

# A preliminary investigation into the general ecology, status and habitat of the Seychelles sheath-tailed bat *Coleura seychellensis* (Emballonuridae)

FLAVEIN JOUBERT

Ministry of Environment & Natural Resources,  
P.O. Box 445, Victoria, Mahé, SEYCHELLES  
[[fjoubert@env.gov.sc](mailto:fjoubert@env.gov.sc)]

*Abstract.*— An evaluation of the occurrence of the Seychelles sheath-tailed bat (*Coleura seychellensis*) on the islands of Mahé and Silhouette (Seychelles) was attempted. Abandoned caves were documented. The presence of *C. seychellensis* was confirmed for Mahé and a previously unknown population was located and studied on Silhouette. Techniques for field study, habitat and diet analysis were successfully applied to *C. seychellensis*. Most of the results were limited but foraging, habitat and population are discussed and some conclusions are drawn.

*Keywords.*— foraging, biomass, echolocation, Silhouette

## INTRODUCTION

Bats (Chiroptera) are presently one of the world's most endangered mammal groups. Insufficient knowledge of many species has led to human induced changes having negative effects on populations. Island populations such as Livingstone's flying fox (*Pteropus livingstoni*) in the Comoros islands (HUTSON 1994) are particularly vulnerable to encroachment and disturbance by humans.

Although flight and a nocturnal nature allows bats to exploit little used resources such as flying insects, it has also resulted in a greater need for adaptations and more acute performance. Flight itself is physiologically a very demanding propulsion method, imposing limits on body parameters such as weight and imposing demands on food intake. Bats do not only have to contend with flight and its limits; maximising foraging coverage does not necessarily entail greater gain per unit effort due to other factors, such as the aerial performance and detection abilities. Thus the strategies involve compromises between the different demands (BARCLAY & BRIDGHAM 1991). Detection of prey and obstacles is achieved by the use of high frequency ultrasonic calls to convey information on the position, velocity, texture and size of prey.

The old world genus *Coleura* (Emballonuridae) appears to be limited in species but is fairly widespread within its range in Arabia and sub-Saharan, Africa. Available literature cites the presence of one species (*C. afro*) on mainland Africa and another, *C. seychellensis* PETERS, 1868, restricted to the granitic islands of Seychelles (HILL & SMITH 1984). Apart from the plant feeding pteropodid fruit bats this is the only mammal species endemic to these islands (RACEY & NICOLL 1984). In NICOLL & SUTTIE (1982; after

HILL 1971) it is treated as having two subspecies, *C. s. seychellensis* and *C. s. silhouettae*, the former inhabiting Mahé and Praslin and the latter Silhouette and La Digue. From what can be gathered *C. seychellensis* appears to have been abundant up to the late 70's. Older people recall seeing large numbers emerging *en masse* at dusk to feed around Victoria and Mammelles (Mahé), and visiting caves containing thousands of bats on Silhouette (Silhouette residents *pers. comm.*). This claim is further substantiated by abandoned caves on most of the islands (see results and also NICOLL & SUTTIE 1982). Agreement with TUTTLE (1979) that guano deposits are good indicators of numbers would lead to the conclusion that the magnitude of decline may have been as high as 90%. Recent sightings indicate that *C. seychellensis* is now extremely rare, but also that small fragmented populations still remain on all four islands,

Ever since the first colonisers arrived in the late 18th century the Seychelles islands endured human interference and alterations to habitats. Present day animal and plant communities give only a general idea of the original ecology; some documentation is available on the original biota but much testifies to a legacy of plunder and mismanagement. Of the human induced ecological changes which may have had effects on the population of *C. seychellensis* the most visible is that of vegetation change.

SCOTT (1933), in a detailed report on the Seychellois insects commented on the level of association between insects and the endemic and indigenous plants. Considering the proliferation of secondary vegetation, an immediate conclusion would be that insect species may have changed accordingly. In a short term study BROWN (1984) argues that vegetation successional stages have associated with them insects with distinct life history traits, an argument which follows the r to K changes in size, mobility, and niche breadth. GASTON & LAWTON'S (1988) statistical analysis of insect datasets adds weight to the idea of small size being a characteristic feature of insects of early successional stages, with size being considered as a factor determining distribution, variability and abundance. However a strict negative correlation is ruled out, which means that some of the theoretical assumptions may not hold true. Similarly WOLDA (1987) in evaluating disturbed habitats in Panama concluded that the effects on insect populations were not as extreme as predicted.

BARCLAY & BRIDGHAM (1991) give an explanation of the relationship between detection ability, body size and prey size in aerial insectivorous bats. The negative relationship between body size and vocalisation frequency indicates that dietary niche breadth is restricted for large but not for small species. In the light of the ecological changes it is apparent that changes in prey availability may have affected *C. seychellensis*. The present study considered predator-prey relationships in the context of selection and limits to available prey to help resolve the question of selection and availability. This work was carried out as a final year project for the BSc in Environmental Studies at Manchester Metropolitan University in 1996.

## METHODS

Numerous established techniques were used for field study and analysis of use of habitat by *C. seychellensis*. Most work was carried out on Silhouette island as bats from the roosts (A&B) forage over the area, it contains a variety of habitats and work could be carried at any time (early morning & evening) due to relatively easy access. Sticky traps were used for insect sampling on Silhouette in August and September 1995 at the La

Passé site. Vegetation analysis and cartography were also carried out at the Silhouette site. Echolocation surveys were carried out on Mahé and Silhouette between July and September 1995 following from trial surveys on Mahé in August 1994. The echolocation survey covered the whole of north and north-west Mahe (to Belombre). On Silhouette it was carried out on the east coast from La Passe to Anse Lascars. Faecal matter was analysed at the Seychelles Polytechnic, Anse Royale, Mahé.

Likely roosting caves on Mahe, Silhouette and La Digue were visited during 1994 and 1995. Cave characteristics and evidence of occupation by bats, such as guano, were recorded.

### ***Echolocation surveys***

The use of ultrasonic calls of bats for the determination of numbers and activity is well documented (FENTON *et al.* 1987; FULLARD 1989). Calls of species are distinct and temporal coincidence amongst individuals is rare, allowing tracking even in circumstances whereby many individuals are present. Apart from allowing the detection and estimation of numbers of foraging bats without visual contact, it can also be used to determine the frequency of prey capture (FENTON 1985) and other social interactions. It is presently one of the most recognised techniques in bat research (THOMAS & LAVAL 1988) as it is non-intrusive and relatively easy to use. In this particular case there was no other echolocating bat species and the frequency of calls of *C. seychellensis* was known in advance from trials carried out in 1994. Likely feeding places were patrolled using Batbox II and Limbrick bat detectors at different times of the evening to ascertain the distribution of feeding bats. In most cases the Batbox detector was tuned to 40kHz but this was varied in the proximity of feeding bats to work out call patterns. Areas for error are minimal when using this approach but it was found that the song of certain insects and other noises could sometimes cause interference, but it was relatively easy to discriminate between these background noises and bat calls. The performance of the Limbrick detector was poor when it came to resolving call patterns and this coupled with a shorter range to limit its use.

### ***Prey sampling***

Sticky traps were the most appropriate method of sampling because of the ease of construction and use. It is a non-selective method, as opposed to attractors such as light traps, guarantees almost 100% retention of trapped insects and also does not require power or expensive material. Although the efficiency of this method is dependent on wind velocity (KUNZ 1988) its efficiency is constant between 2-10mph, with highest efficiency at low wind speeds (TAYLOR 1962). Cylindrical sticky traps present an omnidirectional sticky surface which entangles flying insects upon contact. Under calm conditions it will therefore be independent of air movement as it collects insects flying from whichever direction, but the situation changes with strong wind as certain small insects may be carried along in the airstream. During the study period wind conditions were calm.

Five sticky traps were used for sampling. These were constructed out of 50cm lengths of 4 inch PVC pipes over which was stuck white cotton fabric, giving a total area of 1,728cm<sup>2</sup>. Trap surfaces were coated with Oecotak non setting glue. All traps were wrapped in clingfilm before and after deployment. Sampling was carried out over three nights; on the first night sampling was random on the coast and hill and on the two re-

maining nights sampling was done along a transect from the roost down to the coast. Traps were set at 6pm and retrieved at 6am in all cases, those times corresponding to sunset and sunrise. On the hill traps were set above the canopy whilst on the coast they were set at half canopy height. This strategy was adopted firstly because of the safety aspects and logistics of setting and retrieval of traps. Traps could be set on a pole above the relatively low canopy of the hill vegetation, but the vegetation type and high canopy (>20m) of the coast prevented such an operation. In addition it was found that bats fed within the vegetation and at lower than half the canopy height on the coast, whilst on the hill low level foraging was prevented by the closed canopy.

Trap contents were identified to order level using BOROR & DELONG (1964) as a guide. Measurements of length and width were taken in millimetres, but for small individuals the dimensions were estimated to the nearest 1/3 or 1/2 millimetre.

### *Analysis of faecal material*

Faecal analysis is one of a few methods available for working out prey utilisation in bats, as the actual taking of prey is virtually impossible to monitor in aerial insectivorous species. It is also non destructive method (WHITTAKER 1988) used successfully in past studies (JONES 1990), and is especially recommended for insectivorous species as the exoskeleton of insects present readily identifiable fragments (WHITTAKER 1988). The method can be used in conjunction with prey availability data to test for prey selection and habitat use.

25 faecal pellets were collected from roost A (La Passe) during the insect sampling period. Collection was achieved by spreading three plastic sheets (50x50cm) under the points with greater guano accumulation for eight days. Pellets were frozen in individual containers (small plastic petri dishes). Before analysis each sample was moistened with a detergent solution and left to loosen for 24 hours. This is different from the method proposed by MCANEY *et al* (1991) or that used by JONES (1990) which makes use alcohol for wetting, but it was found to be as effective in loosening the samples. Samples were prised apart using fine dissecting needles and analysed under a binocular microscope at x40 and x100 magnification (Carl Zeiss Technical microscope, courtesy of Seychelles Polytechnic, Humanities and Sciences). All identifiable parts were drawn under dark ground illumination and later classed according to order using BOROR & DELONG (1964), WHITTAKER (1988), RICHARDS & DAVIES (1977), MCANEY *et al* (1991) and CHAPMAN (1982).

### *Vegetation analysis*

Vegetation in the sampling area was recorded by using a transect and quadrat. The dimensions of the transect was calculated so that it could accommodate a quadrat of minimum size. Minimum quadrat size was calculated from a species area curve, as outlined by GOLDSMITH & HARRISON (1976). According to SPELLERBERG (1991) the minimum area is the point where the slope of the curve approaches 10%. In this case however the inception point was found to be inadequate (just over 20m<sup>2</sup>), and the minimum area was taken as a higher value (80m<sup>2</sup>) corresponding to a second change in the species area curve. Transect width was thus taken as 10m so that it could accommodate quadrates of 10x8m. Within the transect 10 such quadrates, equidistant from each other were used for vegetation analysis. Plant species were identified from ROBERTSON (1989), and canopy dimensions were recorded for all species present (excluding grasses, herbs and climbers).

## RESULTS

Table 1 lists roosting caves encountered during the 1994 and 1995 surveys. Note that most area at low altitude. Other caves with possible signs of occupation were found at Cap Matoopa and Cap Ternay (Mahé). These have not been listed as material collected was not positively identified as bat guano. An attempt was made in 1995 to try and locate the cave on La Digue mentioned by NICOLL & SUTTIE (1982); a wide area was covered but no cave was found.

**General observations**

Foraging bats were found at two sites on Mahé on 02 August 1994; two individuals were found separately at Anse Major (west of Danzil) and two more together at La Gogue (reservoir area). Another foraging bat was recorded at Machabée on 21 July 1995. Observations on feeding bats agree to some extent with the conclusions drawn from wing morphology by NICOLL & SUTTIE (1982); namely that *C. seychellensis* is a high and fast flying bat. It showed however that to assume complete restriction on flight performance by morphology may be somewhat erroneous and ALDRIDGE's (1986) conclusions give cause for deviating from the basic assumption derived from PENNYCUICK's equation for gliding flight (PENNYCUICK 1975). High and fast flight was observed only rarely and these involved only a few individuals and were under windy conditions (20m altitude with swoops to 5m, observed Mahé 1994 and Silhouette 1995). In most cases bats fed at low speeds in relatively cluttered surroundings (e.g. within the coastal vegetation, Silhouette).

Table 1. Roosting caves on Mahe and Silhouette

Location		Description	Visited	Notes
Mahé	La Reduit,	10m altitude. Steep rocky coastal location, dry, 2 <i>Pandanus</i> species, 4m ceiling, 2m guano deposit	July & Sep 1995 No bats	Indication of a small population some time ago
	Takamaka			
Silhouette	Grand Barbe	10-15m altitude, gentle slope with secondary vegetation next to coastal plain, ceiling 1.5-2m. Shallow angle, narrow opening, extensive guano deposits (c8m)	July 1995. No bats	Indication of large population or long term occupation. Residents claim that bats were present up until recently.
	Pointe Coco	10m altitude, steep 'glacis', dry conditions, roost under an overhang, ceiling 1.5-3m, moderate to steep angle, guano deposits patchy, some washed away	July 1995 No bats	Some time may have elapsed since last occupation
	La Passe	A 30m altitude in boulder field Mixed vegetation, palms and exotics, ceiling 1.5-3m, slight angle, large guano deposit B ceiling >3m, angle slight to steep, 3m guano deposit	July & August 1995 14 bats 11 bats	These bats were the subject of this study. Counts may have an error of $\pm 3$ . All appeared mature, population structure was not investigated

A best approximation of foraging vocalisation in *C. seychellensis* would be of the long narrowband constant frequency (CF) type with a shallow PM terminal phase, in agreement with NEUWELER and FENTON's (1988) classification of its closest relative *C. afra*. Two major harmonic bands were identified at 40kHz and 25-30kHz, with the terminal FM sweep reaching high in the audible range. Roosting bats were found to be non-

vocal, unless disturbed, when high pitched audible calls were made. When flying within the roost bats produced audible orientation calls.

Emergence patterns were not monitored (cave characteristics and personnel being limiting factors), but the success of encounters at different times in the evening suggest that *C. seychellensis* may exhibit a bi-modal pattern of emergence, concentrated around late evening and at dawn. Dawn observations on Silhouette proved more fruitful often with over ten individuals feeding gregariously and remaining in the same area (marsh area) until it got light. Evening sightings were often one or a few individuals, most of which were transitory. The observed pattern however may have been a result of circumstances during the study period as activity could be influenced by such diverse factors as lunar cycle (ERKERT 1982) and spatial and temporal distribution of prey (BRADBURY & VENRENCAMP 1976).

Some disparity in size was observed, especially when individuals flew together within the roost. It is known that *C. seychellensis* is sexually dimorphic (NICOLL & SUTTIE 1982) but no attempt was made to work out population structure using that approach as growth stages could easily invalidate the data.

Most bats transferred from roost A to roost B when disturbed (B was left undisturbed throughout the whole period), although some individuals tended to roost in the open. This could be linked to some form of territorial behaviour observed both at the roost and in foraging bats whereby chasing would be accompanied by a continuous stream of clicks (which were audible at the roost).

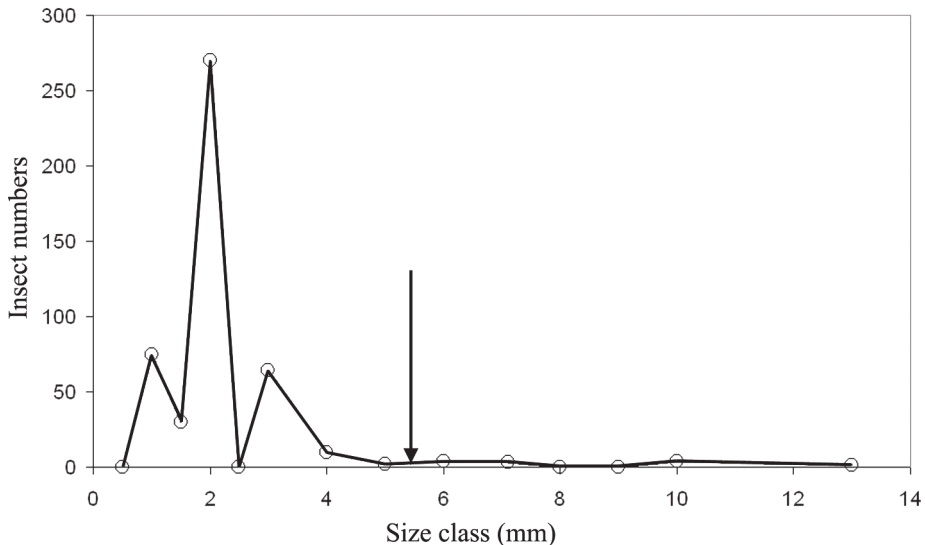


Fig. 1 Insect size distribution

***Insect prey data***

*Prey size distribution.*— Fig. 1 shows the size distribution of insect sizes for all fifteen

traps. The distribution is highly skewed towards lower sizes. Tests for skewness and kurtosis (EBDON 1995) give very high values: skewness = 2.1, kurtosis = 6.5. The values show that the insects sizes present are not normally distributed, and further statistical analysis was not carried out.

*Minimum size limit.*— Minimum size limit is calculated on the assumption that the minimum size detectable is a function of the shortest wavelength attainable, in other words highest frequency. 50kHz was taken as the upper vocalisation frequency of *C. seychellensis* (see below), this corresponds to a wavelength of 6.88mm (effectively equivalent to the smallest detectable target). MOHL (1988) defines acoustically small targets (in bats) as those which satisfies the equation (where  $a$  = target diameter,  $\lambda$  = wavelength) :

$$2 \times \pi \times a / \lambda = 5$$

Applying this equation to a frequency of 50kHz gives the lower value of 5.47mm as the minimum detectable size.

*Biomass of size classes.*— Fig. 2 shows mean biomass for the different size classes, for ease of calculation each insect is assumed to be uniformly cylindrical, and volume calculated using the equation for a cylinder. BRADBURY & VEHRE CAMP (1976) used length as a measure of biomass, but this was not used as it gives an ideal pattern, independent of the width of individuals. Total biomass itself does not show such a trend of increasing values; high variability together with the skewness in number tends to dampen such a trend.

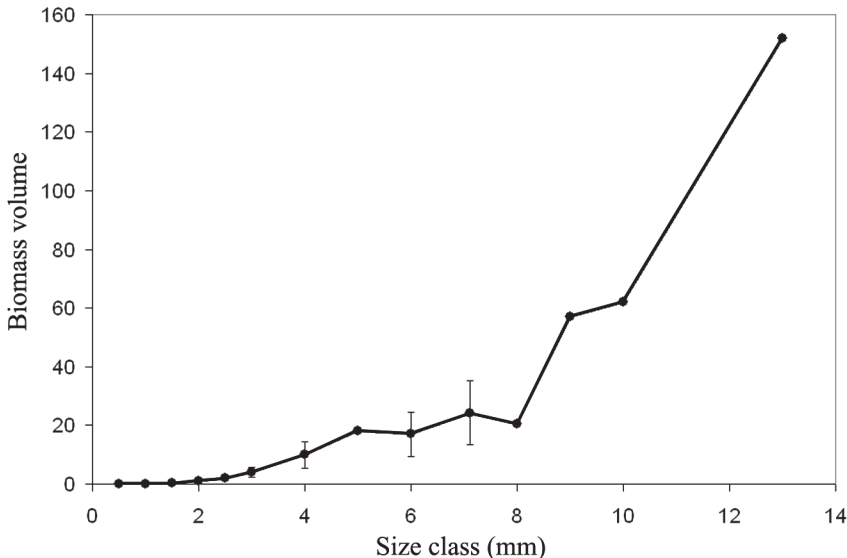


Fig. 2 Biomass distribution

*Size and biomass of taxa.*— Fig. 3 shows the distribution of sizes and biomass for the insect taxa present (error bars equals one standard deviation). Low abundance for certain orders such as Hemiptera prevented a more accurate calculation of the mean size.



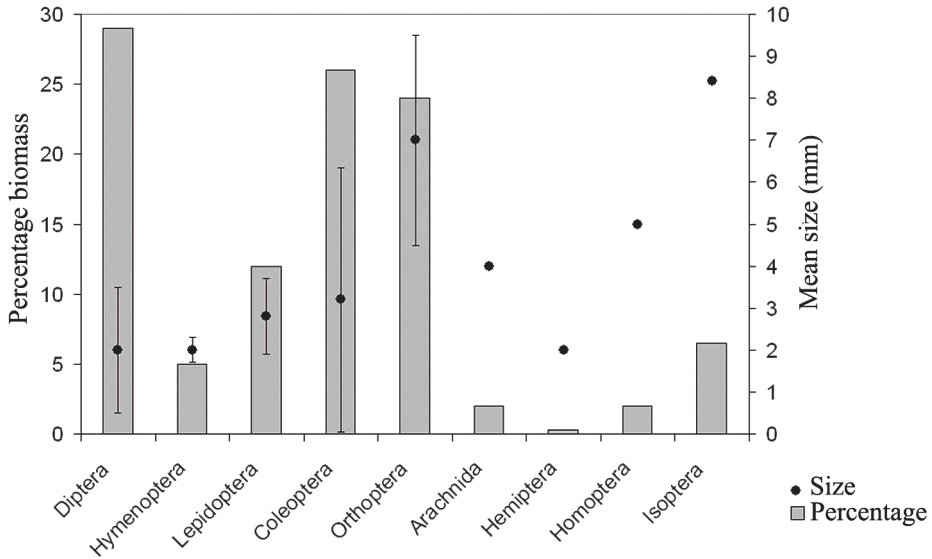


Fig. 3 Biomass and size of invertebrates. Error bars represent one standard deviation

**Prey and prey consumption**

*Insect fragments and identification.*— Insect numbers in each sample were estimated by calculating the minimum number of individuals for the fragments present (WHITTAKER 1988) (Fig. 4, Table 2). For a few samples difficulties with the type and size of insect fragments meant that identification was not complete, but that applies to.

Table 2. Summary of prey available and eaten

Order	Total		Over 5mm		Percentage eaten
	% prey	% biomass	% prey	% biomass	
Diptera	40	28.8	18.8	24.6	30.5
Hymenoptera	48	4.8	6.3	2.6	25
Lepidoptera	6.3	10.3	6.3	1.9	19.5
Coleoptera	2.5	24	12.5	25.4	22
Orthoptera	1.8	22	37.5	32.5	0
Arachnida	0.5	1.2	0	0	0
Hemiptera	0.2	0.1	0	0	3
Homoptera	0.2	1.3	6.3	1.9	0
Isoptera	0.5	7.5	12.5	11.1	0

*Analysis of preference.*— Fig. 5 give the results for analysis of preference using Cock's (1978) method 4 for all combinations of prey present. The same procedure was also repeated for insect numbers above the 5.47mm size limit (taken as all above 5mm) derived above. The clumping of data and apparent preference of most species over Diptera and Hymenoptera is replaced by a more complex relationship between the common taxa and high selectivity against Orthoptera when only large insects are considered.



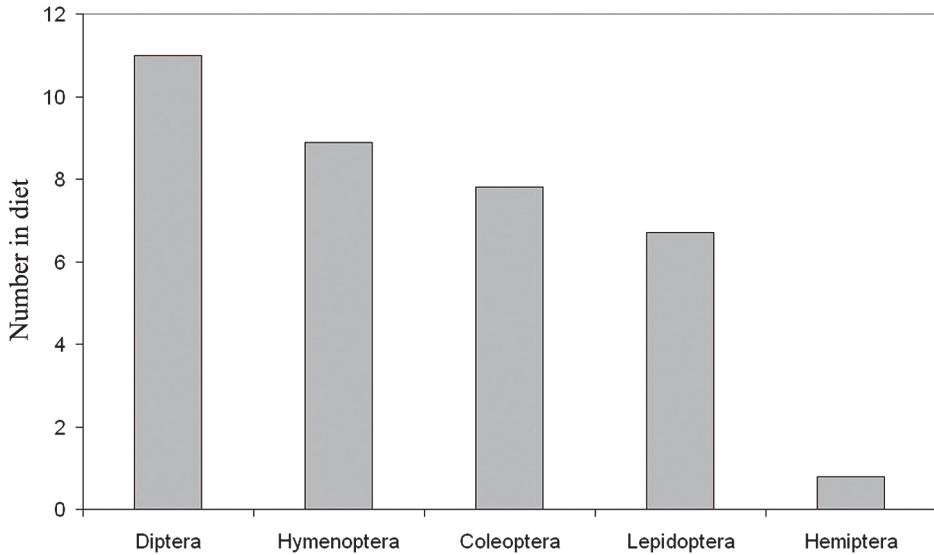


Fig. 4 Diet analysis

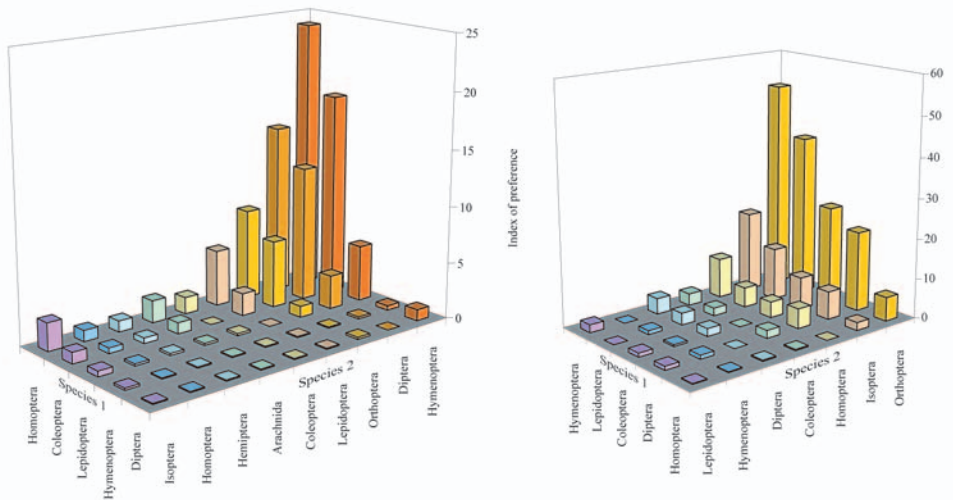


Fig. 5 Preferences from all data and from prey over 5.5mm

**Transect data; traps and quadrats**

Fig. 6 shows insect number and species number along the transect. Definite trends can be seen in these values but these need to be considered together with the diversity data below, which merges both elements. Shannon- Wiener and Simpson diversity indices were used to analyse both vegetation (Fig. 7) and insect data. Note that point 5 corresponds to the marsh area, which contains only trailing ground vegetation.

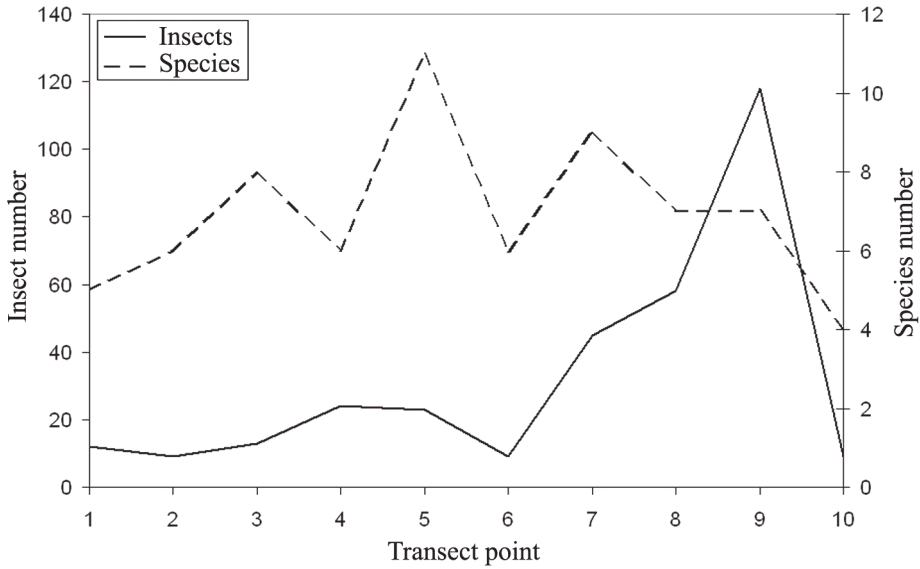


Fig. 6 Insect distribution (transect point 1= coast, 5 = marsh, 10 = roost)

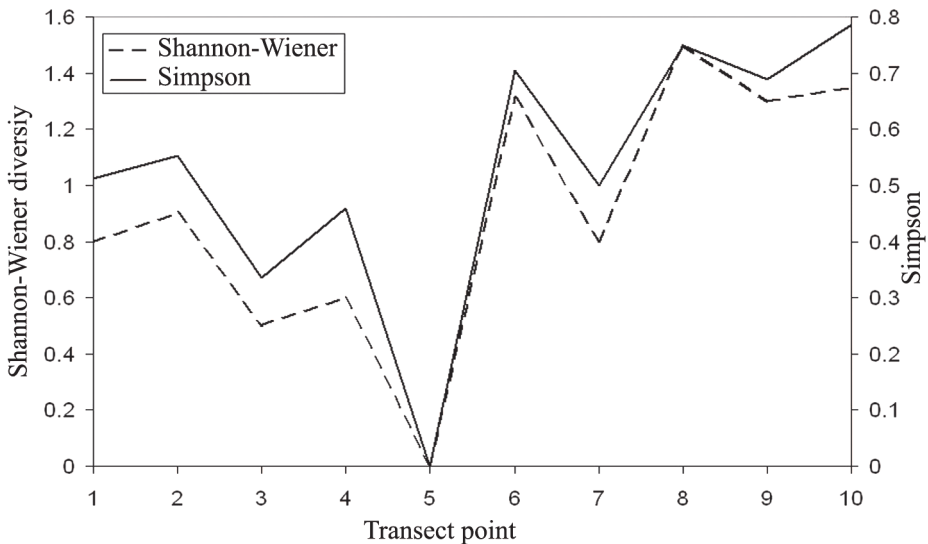


Fig. 7 Vegetation diversity

#### DISCUSSION

The echolocation surveys and surveys of caves are incomplete. Confirmation of the presence of *C. seychellensis* has been achieved but this represent only a fraction of the total area where it may occur.

The insect size data give a fair indication of the general pattern of distribution, especially when the two intermediate values. The 2mm class has highest frequency although this does not mean greatest number of species. It should be noted that the bulk of insects in that size class is composed of Hymenoptera (chalcidoids ?), and that these are from only a few traps. Basic theories of community structure and niche space produce such distributions; thus it could be assumed that the observed pattern is a suitable approximation of the actual distribution. A characteristic feature of the Seychellois insect fauna is their small size, so skewness towards lower values would be expected. SCOTT (1933) noted such a pattern, attributing it to the remote oceanic island effect. As a resource base for an insectivore, we thus find that even initially there must have been a tendency for small insects.

The effect of successional changes on size distribution also needs to be considered. If BROWN's (1984) sequence of events holds true, then a shift in size towards smaller species, would have to be accepted. However, to assume a downward shift in size is to assume that the new vegetational composition has provided a release mechanism for the smaller species, most of which are endemic. This general shift however need not occur because not all guilds are equally affected (SOUTHWOOD *et al.* 1982). Insect distribution could also be affected by a general depression of the abundance curve, i.e. reduction of diversity across the whole range of values. This effect would fit in well with a model which considers reduction in all plant associated insects (including phytophages) as a result of host plant loss. Such insects follow lognormal patterns and their removal will have consequences for all classes.

A size limit has been added to the distribution not only as a measure of detection efficiency but also to stress the importance of prey quality. It shows that the generalisations about abundance of tropical insects, and in the case of abundant prey for bats (HAILS 1982), may not hold true for *C. seychellensis*. The absolute value for the size limit may be an underestimate as maximum vocalisation frequency lies lower than 50kHz.

MOHL's (1988) equation for size detection however is derived from laboratory measurements, thus there should be some allowance for error in replication in the field. Nonetheless it should be appreciated that a size limit exists, which bars *C. seychellensis* from utilising all of the prey present. Size distribution alone gives the impression that the odds of acquiring sufficient food are stacked against the predator in this case. However, although less than 4% of the prey are available to the predator, this small percentage contains over 50% of the biomass.

Biomass content is a limiting factor imposing its own limits on size classes utilised. Optimising energy extended in foraging and energy gained for each capture should thus entail the capture of very large prey, but it should be remembered from the distribution that the probability of encounter of large prey is small. The frequency of large prey should thus tail off, not because of detection but because of prey scarcity. Optimisation of biomass gain itself implies indiscriminate capture of all prey species present, but each species has its own susceptibility to capture (take for example the response of arctiid moths and lacewings) and furthermore bats may actively select for certain prey species using cues other than signal strength.

The 5mm mark represents a region whereby gain in biomass per capture starts to rise more rapidly. It shows that a detection limit set at that value does not present a special problem for *C. seychellensis* as long as there are sufficient captures to offset energy

expenditure. The size and biomass content of each insect taxon has implications on its utility. In biomass terms Diptera appear to present the best option, but size limits their utility. With biomass and size combined (Fig. 3), the orthopterans and coleopterans present the best option. Orthoptera may not represent a stable fraction of the aeroplankton: cockroaches may fly frequently but the other members of the group (crickets etc.) appear to be mostly sedentary. This leaves Coleoptera, Lepidoptera and Diptera as important food items, a condition which is reflected in the diet results.

From Table 2 it can be seen that the percentages of insects present are not reflected in the diet. Diptera and Hymenoptera are less than expected and Lepidoptera and Coleoptera more than expected. Preference testing indicate that avoidance of Diptera and Hymenoptera appear only because all species are being considered together. They are common but small, thus it may not be outright rejection but rather their unavailability which gives rise to such values. Rejection of those common orders would indicate a highly specialist predator, a strategy which would most likely be unsuitable for an aerial insectivore. When considered in terms of a size limit (Fig. 5), a general reduction of extreme preference values is observed amongst the commonly eaten species (Diptera, Coleoptera, Hymenoptera and Lepidoptera). These indicate that the issue of restriction/selection for larger prey is but may be only a result of size distribution. A notable relationship is the higher selection for all orders over Orthoptera. This confirms that orthopterans, because of their habits may be unavailable as a prey resource. Possible errors in this interpretation may arise from miscounting individuals in faecal matter. Fragments present in the faeces indicate that *C. seychellensis* may cull certain parts of prey which means that diagnostic parts for certain taxa, e.g. coleopteran elytra, may be lost. Also certain species may provide comparatively more, and more readily identified fragments, e.g. Lepidoptera, which could lead to overestimation. Isoptera may be one of the orders presenting such a problem as they are soft bodied and readily shed their wings, leaving few hard parts for identification.

Interpretation of the preference results could lead to two different conclusions. Habitat requirement may be determined by the preferences expressed in the results. Thus it could be predicted that *C. seychellensis* would forage over habitat rich in the preferred species. A second interpretation would be that the preference values are the product (not the cause) of foraging over different habitats, which means that specific selectivity is not occurring. To obtain null values for preference *C. seychellensis* would have to forage over all habitats, a proposition which goes against optimal foraging. BRIGHAM (1992) encountered a similar effect in *Myotis yumanensis*, whereby dietary composition reflected swarm composition over the predominant foraging sites. Thus the second interpretation provides a simpler explanation which fits in with assumptions about foraging and also makes sense in light of the data limitations. NEUWELER & FENTON (1988) classifies bats such as *C. afra* (long narrowband calls, shallow FM, high wing aspect ratio), as species which feed mostly in open areas, but this is not a strict classification and deviations may occur. From the field observations and the above classification it could be inferred that *C. seychellensis* also forages above canopy height, but this does not take into account the quality of each site and the effect it may have on foraging.

Time constraints during the sampling period meant that habitat characteristics could not be analysed in any great detail. This affects the significance of conclusions drawn, especially those about spatial distribution of prey. The conclusions should thus be

taken as preliminary, and may need to be reviewed after further research. An attempt was made to measure success over different habitats by monitoring PM sweeps, which indicate interception. All results were rejected however because it was found that the emission of PM sweeps did not necessarily indicate successful capture; the reason being that in certain cases the rate of emission would have to be taken as indicating negligible handling times. Observations of feeding bats suggest that *C. seychellensis* has a preference for the coastal zone, feeding mostly over marshland. Foraging over hillside vegetation was not sustained and covered larger areas, although the hillside has much higher insect numbers, that in itself is not sufficient due to low prey quality. The preferred foraging sites actually correspond to the zone of highest insect diversity. Concentrated feeding within that zone thus indicates that *C. seychellensis* may be an opportunistic predator rather than one which shows prey preference. Utilization of prey within that zone would entail deviation from classifications such as NEUWELER & FENTON'S. However this is not indicative of a misclassification, but instead it demonstrates flexibility in the foraging habits of the bat.

A combination of factors including marshland and open ground vegetation may be the cause of such a high diversity. A negative correlation between vegetation and insect diversity were obtained from the data (product moment correlation; Shannon = -0.8, Simpson = -0.7). These values are not necessarily significant as the vegetation data are from two different zones, each with its distinct composition and diversity. Accepting the correlation values reinforces the view that insect diversity increases from the hill to the coast in agreement with earlier work on altitude and insect diversity which has found in many cases there are low and mid elevational peaks in insect diversity (MCCOY 1990). Existence of such diversity peaks leads to questions about what their importance is to *C. seychellensis*, and whether such trends have been altered by human activities.

The drop in insect diversity on moving up from the coast corresponds to the occurrence of secondary vegetation. A natural drop in the diversity of aerial insects may be present due to several factors (e.g. different habitat, windier), but it would be of interest to see whether such a trend has been accentuated by the vegetation. An order whose diversity could be used as an indicator is the Coleoptera. which represent important prey items in the recorded diet and also in terms of biomass and size. SCOTT (1933) reported over 80 species of Coleopterans as being directly associated with, or frequenting palms and other endemic plants. Loss of such plants would mean loss of many Coleopterans, but a simple cause and effect relationship with the decline of *C. seychellensis* may not necessarily be an appropriate description.

Island Biogeography Theory (WILLIAMSON 1983) raises questions as to why equally volant insectivorous bat species are not present in the granitic islands although *Traienops furculus*, *Chaerophon pusilla* and *Taphozus mauritianus* are said to occur on Aldabra (RACEY & NICOLL 1984). It can be argued that niches exists on the granitic islands which could sustain *Coleura seychellensis* but have barred other vagrants from establishing a foothold, or *C. seychellensis* that it represents a remnant population isolated as a result of geologic and sea level changes. *C. seychellensis* is present at very low densities on Mahé, but appears to be at slightly higher densities on Silhouette. If a population like that observed at La Passe (Silhouette) is present in all areas, then it can be concluded that a small but viable population is still present on Silhouette. The fragmentation and low population on Mahé raises doubts as to the prospects of breeding and therefore future survival of *C. seychellensis* on that island. A general lack of information on the surviving

population appears to be hampering any effort to set up conservation programmes for the species.

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