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 3000 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).


**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

<table>
<thead>
<tr>
<th>Date and time of reading</th>
<th>Temperature °C</th>
<th>relative humidity %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>1974</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.6; 01h30</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>07h30</td>
<td>12</td>
<td>12.5</td>
</tr>
<tr>
<td>15h45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.6; 20h15</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>12.6; 02h00</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>19.6; 00h10</td>
<td>10.5</td>
<td>15</td>
</tr>
<tr>
<td>9.9; 23h45</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>1975/76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.12; 01h15</td>
<td></td>
<td>14.5</td>
</tr>
<tr>
<td>05h30</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>11.12; 20h45</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>13.12; 20h30</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>7.1; 20h50</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>14.1; 21h40</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

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.](image-url)
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>
<thead>
<tr>
<th>Date</th>
<th>Caught (c)</th>
<th>Recaptured (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 1974</td>
<td>208</td>
<td></td>
</tr>
<tr>
<td>9 Sept. 1974</td>
<td>112</td>
<td>7</td>
</tr>
<tr>
<td>14 June 1975</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>9 Jan. 1976</td>
<td>89</td>
<td>9</td>
</tr>
</tbody>
</table>

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 availability 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 schreiberi and 30 Rhinolophus capensis occurred; in summer 1975/76 up to 800 Miniopterus schreiberi (with a few M. fraterreus 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 squeaks 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 uncer-
tain 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 ef-
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 obser-
vations – 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 – main-
lly 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 daylight, 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 Misteltoe (*Viscum obscurnum*) 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 asymptote 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
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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