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ON THE ECOLOGY OF THE FRUIT BAT, *ROUSETTUS AEGYPTIACUS LEACHI* (A. SMITH, 1829) IN THE TSITSIKAMA COASTAL NATIONAL PARK

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Abstract – Field observations were carried out on *R. aegyptiacus* in the Tsitsikama Coastal National Park in the winter of 1974 and the summers of 1975 and 1976. The roost of the fruit bat population was a cave in the narrow gorge of the Storms river. The population was estimated at 3 000 bats. Activity during the night was found to be significantly longer in summer than in winter. The possible reaction of these bats to the commencement of activity to moon light conditions at the cave is discussed.

Food items (*Ekebergia capensis, Cassine crocea, Acokanthera oppositifolia* and *Viscum obscurum*) were established by direct observations or by identification of food remains and seeds in the guano.

Time of birth of infants was calculated from the forearm length of captured bats. According to these calculations parturition takes place during October to June with a peak in December.

Introduction

The four subspecies of *Rousettus aegyptiacus* (i.e. *aegyptiacus, arabicus, unicolor* and *leachi*) are distributed over most of Africa and Arabia from the eastern-Mediterranean through south eastern Persia and Baluchistan and into West Pakistan. The subspecies *R. a. leachi* inhabits southern and most of eastern Africa (Hayman & Hill 1971; Kingdon 1974).

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This species of *Rousettus* generally roosts in caves or cave-like shelters like the other species and can orientate visually as well as acoustically. This ability has most probably evolved separately from that in Microchiroptera (Kingdon 1974; Novick 1958).

Although *R. aegyptiacus* is regarded as the best known species of the genus (Kingdon 1974), amazingly few detailed data on their biology are available (Eisentraut 1963; Kulzer 1958, 1969a and b; Lombard 1961; Mutere 1968; Jacobsen and du Plessis 1976). Some other papers deal with special physiological and other factors (Griffen, Novick & Kornfield 1958; Kulzer 1963, 1966; Kaisila 1966; S. Erkert 1970; Kock 1972; H. G. Erkert 1974; and Keegan 1975).

Material and Methods

The study was carried out in the Tsitsikama Coastal National Park, Republic of South Africa (34 02'S, 23 54'E). The area receives rain throughout the year with two peaks during April–May and August–September. The mean annual rainfall is approximately 1 000 mm and the mean annual temperature is 18,2° C (mean winter and summer temperatures are 16° C and 20° C respectively). The Park is situated in an area along South Africa's rocky south coast and has good representative stands of the southern Cape Coastal indigenous forests.

Some observations were made in the coastal forests but the bulk were made at a roosting place of a *Rousettus aegyptiacus leachi* population which was situated in a cave in the gorge of the Storms river, a few hundred metres upstream from where the river runs into the sea. The cave was accessible by boat only during fair weather. The observation point was either the boat anchored in front of the cave or a small level area at the cave's entrance.

Climatological instruments were installed at roughly the middle of the cave. Maximum and minimum temperatures and relative humidity were recorded at irregular intervals and measurements are given in Table 1. It must be assumed that temperatures at the ceiling among the fruit bats would be somewhat higher than those given.

Observations were done on the nocturnal activity of the bats, which included the time of leaving and returning to the cave. When natural light was adequate, they were counted leaving or returning to the cave. However, a spot light had to be used mostly to establish the number of fruit bats inside the cave at regular intervals. Eleven continuous observation periods were carried out throughout the nights of April/June 1974 and another eight during November/December 1975 and January 1976.

Four hundred and thirty-four individuals of this population of fruit bat were caught, sexed and the forearm measured. They were marked with a small numbered metal tag in the ear and released. Data on food items were either collected by direct observation on feeding *R. aegyptiacus*, by collecting the remains of fruit and by identification of seeds in the guano.

Table 1

Temperature and relative humidity in the Storms River cave

Date and time of reading	Temperature °C min	max	relative humidity %
1974			
1.6; 01h30	12		88
07h30	12	12,5	88
15h45	12	14	89
5.6; 20h15	10	14	88
12.6; 02h00	11	15	88
19.6; 00h10	10,5	15	76
9.9; 23h45	8	17	94
1975/76			
10.12; 01h15	14,5		–
05h30	15		–
11.12; 20h45	17		–
13.12; 20h30	17		90
7. 1; 20h50	17,5		94
14. 1; 21h40	18		–

Results

The Roost

The studied population of *R. aegyptiacus* used a cave near the mouth of the Storms river, situated in a deep narrow gorge, as their daily roost. The entrance of the cave faces west (Fig. 1). Light of the sun and moon

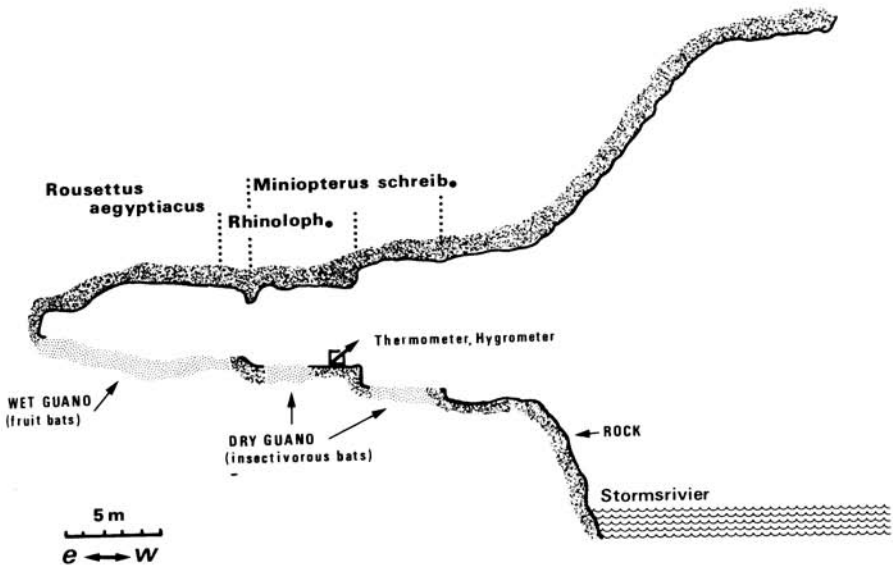

Fig. 1. The cave in Storm river gorge.

reaches the entrance to the cave directly for only a short period per day. Light was also reflected into it from the opposite side of the gorge (west side). The cave can only be reached via the river and has therefore been undisturbed for at least ten years (the Park was proclaimed in 1964). Prior to the establishment of the Park, guano was collected by local farmers in the cave while the bats were smoked out periodically.

The fruit bat population consisted of about 3 300 individuals in September 1974 and approximately 3 200 in January, 1976 (These crude guesstimates were made by using the "Lincoln index" method – see Table 2).

Table 2

Mark-recapture data

Date	Caught (c)	Recaptured (r)
June 1974	208	–
9 Sept. 1974	112	7
14 June 1975	13	–
9 Jan. 1976	89	9

Lincoln Index: $N = \frac{c \times m}{r}$ (m is the number marked in the population)

Population estimate for Sept. 1975: $N_1 = \frac{112 \times 208}{7} = 3\,328$

Population estimate for Jan. 1976: $N_2 = \frac{89 \times 326}{9} = 3\,224$

The fruit bats occupied the back of the cave, hanging there during the day in a characteristic pattern. When sun-rays were reflected from the opposite wall into the back of the cave part of the population changed its roosting-place to escape the light and then continuous fighting for the darkest niches and crevices resulted. It seems possible that the availibility of dark places acts as a rough regulator, limiting maximum numbers of fruit bats in this cave.

In the dark places in the centre of the cave several species of insectivorous bats were found. In winter 1974 up to 20 *Miniopterus schreibersi* and 30 *Rhinolophus capensis* occurred; in summer 1975/76 up to 800 *Miniopterus schreibersi* (with a few *M. fraterreulus* among them) plus 60 to a few hundred *Rhinolophus* sp. were present. In January 1976 clusters of 30—40 adult and juvenile *Rhinolophus* sp. were found in the cave (most of them *R. capensis* but *R. clivosus* was also present in other caves in the Park together with *R. capensis*).

Activity

Observations on the population of *R. aegyptiacus* in the Storms river gorge in 1974 showed flight activity during day time only when sun was reflected into the cave. Presumably this was in an attempt to escape from the light. Most individuals seemed, however, to be awake and screams and squeeks could be heard continuously.

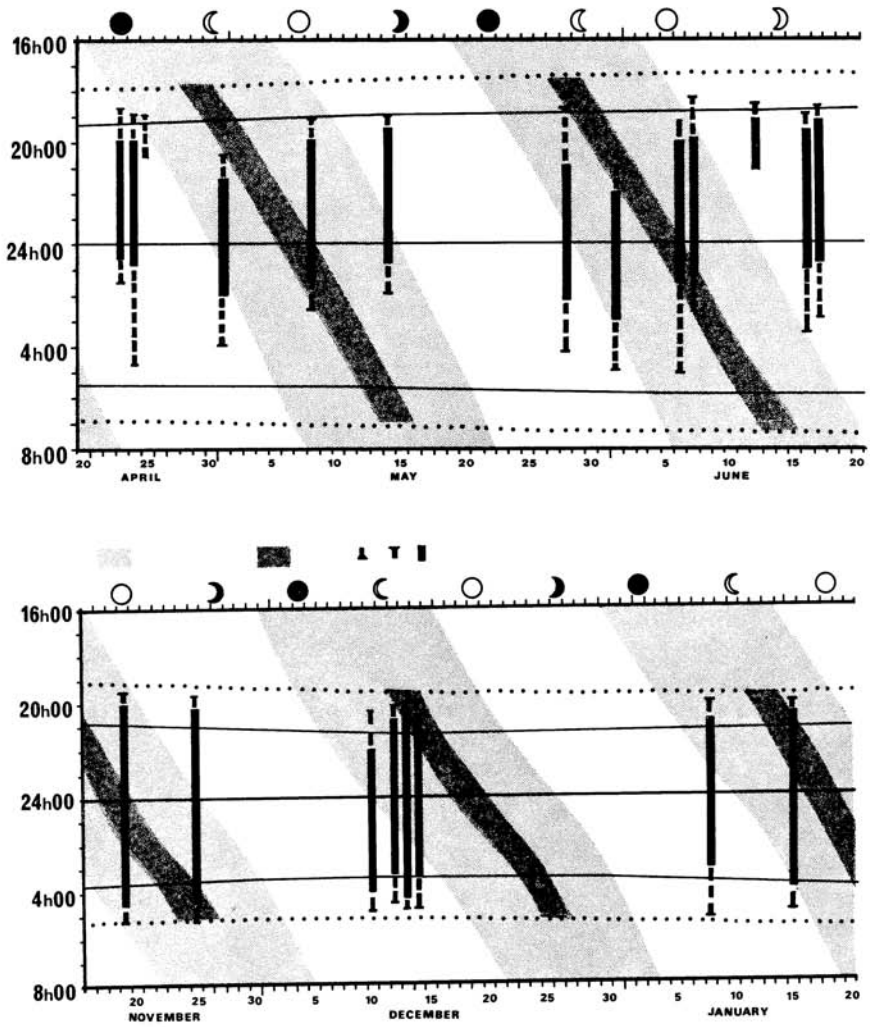

Fig. 2. Activity of *Rousettus aegyptiacus*
a winter 1974
b summer 1975/76
onset of emergence from cave
last individual returning to cave
period the cave is empty
sunrise and -set
moon
moonlight in the gorge (approx.)

In the present study maximum activity time (that could be spent outside the cave) is regarded from the onset of emergence from the roost until the return of the last individual to it; minimum activity time is taken as the period between the last individual leaving the cave and the return of the first (i.e. the period the cave is empty per night). There

were, however, two nights when some adult individuals were present at the roost while the rest of the population was away feeding. It is uncertain whether these had never been out or possibly had emerged among the first individuals and returned for some reason before even the majority had gone. Defaecation of two individuals during the period of emergence indicated that the latter was the case on both occasions as digestion of their food takes at the utmost a few hours (Lombard 1961; Wickler & Seibt 1977).

The activity data indicated a different winter and summer pattern.

During winter 1974 the fruit bats started their activity between 54 min. and 166 min. after sunset, the mean time being 86 min. after sunset and the end of activity was between 126 min. and 320 min. before sunrise (mean: 216 min.). There is a clear wave-like change in the onset and the end of emergence from the return to the cave (Fig. 2a).

In summer 1975/76 the fruit bats exhibited quite a different pattern; the most noteworthy is that the period of activity was appreciably longer than during winter – regardless of the shortened dark phase, but follows the changing length of the dark period. The differences in the start of emergence were only small: varying between 20 and 55 min. after sunset (mean: 31 min.) while the end of activity was between 35 min. before and 10 min. after sunrise (mean: 12 min. before) Fig. 2b.

Activity patterns of bats have been studied over many years and in general they were usually closely related to sunrise and sunset although this could be modified by other factors (Herreid & Davies 1966).

The above mentioned pattern applies clearly to the summer period at the Tsitsikama Coastal National Park and was also found in the onset of activity in the Eastern Transvaal where similarly, some lunar periodicity in the length of the time the whole population took to emerge from the roost, was suspected (Jacobsen & du Plessis 1976). At Storms river gorge the delayed onset of emergence of *R. aegyptiacus* at times when the moonlight reaches the gorge when they were about to leave was very pronounced (see Fig. 2a). Erkert (1970) has shown the synchronizing effect of changes in light intensity under low light conditions as well as the inhibition of activity by the influence of light – further she found a very stable activity pattern for *R. aegyptiacus* which agrees with our field observations – the activity phase is rather the same during one season except under the influence of moon light in winter. The apparent lack of moon light influence on the bats' activity during summer could be caused by a number of factors, the most obvious being the breeding season, which is discussed later. The rather short activity period during the long winter nights, could at least, to some extent be the result of temperature.

Food and Feeding

The present observations were from an area of indigenous forest where *R. aegyptiacus* was only seldom found in adjacent orchards – mainly when the plums were ripe. Several individuals of *R. aegyptiacus* were observed at a Cape ash tree (*Ekebergia capensis*) bearing ripe fruit during

June 1974. The tree was surrounded by other bushes and trees forming a dense although incomplete leaf-canopy. The fruit bats came diving down through this canopy and often hovered around an *E. capensis* branch or would alight on it for a few seconds, leaves could be heard rustling and sometimes fruit fell after which the bat flew off. On one occasion a short fight between two bats was heard. Covering the above area during day-light, a search revealed small concentrations of fruit remains below branches which were used as perches. Jacobsen & du Plessis (1976) noted that the use of these perches were relatively permanent while the fruit was available in their immediate vicinity. From the fruit remains, fruit from the following trees were identified; Cape ash (*Ekebergia capensis*), Saffronwood (*Cassine crocea*) and Bushman's poison (*Acokanthera oppositifolia*). Although these bats discard all hard particles in their food before swallowing the pulp and juice (see also Kulzer 1958; Lombard 1961) the fresh guano in the cave was searched whenever possible for food remains. During mid-June the guano was found to contain a high concentration of Mistletoe (*Viscum obscurum*) seeds. These seeds are embedded in a very sticky, fleshy substance and the bats probably cannot discard them when swallowing the soft parts and juice. The guano is also in a very sticky state at this time indicated a strong preference for this fruit by these bats.

During winter 1974 several individuals of *R. aegyptiacus* were collected immediately following their return to the cave, killed and the contents of their stomachs and intestines investigated. We were unable to identify anything from this as all contained only juice with the odd plant fibre.

A summary on "Fruit bats and bat flowers" is given by Kock (1972), and further contributions of feeding can be found in several papers (Kulzer 1958; Lombard 1961; Start 1972; Jacobsen & du Plessis 1976) and in some of them *Ekebergia capensis* is mentioned whereas the other food items identified during this study are new to the food list of *R. aegyptiacus.*

Period of Parturition

Mutere (1968) regards forearm length as a good indication of age in *R. aegyptiacus* and its rapid growth in the first three months makes ageing of young animals up to this age possible and relatively accurate, after this the growth curve approaches an asymtote and individuals with a forearm length of 90 mm and over can be regarded as adults.

The month of birth in the present study has been estimated using Mutere's forearm age relationship. The data were from captured and marked young up to three months of age; to all others we refer to as "older juveniles". (Forearm measurements are given in Table 3).

Mid June 1974 a total of 208 individuals were caught in the cave at the Storms river. Three of them (1,4%) were born in March, 25 (12%) were older juveniles and the rest (180, 86,5%) were adults. In early September 1974, 112 *R. aegyptiacus* were marked in the same cave and measurements indicated one birth in June (0,9%), 19 older juveniles (17,0%) and

Table 3

Age distribution of bats caught

Maximum forearm length and corresponding age / Date of capture	64,5 mm 4 weeks	72,2 mm 8 weeks	80,0 mm 12 weeks	89,9 mm Older juveniles	> 90,0 mm Adults	Total
11, 12, 13, 18 and 19 June 1974	–	–	3	25	180	208
9 September 1974	–	–	1	19	92	112
14 January 1975	2	2	2	2	5	13
9 January 1976	24	12	–	5	57	98

92 (82,1%) adults. Among the thirteen fruit bats caught in January 1975 two females had twins, which seems to occur fairly frequently (Kulzer 1966; Walker 1975; Jacobsen & du Plessis 1976). Measurements in this case revealed October, November and December as months of birth, two older juveniles and five adults. In January 1976 most of the females captured were still carrying infants (no twins were recorded on this occasion, but 24 (24,5%) had been born in December and 12 (12,2%) in November. These data show that birth in *R. aegyptiacus* takes place from October until June in the southern Cape Province; in the Eastern Transvaal Jacobsen and du Plessis (1976) found neonates from October till April and a pronounced peak in numbers in November/December. It therefore seems evident that *R. aegyptiacus leachi* is a seasonal breeder with one annual breeding season in southern Africa. The breeding season varies considerably in different parts of the wide range of the species; *R. aegyptiacus leachi* has a biannual breeding season (March, September) just prior to the month of higher rainfall in Uganda (Mutere 1968), while at Lake Baingo (Kenya) the breeding season is July, August (Kingdon 1974) and in Zambia and probably in southern Congo it occurs in October (Walker 1975). In Cameroun pregnant females of *R. aegyptiacus unicolor* as well as those with small young were captured between November and March but it is unknown whether birth of young is restricted to the dry season (Eisentraut 1963). *R. aegyptiacus aegyptiacus* were found breeding throughout the year in Cairo (Kulzer 1958) whereas in Cyprus the majority of females were pregnant at the end of February and beginning of March (Spitzenberger & Bauer, *pers. comm.).*

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