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TERRITORIAL AND INTERGROUP BEHAVIOUR OF THE LESSER BUSHBABY, *GALAGO SENEGALENSIS MOHOLI* (A. SMITH), IN SEMI-NATURAL CONDITIONS AND IN THE FIELD.

by

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A thesis presented to the University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Science.

JOHANNESBURG
OCTOBER 1969.

I hereby declare that this dissertation is my own work and has not been submitted to any other university.

S.K. Bearder.....

S.K. BEARDER.

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1. INTRODUCTION

The lower primates, collectively known as the prosimians, comprise 6 families or 51 species, of these 29 are found in Africa and the Republic of Malagasy.

The prosimians evolved some 70 million years ago from primitive insectivore stock, diversified and gave rise to the New and Old-World monkeys, the apes and man. They have adapted to arborial life by climbing and grasping but have retained much of the special sensory equipment of their primitive mammalian ancestors. (Washburn & Hamburg, 1965). With the exception of some of the Malagasy species the prosimians have adapted to a nocturnal life.

The Sub-Family Galaginae, consisting of six species of bushbaby or galago, are of particular interest in having the widest distribution of all the African prosimians. They are found from Senegal in the North East to Natal in the South (Hill, 1953).

Behavioural studies of the prosimians have been somewhat neglected in comparison with studies of the monkeys and apes. While they have become highly specialised to a particular way of life, they nevertheless remain relatively primitive in structure and brain size and are therefore of importance when considering evolutionary trends within the Order: Primates.

Long term field studies of the behaviour and ecology of Malagasy Lemurs, most of which are diurnal, have been made by Petter (1956, -62, -65) and Jolly (1966). Very little information on field work is available for any African prosimian species, all of which are nocturnal, with the exception of brief field notes

on Galago senegalensis and G. crassicaudatus (Haddow & Ellice, 1964), and one field study on G. senegalensis bradfieldi (Sauer & Sauer, 1963).

One of the major problems encountered in the study of a nocturnal prosimian is that, because of its highly specialised sensory equipment, the human observer does not perceive the world of the animal he is studying; he cannot smell, touch or see in the same way. In field studies, the roles played by the various senses are somewhat easier to interpret, since the influence of the environment is more varied than in the laboratory. On the other hand, only in the laboratory is it possible to determine experimentally the relative roles of each of the senses.

The present study makes use of several pieces of special equipment to overcome many of the difficulties inherent in making continuous observations of a nocturnal animal in its natural habitat. The general objectives of the study were twofold; firstly, to investigate the ecology and behaviour of the Lesser Bushbaby or nagapie (Galago senegalensis moholi), in the field over a 12 month period. A second objective was to interpret some of the behaviour seen in the field by means of observational and experimental studies of a group of 26 captive bushbabies maintained under semi-natural conditions in the laboratory.

The most important field objectives were to gather information on the size, composition and functioning of bushbaby groups and to show how they are formed and maintained. Also, to record certain aspects of behaviour in the wild, including the mother-infant relationship and auditory communication, which could be compared

with existing data in the laboratory. (Lowther, 1939 & 1940; Andrew, 1963 & 1964; Doyle et al. 1967 & 1969; Andersson, 1969). In the laboratory, the most important objective was to analyse the social structure of the group, by investigating relationships in diadic situations.

By these means it was hoped to provide a basis for more comprehensive studies of the ecology and adaptive mechanisms of the Lesser Bushbaby and other small nocturnal primates.

2. ECOLOGY

2.1 STUDY METHODS AND MATERIALS

Observations of nocturnal animals provide several unusual problems which can only be overcome after some time in the field. To maintain contact with an animal and record its behaviour at night, without causing any disturbance which might disrupt its normal activity, is more difficult than to fulfil the same requirements for a diurnal species.

Field methods were developed gradually as the habits of the bushbaby became apparent. After some trial and error it was discovered that the most practical means of seeing the animals at night was through the use of a headband torch, covered by a red filter. This left the hands free and since bushbabies are insensitive to light at the red end of the spectrum, it was possible to see them clearly without causing any disturbance. The torch was powered by a small six-volt accumulator battery which could be carried in a shoulder bag. It provided a strong beam of light for long continuous periods and did not need recharging until 17 hours of use. Six-volt hand lanterns were used to provide extra light on occasions.

Towards the end of the study, use was made of a Starlight Scope provided by the National Geographic Society of America. This is a portable battery powered, electro-optical instrument for visual observation at

night. It uses the natural light (moonlight and/or starlight) of the night sky for illumination of the image, the brightness of which is amplified to such a degree that it can be seen with the naked eye. This is achieved by an image intensifier assembly powered by a 6.75 volt mercury battery. The scope was found most effective for observations from a fixed position.

Due to the great activity and long distances travelled by bushbabies, it was usually not possible to observe them by remaining in one place. It was necessary to follow them at a walking pace in order to keep them within the torch beam. Occasionally they would resort to extremely rapid and quiet movement, so that it proved difficult to remain in contact with them. The usual observation distance was between 10 and 20 feet, although the animals would sometimes come to within 1 foot of the observer.

Bushbabies were found during the day by searching for nests and sleeping sites. After some practice it became possible to recognise suitable sleeping trees and thereby reduce the amount of time necessary to locate a sleeping group or individual.

At night the animals were located partly from the loud calls which they made but mainly due to the nature of the tapetum lucidum of the eye which reflects light from behind the retina so that when a light source is beamed at the eye, some of the light is reflected

straight back again. Movements of the observer at night caused bushbabies in the vicinity to stare in the direction of the noise, making it possible for the observer to locate them at distances over 100 yards. If the bushbaby was close to the observer the reflected light from its eyes could be dazzling.

Having gained a thorough knowledge of the study area, the normal procedure was to follow one or sometimes two bushbabies for a period of up to 8 hours each night. Occasionally it was possible to follow the movements of up to 8 animals at one time, without confusion. The total number of observation hours, made at different times of the night, is shown in the histogram (figure 1). Ideal conditions for observation included a good moon with a light layer of cloud to prevent glare and no breeze. Observations were made under a variety of weather conditions, including strong winds and heavy rain. On rare occasions only was it too dark for effective orientation.

When a bushbaby was observed for the first time it was nervous of any sudden movements or the close approach of the observer. After the animal had been followed for approximately half an hour, however, it became accustomed to the presence of the observer and rarely looked in his direction. While this made tracking somewhat more difficult, it also allowed the observer to get much closer. Bushbabies which had been observed

previously showed little or no reaction towards the observer on subsequent occasions.

During each hour of observation the exact movement and behaviour of each animal could be clearly seen under the red light, apart from brief periods when they became obscured. The duration and frequency of different behaviour patterns were recorded on 8 event counters and two stop watches, mounted on a board for convenience. At the end of each hour this information was written on a record card (figure 2), so that the routine behaviour could be assessed by the hour. All unusual behaviour was recorded in shorthand on a notepad, either as it happened or immediately afterwards. Finally the sequence of events was written out fully on the following day.

A tracing was made of an aerial map of the study area (scale: 1 inch = 400 yards) to show each group of trees in relation to roads, furrows and fire-breaks. Twelve portions of this tracing were enlarged photographically to a scale of 1 inch = 70 yards, so that all movements of each group of bushbabies could be plotted with reference to the particular trees used.

The positions of nests and sleeping sites were also recorded during the year.

No attempt was made to mark the wild bushbabies during the course of the study, due to the inconvenience and a reluctance to interfere in any way with their normal life.

Fig.1. Hours of observation. Total-440.

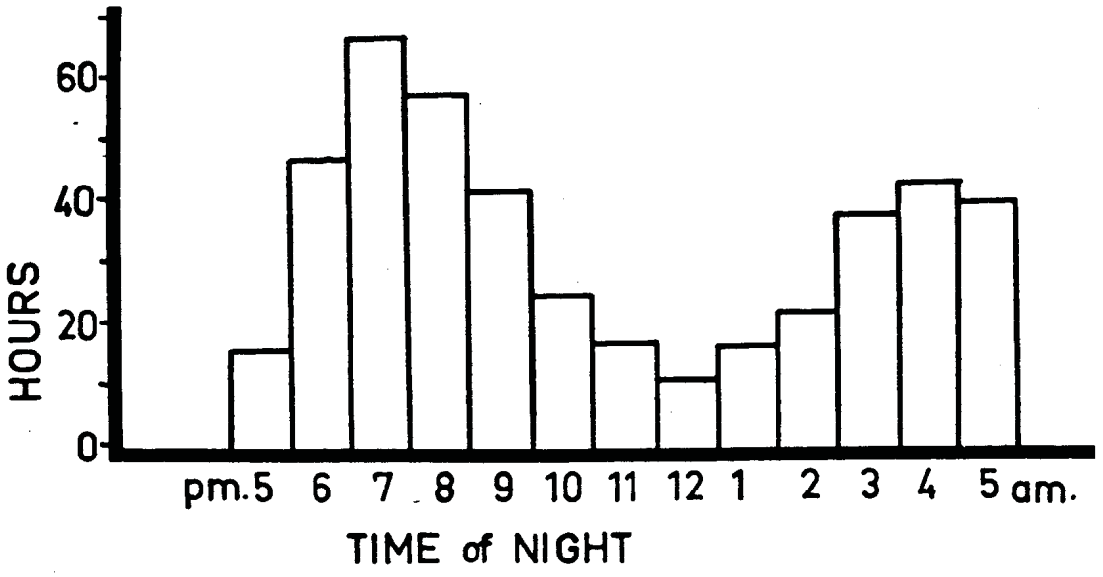


Fig.2. Sample of hourly record sheet.

25-2-69	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	TOTAL
Trees			70	119	179	222					49	105	167			
Feed			7	10	12	12					12	49	55			
Time			1	3	3	–					3	10	15			
Ground			14	16	26	28					3	29	41			
Time			–	–	–	–					–	–	–			
Groom			5	9	28	51					4	33	34			
Sc. Mk.			9	11	11	12					1	1	1			
Alone			60	60	15	0					60	60	3			
Tog.			0	0	45	60					0	0	20			
Vocal			59	88	103	110					35	31	41			
Vo.			1	1	5	11					3	3	3			
Whistle			0	1	4	5					0	5	9			
Yap			0	0	0	1					0	2	4			
Rest			0	0	5	15					0	0	0			

Several other means of recognising individuals and groups were used as summarised below.

(a) Recognition of individual features. Certain animals had torn ears or characteristic tails. One had a large tumour on the right hand side of its neck. It was, however, not possible to distinguish all individuals.

(b) Groups of a particular size and composition repeatedly used the same sleeping places over several months. Members of these groups were followed from the nest in the evening and again before returning to it in the morning, in order to establish the home range. Neighbouring groups could be seen and heard during this time. The approximate distribution of groups could be established by walking for several miles on one night, when it was possible to see from 20 to 30 bushbabies. The sleeping places of several groups could be found on a single day.

(c) Since the movements of each group at any one time were limited to a definable range, group members could be found without difficulty once this range was known. Each bushbaby had characteristic movements, repeatedly used certain trees for feeding - made particular jumps and followed recognisable routes.

(c) Mothers with small infants formed a recognisable unit and males were easily distinguished from this unit. Juveniles were also recognisable due to their smaller size and restricted movements within each area.

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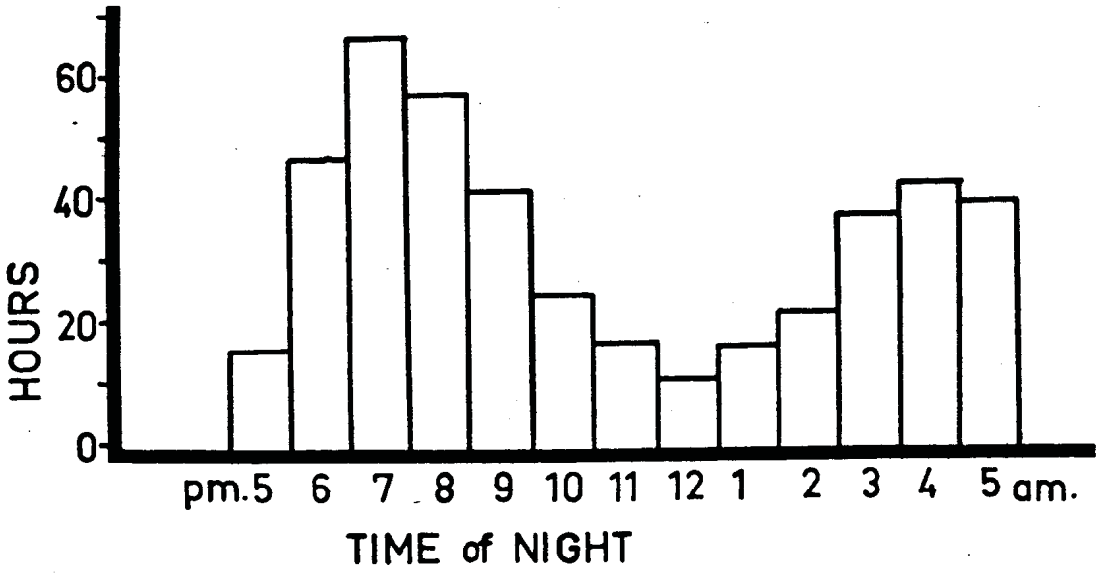


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Time			1	3	3	–					3	10	15			
Ground			14	16	26	28					3	29	41			
Time			–	–	–	–					–	–	–			
Groom			5	9	28	51					4	33	34			
Sc. Mk.			9	11	11	12					1	1	1			
Alone			60	60	15	0					60	60	3			
Tog.			0	0	45	60					0	0	20			
Vocal			59	88	103	110					35	31	41			
Vo.			1	1	5	11					3	3	3			
Whistle			0	1	4	5					0	5	9			
Yap			0	0	0	1					0	2	4			
Rest			0	0	5	15					0	0	0			

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The problem of tracing nightly movements was overcome by placing white marker cards on the thorn trees and pacing out the distance travelled on the following day. Particular places of interest, marked in this way, could be examined in more detail during the daytime.

During the year 152 bushbabies were observed in their natural environment. 104 of these were in one area of approximately 900 acres. Some of this land was either cultivated or without bush cover thus reducing the actual study area to approximately 600 acres.

Colour and black and white photographs were taken using flash from a distance of 15 feet or less. The light did not appear to disturb the animals in any way.

Towards the end of the study two pairs of laboratory born bushbabies were released into the wild and observed for a period of 13 days.

2.2. TREATMENT OF DATA

All behavioural data were summarised numerically on record sheets in terms of frequency of occurrence and duration, during each hour of the night throughout the study period. The records were then averaged to facilitate seasonal and diurnal comparisons. The routine behaviour and extreme examples observed are illustrated in table 1. Interesting and unusual types of behaviour were recorded in detail. Much of the data collected has little signifi-

Table 1. Analysis by the hour of behaviour in the field.

Hours of observation - 430 Number of bushbabies observed - 152

BEHAVIOUR	MEAN NUMBER/HOUR Winter	Summer	EXTREME MAXIMUM/HOUR Winter	Summer
Distance travelled	215 yards	185 yards	540 yards	512 yards
Number of trees used	50	45	171	116
Frequency of				
(a) Feeding	21	6	80	43
(b) Self-grooming	3	6	11	42
(c) Scent-marking	2	2	14	12
(d) Going to the ground	10	4	30	27
Duration of				
(a) Feeding	12 minutes	1 minute	24 minutes	60 minutes
(b) Social activity	18 "	18 "	60 "	60 "
(c) Resting	5 "	6 "	60 "	60 "
(d) Sleeping	0 "	1 "	0 "	45 "

cance in a one year study, but is available for a more comprehensive analysis over several years.

Records have been compiled of the temperatures, rainfall, length of day, state of the moon and changes in vegetation, in order to relate behavioural observations to the environmental conditions. Significant data are recorded in the form of tables, maps, graphs and histograms.

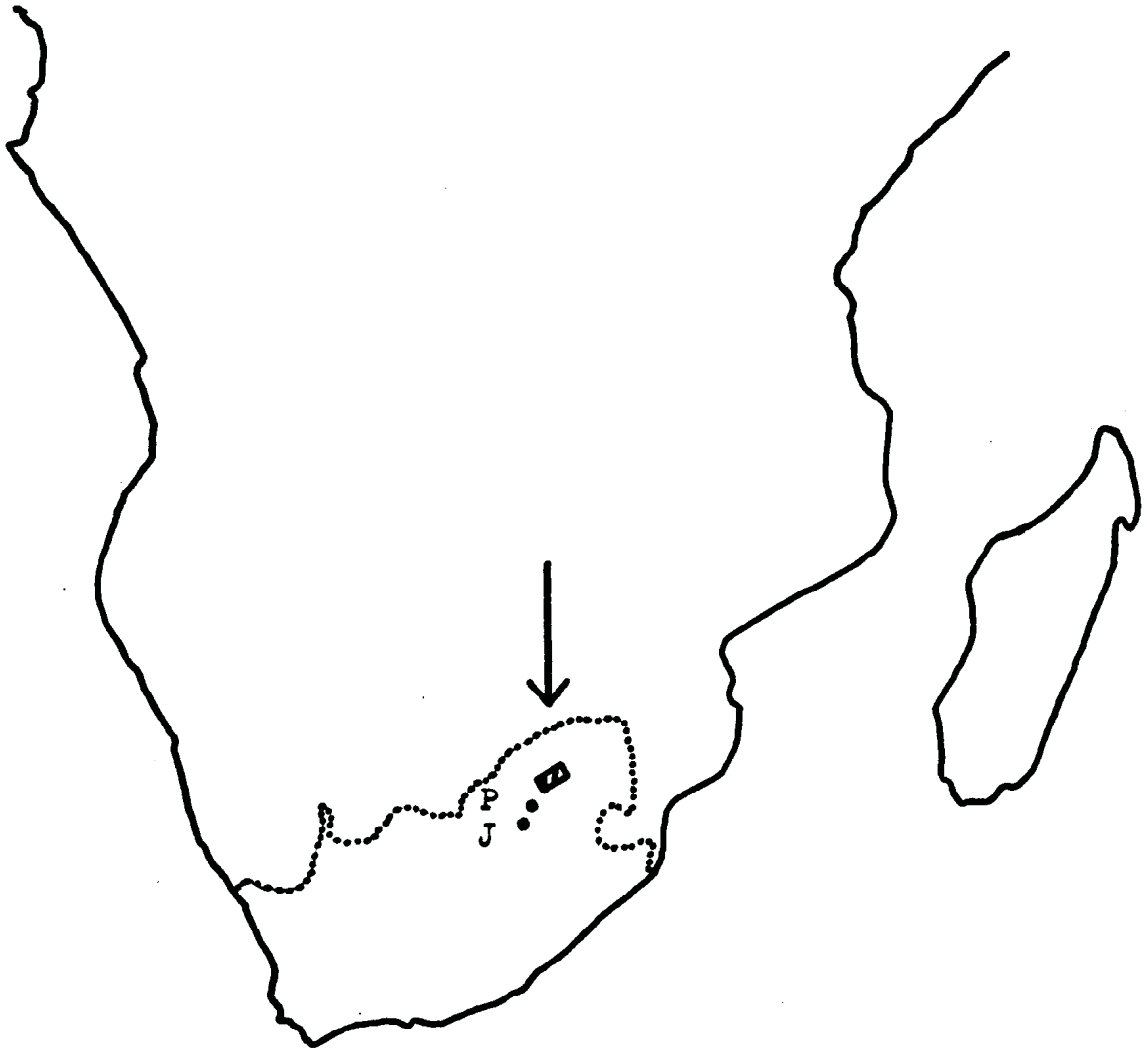
2.3. DESCRIPTION OF STUDY AREA

The study was made at three locations in the Northern Transvaal between Nylstroom and Pietersburg (figure 3). This region, which has an altitude of 3,500 feet, is predominantly flat karoo sandstone with a vegetation typified as thornveld. The extreme minimum temperature recorded is 20°F ranging up to 100°F, with sometimes a difference of 30°F between night and day. The average rainfall is 23.57 inches per year, which falls during the summer months from October to April.

Of the three study areas, Makapansgat, Nylstroom and Naboomspruit, only short surveys were made at the first two. The majority of work has been done on a Private Nature Reserve at Naboomspruit. The reserve contains a variety of game in addition to a large stock of domestic cattle.

The soil type on this farm is a sandy loam with no stones. Two-thirds of the vegetation is Acacia thornveld and one-third Tambootie association with clays.

Fig.3. Location of study area.



Lat.26.27 Long.24.35

Vegetation: Bushveld & Grassland.

P.... PRETORIA.

J.... JOHANNESBURG.

The following trees are common:

SPIROSTACHYS AFRICANA : ACACIA HAEBECLADA

ACACIA RETINENS : ACACIA CAFFRA

ACACIA DETINENS : ACACIA KAROO

ACACIA BURKII .

ACACIA ROBUSTA.

DICHROSTACHYS GLOMERATA.

The farm lies in a shallow river valley but the river is only seen when in flood. It may then be up to five miles wide. Other primates in the region are Vervet monkeys and Baboons in the higher parts.

2.4 GROUP SIZE AND COMPOSITION

The bushbabies seen within the three localities of the study area comprise approximately 45 family groups, each living in a definable area. The composition of the sleeping group in any one of these areas, varies during the year. Not all members of the group necessarily share the same sleeping place nor does each group always sleep in the same place, so that a total of 119 sleeping groups have been found in all. The numbers of animals in these groups were as follows:

Number of animals in Group.	Number of Occurrences.
1	47
2	36
3	28
4	6
5	1
6	1.

Where it was possible to establish the sex and age of individuals the following groups were seen:

1. Adult ♂, Adult ♀ with infants or juveniles.
2. Two adult ♀'s each with infants.
3. Adult ♀ with two sets of juvenile twins.
4. Female with a single infant, twins or juveniles.
5. Adult ♂, Adult ♀.
6. Juveniles alone.

Six adults or sub-adults were found sleeping together but it was not possible to establish individual relationships within this group, nor identify the sex.

The present data for the size and composition of groups coincides with that of Haddow & Ellice (1964), for G. senegalensis in East Africa. Buettner- Janush (1964) observed a maximum of 5 G. senegalensis sleeping in one nest in Kenya, while Sauer & Sauer (1963) found between 1 and 7 individuals sharing a nest in South West Africa. They consider the large groups to be formed from more than one family.

Laboratory data suggests that each large group consists of an adult male, female and her offspring of one or more generations. (Doyle & Bekker 1967a). Sometimes the male sleeps alone away from the family group, only sleeping with them on occasions. In one instance, two groups, each consisting of a male, female and twin infants, shared an area previously occupied by a single

group of three. Later, all four juveniles and a single female were found sharing the same nest.

Variations in group size and composition for the main study area are summarised in table 2. If the area is sub-divided into a number of sections approximating the original range of each group, the number of animals living in each section changes during the year due to the movement of individuals from one section to another as well as to births and presumably deaths. During July 1968, a total of 71 animals was found. In March 1969, 96 animals occupied the same area after 33 known births. This represents a loss of 8 animals. True population dynamics can only be established through long term marking studies.

2.5. NESTS AND SLEEPING SITES

During the year 86 nests and 79 sleeping sites were found, totalling 165 sleeping places in all. A sleeping site may be defined as a particular tree used repeatedly for sleeping purposes by one or more animals. Frequently individuals sleep on the same fork or branch of that tree so in effect, the sleeping site is used as if it were a nest, forming a "home" to which the animal returns at the end of each night.

Since it is a good deal easier to find a nest than it is to spot a sleeping animal, it is considered that the

Table 2. Group composition June 1968 - March 1969

Home range number	JUNE 1968 Adult/Juvenile/Infant			NOVEMBER 1968 Adult/Juvenile/Infant			MARCH 1969 Adult/Juvenile/Infant		
1	2	1	0	2	0	0	1	0	0
2	2	1	0	3	0	0	4	0	4
3	3	1	0	3	0	1	4	1	3
4	2	0	0	2	0	0	1	0	0
5	2	0	0	2	0	1	2	1	1
6	2	0	0	2	0	2	2	1	0
7	2	0	0	2	0	2	2	1	2
8	3	0	0	3	0	1	4	1	2
9	2	0	0	2	0	0	2	0	2
10	5	0	0	5	0	0	4	0	0
11-28	42	1	0	41	0	1	40	0	11
TOTALS	67	4	0	67	0	8	66	5	25

number of sleeping sites actually used was at least double the number found. Also, nests are semi-permanent so that, unlike sleeping sites, they indicate previous use even when not occupied.

The proportion of nests and sleeping sites occupied by different sized groups is shown in figure 4. A high percentage of the sleeping sites were occupied by a single animal (51%) compared with a low percentage of nests occupied by one animal. Sixty-six percent of all nests were occupied by groups of two or three. It would appear that lone bushbabies seldom build nests though they may occupy an old nest.

The situation of sleeping places and use of nesting material in the study area is shown in table 3. Bushbabies were discovered sleeping in dense, thorny trees on nests, forks, branches or in the midst of clumps of mistletoe and occasionally in cavities or hollow trees. The height of these places above the ground is shown in figure 5, while examples are illustrated on plates 2, 3 and 4.

Bushbaby nests are invariably constructed from flat, soft leaves taken when green and placed in thorn trees to form an open topped platform. Leaves and small branches are usually taken from broad-leaved trees or climbers growing in close association with the thorn trees. Occasionally nests are built on a platform of twigs

Table 3. Use of Sleeping Trees and Nesting Material

Type of tree	Number of Nests	Number of sleeping sites	TOTAL
Dichrostachys glomerata (Sicklebos)	18	22	40
Acacia tortilis (Umbrella thorn)	14	18	32
Acacia nilotica subsp. kraussiana (Red Heart).	12	11	23
Acacia karoo (Sweet Thorn)	12	5	17
Acacia detinens	9	2	11
Spirostachys africana (Tambootie)	4	6	10
Grewia sp.	3	1	4
Ziziphus mucronata (Buffalo Thorn)	2	0	2
Rhus pyroides	0	2	2
Acacia robusta	1	1	2
Burkea africana	1	0	1
Others	10	7	17
TOTALS	86	75	161

Nesting Material	Number of times used
1. Rhus sp.	30
2. Ziziphus mucronata	8
3. Viscum sp./Loranthus sp.	5
4. Grewia sp.	3
5. Pelteforum africanum	2
6. Other broad-leaved trees & climbers	25
7. Old bird's nests and hollows	13