000	8,500

Seychelles sheath-tailed bat

The La Passe roost on Silhouette has passed through a period of decline in 1996 and a recovery since 2001. These changes may be associated with changes in the surrounding environment. When first visited in 1995 the plateau near the roost was largely open grassland under coconut plantation. At this time bats were recorded feeding mainly around the marsh (JOUBERT 2004). In 1996 cinnamon bark harvesting occurred near the roost and this was thought to represent a disturbance risk and a habitat alteration (DoE 1996), cropping of cinnamon has not occurred near the roost since that date. At this time a copra dryer was also in operation on the plateau and smoke from the dryer was found to be entering the roost in 1997. The copra dryer ceased to function in 1998 and since that date no disturbance has occurred at the roost. Coincidental with this, vegetation management has been carried out to prevent invasion of alien tree species (principally *Cinnamomum verum* and *Tabebuia pallida*) and creepers (*Pueraria phaesaloides* and *Passiflora foetida*) around the roost. Increases in the number of bats in the roost may be associated with this reduction in disturbance and improvement in vegetation. Plateau vegetation has also changed, with an increase in tree cover and denser marsh-fringe herbs and shrubs. The marsh foraging pattern reported from 1995 (JOUBERT 2004) no longer appears to be significant.

The collection of faeces in roost A was not successful, this was probably due to the dispersed distribution of bats in this roost. 365 samples were collected in roost B. The contents of the faeces are summarised in Fig. 5 and Table 4.

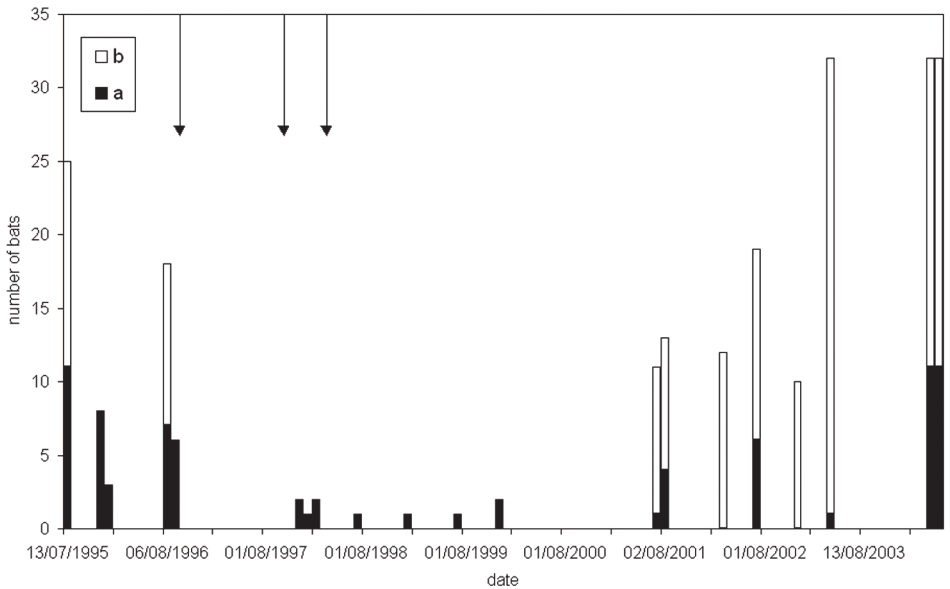

Fig. 5 Contents of *Coleura seychellensis* faecal samples from the La Passe roost and comparison with aerial insect abundance in different habitats.

Table 4. Contents of *Coleura seychellensis* faeces from the La Passe roost, Silhouette

		13/7/99 (n=4) Roost A		6/2004 (n=16) Roost A		6/2004 (n=200) Roost B	
		sample	n	sample	n	sample	n
Lepdioptera							
	scales	4	?	9	?	170	?
	medium leg	4	24	9	15	7	7
	small leg	0	0	0	0	4	4
	TOTAL	4	24	9	15	181	?
Dermaptera							
	Labia sp.	0	0	0	0	1	1
	earwig?	0	0	0	0	2	2
Coleoptera							
Chrysomelidae	Cassidini larva	0	0	0	0	1	1
Curculionidae	*Cratops segregatus*	0	*0*	0	0	7	7
	Cratops griseovestitus	0	0	0	0	20	20
	Sp. 1	0	0	0	0	1	1
	Rhyparidula seychellensis	0	0	0	0	3	3
Oedmeridae		0	0	0	0	12	12
Family ?		4	6	3	4	3	3
	TOTAL	4	6	3	4	47	47
Hymenoptera							
Braconidae		0	0	0	0	21	45
Cynipidae		0	0	0	0	1	1
Chalcidae		0	0	0	0	2	2
Formicidae	*Monomorium floricola*	0	0	0	0	1	1
	Pheidole megacephala	1	1	0	0	0	0
	Technomyrmex albipes (alate)	0	0	0	0	2	2
	T. albipes (workers)	0	0	3	4	0	0
	Tetramorium simillimum	0	0	0	0	6	6
	TOTAL	1	1	3	4	33	57
Isoptera		0	0	0	0	2	2
Diptera							
Chironomidae	Sp. 1	0	0	0	0	2	2
	Sp. 2	0	0	0	0	1	1
Muscidae	*Mydaea mediana*	0	0	0	0	1	1
Psychodidae		0	0	0	0	1	1
Scatopsidae		0	0	0	0	2	2
Tipulidae		0	0	0	0	2	2
	TOTAL	0	0	0	0	9	9
Orthoptera							
Gryllidae		0	0	0	0	1	1
	Zarceus fallaciosus	0	0	1	1	0	0
	Lobopterella dimidipes	0	0	1	1	3	3
	TOTAL	0	0	2	2	4	4
Hemiptera							
Lygaeidae		0	0	0	0	1	1

DISCUSSION

In 1997 a single occupied *Coleura seychellensis* roost was known on Silhouette (La Passe) and two apparently abandoned roosts (Grande Barbe and Pointe Cocos). In addition a high altitude cave was suggested to be occupied by bats in 2004 (BALL 2004), however this has not been substantiated to date. The cave is at approximately 350m a.s.l., in mid-altitude forest. This represents a very different habitat type from the previously recorded roosts and if substantiated would indicate that the species may be more widespread and abundant that previously recognised.

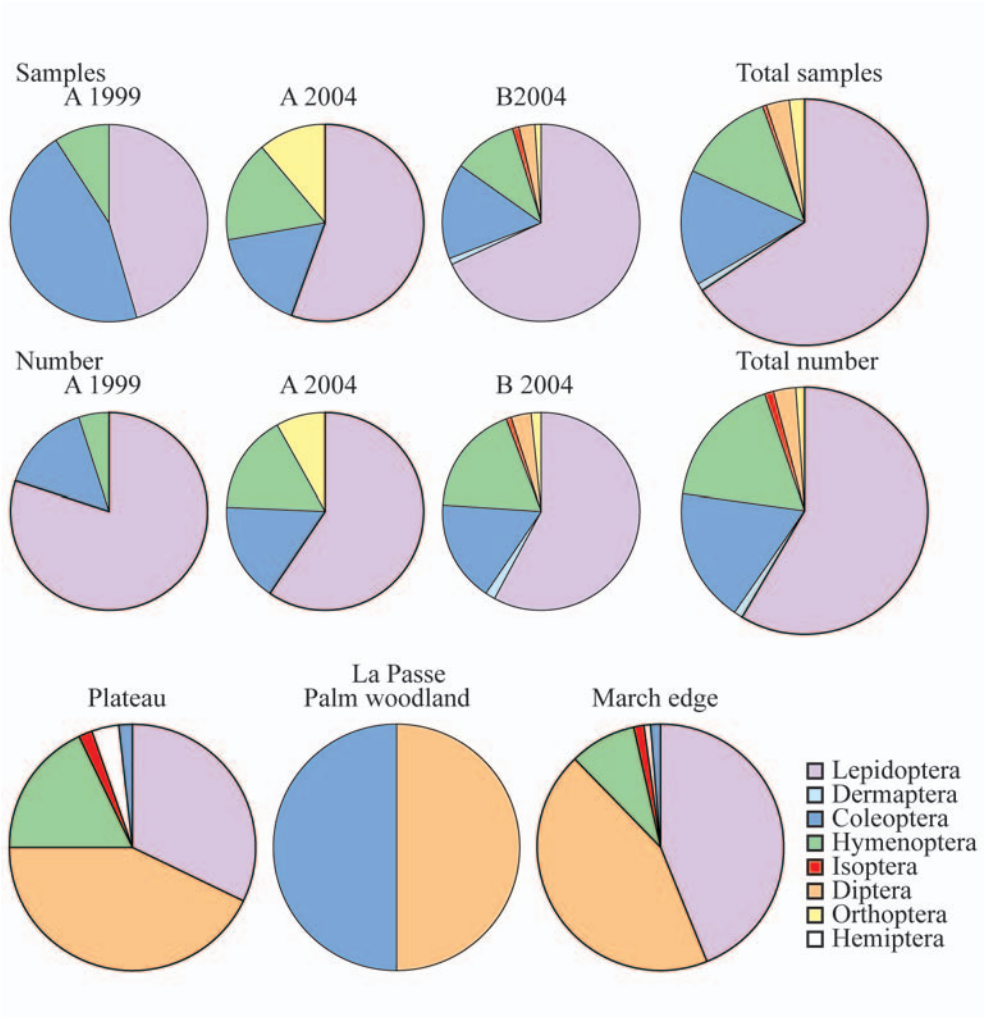

Fig. 6 Numbers of bats recorded in the La Passe roost since 1995, arrows mark the changes in the surrounding environments: 1 - cinnamon cropping near the roost; 2 - decline in use of copra dryer; 3 - final cessation of use of the copra dryer

The occupancy of the La Passe roosts has been monitored regularly (Fig. 6) since its discovery in 1995. The known population on Silhouette stands at 32 bats. In addition reports indicate the presence of further small roosts on Mahé (observed by the Ministry of Environment) and La Digue (observed by the author in 1996 at dusk at La Reunion). Seychelles sheath-tailed bat faecal samples are dominated by Lepidoptera (61% of faeces, 71% of items), followed by Coleoptera (41% of samples and 20% of items). These patterns were earlier reported by JOUBERT (1995, 2004) who suggested that this was a notable preference as Diptera and Hymenoptera dominated the area's insect fauna. He further suggested that the vocalisations of this species would not be appropriate for prey under 5.5mm in length. A comparison with the nocturnal insect abundance collected in a flight interceptor trap on the same day supports this, with a strong preference for Lepidoptera and Coleoptera and the exclusion of Diptera. However, the large number of faecal samples examined here include a significant proportion of taxa under 5.5mm in length (Fig. 7).

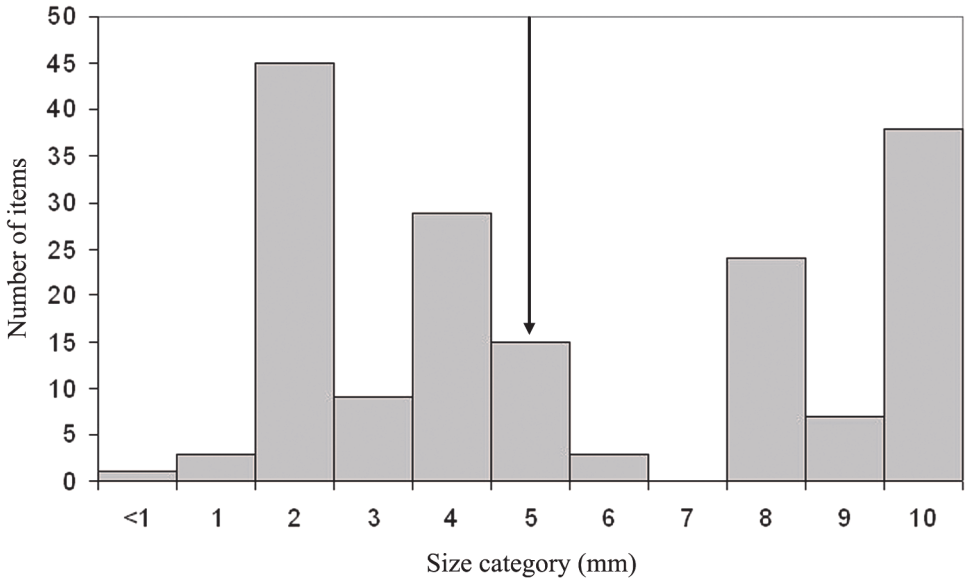

Fig. 7 Size variation in *Coleura seychellensis* dietary items

Of the species identified in the faeces some are associated with low herbaceous vegetation (chrysomelid larva, muscoid flies), some with marsh habitat (Chironomidae) and some with woodland (Curculionidae and *Zarceus fallaciosus*). Some species appear to be too small to be directly consumed; the single cynipid wasp may have been ingested accidentally during capture of another insect and the *Monomorium floricola* may have been present on another food item. The presence of the flightless Chrysomelidae larva indicates that gleaning is used as well as aerial capture. These interpretations are all in accordance with a species feeding opportunistically on a wide range of insects, using a variety of feeding methods and a wide range of habitats.

C. seychellensis has been reported to be a high flying bat based on observations of feeding 15m above ground level (6-20m), flying directly with a slight zigzag pattern (NICOLL & SUTTIE 1982). There are observations of lower flight: 3-5m above ground (MELLAMBY *et al*. 1996) and 1.5-2m above ground, flying up and down and veering side to side (MATYOT 1995). These observations and the dietary data indicate that *C. seychellensis* is largely an opportunistic species, feeding on relatively large insects at a variety of altitudes and habitats depending on where insects concentrations happen to be.

NICOLL & SUTTIE (1982) recorded that the sheath-tailed bats in the Praslin roost were divided into two groups, suggested to be harems with a single male in each in September (1979). The presence of pregnant bats was recorded in November (one in 1977 and 1978, and 2 in 1979). These roosted separately from the main group (both pregnant females in 1979 were together). Young bats were being carried in December (one in 1977 and one in 1979) and April (2 in 1980). Young, free-flying bats were present in the roost in December (one in 1978), January (one in 1978 and one in 1980) and April (2 in 1980). This seems to suggest that a harem system existed in this roost, the date of mating was not determined, but females gave birth in November/December and March/April. An increase in numbers of bats may have followed parturition in June 1979 when the colony was not visited. Thus the data indicate that the females give birth at the start of the north-west monsoon (November/December) and at least occasionally at the end of the monsoon (April). Of the months studied parturition occurred in all three November/Decembers and only 1 of the 3 Aprils (although in the other two years there were small increases in numbers in June/July which could also represent births. 3 of the 4 observed pregnancies resulted in free-flying juveniles. It may be unlikely that the same females gave birth in November/December 1979 and March/April 1980. This would suggest that at least 5 of the 9 bats in the roost in early 1980 were female, as at least two of the bats in October 1979 were male the sex ratio can be estimated to have been between 2:7 and 4:5 (male:female). In the La Passe roost on Silhouette mating has been observed in May (JOUBERT 1996). NICOLL & SUTTIE's (1982) observations of the harem system were limited to three visits, when the bats were in two groups of 4 (with one adult male in each group) (September-October 1979), in three groups of 9, 2 and 1 (June 1980), and in two groups of indeterminate size (July 1980). At other times they were scattered with no clear structuring. The June 1980 observation is also unclear as only one true group existed, with the other three bats being scattered. The harem system therefore cannot be demonstrated unequivocally by these data, similarly observations of the Silhouette roost suggest some social structuring although so far a harem structure has not bee definitely identified (BURGESS & LEE 2004).

The available population data on the Seychelles bats does not permit any analysis of population trends. Differences in total population estimates for the Seychelles fruit bat since 1977-9 reflect differences in survey effort and coverage, this obscures any underlying trends. It is notable that several islands that were reported not to have bats present despite historical records have recently been confirmed as supporting roosts. This may suggest that many of the small islands are not inhabited permanently. This is supported by observations that Round island (Praslin) is mainly used during December-January by females with juveniles (R. BRESSON *pers. comm*.).

The fruit bat is of great ecological significance as a major dispersal agent for some of the endemic forest trees (RACEY & NICOLL 1984). There is a need to quantify this dis-

persal role for the rare endemics and also for some of the invasive alien trees. Ecological data are also needed to determine whether current levels of exploitation for human consumption are sustainable. There are no published reports of movement between populations but unpublished data demonstrate regular movements from Praslin to Aride, Cousin and Cousine. Unpublished data also indicate that bats move from Fregate to these islands. The level of movement between Mahé and Silhouette islands are not known. There is a need to determine whether any of the islands operate as separate populations. This has a bearing on exploitation levels as some populations may act as reservoirs, masking over-exploitation on other islands. Basic biological data are currently lacking, impeding such assessments.

Data on the sheath-tailed bat are similarly limited. Location of further roosts on Mahé, Praslin and La Digue are urgent priorities. Ecological data on reproduction and feeding behaviour are also required before any understanding of their status and the significance of the suspected historical declines can be achieved.

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