

Home Range and Food Habits of the Nilgiri Langur, *Presbytis johnii*

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(With two text-figures)

The disastrous effect of replanting Eucalyptus trees in place of natural forest in South India for short term economic benefits is rapidly causing the deterioration of the fauna indigenous to South India (Daniel & Kannan 1967). The Nilgiri langur, *Presbytis johnii*, is one such endangered species. This monkey is endemic to the evergreen shola areas in the Nilgiri mountains, where I studied it in an effort to understand some of its ecological needs as an aid to its preservation.

This paper offers data on the food habits and home range of three troops of langurs that were studied at Periyar sanctuary in Kerala from March 20 to May 13, 1968, for about 270 contact hours. The period of study just prior to the rainy season, was one of transition in vegetational growth, which enabled observations to be made on the changing diet of these monkeys.

When located, each troop was usually followed and continuously observed with 8×35 binoculars. If observations were terminated temporarily, the troops could usually be found again and observations were resumed. During ten observation days, troops were continually under observation from sun-up to sundown except for a short break in the morning and around noon. Visual sighting of food choices were made and leaf remnants were then immediately collected from the ground after the troop had moved to another area.

RESULTS

Home Range and Territoriality

The three troops which were studied numbered 27, 7 and 21. They were located in that order on a long peninsula of deciduous and evergreen forest which extended into the man-made sanctuary lake from the north. The peninsula area studied was approximately 1.5 km long by 0.3 km wide (Fig. 1). Troops on this same peninsula were studied in 1963 by Tanaka (1965). The areas occupied by his troops B, C and D (numbering 14, 13, 25) correspond almost exactly to the areas of my Troops 1, 2 and 3. Although there is no other evidence of these being the same troops, there is a constancy of the home range areas. At least this allows a comparison of the utilization of the same areas by two troops of different sizes (although historically they may represent a single troop). At no time during the two month study was any troop seen out of the home range areas designated nor in any other troop's home range except in the border overlap zones. This observation leads me to the belief that home range and territory in this species are essentially synonymous.

Fig. 1a and 1b shows the continuously observed trails of each of the three troops and those of one lone male. The concentration of the trails shows the localization of movements around certain preferred feeding and resting areas ('core areas', Kaufmann 1962). Although they had a number of general areas preferred for midday resting or night time sleeping, they were not absolute in their choice and these probably changed seasonally. In contrast, Common langurs, *Presbytis entellus* (Jay 1965; McCann 1933; Prater 1948) and *Colobus guereza* in Africa (Marler 1969) seem to be more rigid in returning to their sleeping sites. The *Colobus* were apparently faithful for periods as long as five years.

The core areas of the Nilgiri langurs seem to change seasonally depending on the availability of preferred food. A map displaying the two main vegetation types (Fig. 2), when compared to Fig. 1a and 1b, shows that most of the activity in all three troops during this deciduous growth season was confined to the deciduous areas. Earlier data on a troop in Troop 3 territory (Tanaka 1965) in contrast, shows a preference for the evergreen areas during January and February. Tanaka's troop often slept the night in the northeast area where my lone male sometimes rested in the midday (Fig. 1d). Common langurs in North India also show this shift in core areas between use in the dry season and the monsoon season (Jay 1965).

Table 1 exhibits the difference in area used by the three troops. Excluding non-forested areas or built-up areas, each troop had available for use 5.0-7.1 hectares of which only 34-67% was used or 2.3-3.9 hectares per troop. This represents .11-.56 hectares per individual

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available. These data seem to indicate that the amount of the territory used doesn't depend on the size of the troop, probably because the troop acts as a unit and food was plentiful at this time of the year. The smallest troop, Troop 2, travelled greater distances in general and was much more erratic than the other troops, which moved in a very regular characteristic manner similar to an accordion, with the first half of the troop moving and then resting or eating while the other half remained eating and resting and then eventually followed. As they rejoined the first half, the latter would just be beginning to move.

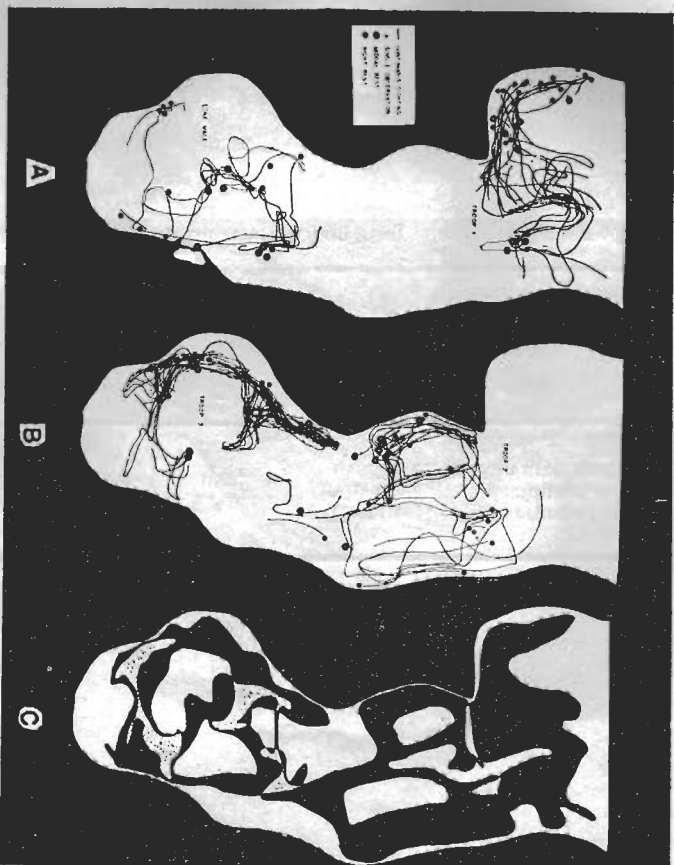


Fig. 1. Home ranges of three troops of Nilgiri langurs and a lone male on the peninsula at Periyar.

- (A) Continuous trails of Troop 1 (top) and lone male (bottom);
 (B) Continuous trails of Troop 2 (top) and Troop 3 (bottom);
 (C) Home ranges of Troops 1, 2, 3 and lone male (in black) and the overlap zones between troops (stippled).

In addition, judging from Tanaka's (1965) work, although the territory size doesn't appear to have changed, the troop size within each territory did change considerably (Table 1). This again indicates no correlation of troop size to territory size, contrary to Poirier's (1968b; 1970a) beliefs. Poirier also mentioned that the concentration and type of food plant in the home range played a major role in determining its size. A comparison of the gross estimates of evergreen and deciduous

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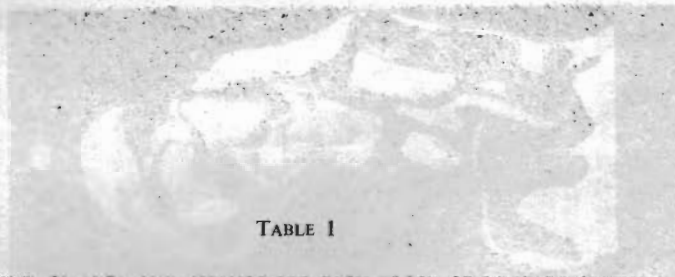


TABLE I

ASSESSMENT OF AREA AND ANIMALS FOR EACH TROOP OF LANGURS OBSERVED

Troop	Total area (hectares)	Area open for use (hectares)	Area used (hectares)	% Area used	Hectares/individual available	% Evergreen/deciduous within area used	Hectares evergreen/deciduous within area used	Troop size
1	5.6	5.0	3.4	68	.13	40/60	1.4/2.0	27 (14)
2	7.3	7.1	3.9	55	.56	40/60	1.6/2.3	7 (12-13)
3	8.3	7.0	2.3	33	.11	60/40	1.4/ .9	21 (25)

Figures in parentheses represent data collected by Tanaka (1965) on troops studied in the same home range.

hectares used (Table I), supports this view. A relatively constant amount of evergreen forest was used per troop (1.4-1.6 hectares). Since the monkeys are wasteful of the food and since neither Poirier (1968b) nor I noted a lack of food, then perhaps a certain area of evergreen forest may be necessary for each troop for some reason other than food.

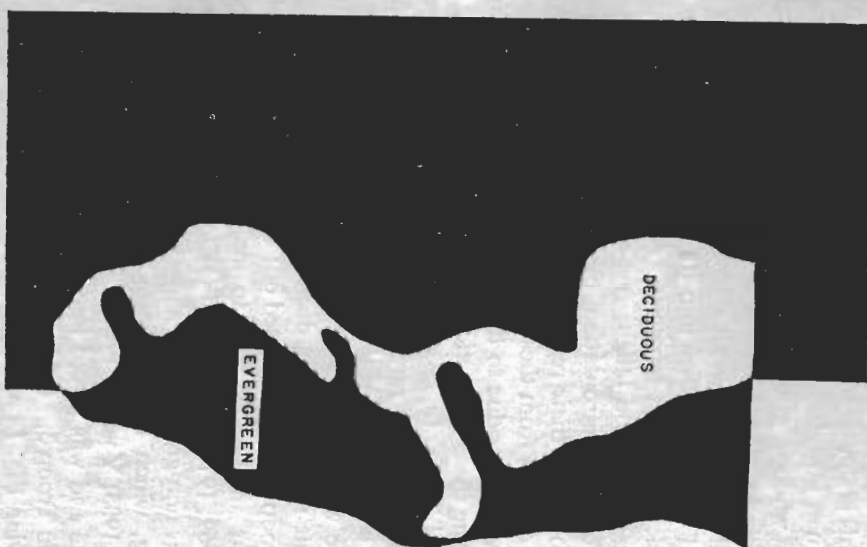


Fig. 2. Vegetational map of the peninsula.

Fig. 1c shows the zones of overlap and the relationship of troop territories to each other. These areas are small defended overlap areas similar to those noted in Lutongs, *Presbytis cristatus* (Bernstein 1968), the African *Colobus guereza* (Marler 1969), and South Indian Common Langurs (Yoshida 1968). The Nilgiri langur male actively defends these borders against adjacent troops. Defence of these territories was noted between adjacent troops on 5 occasions, 4 of which were between Troops 1 and 2. The displays, vocalizations and chases in these cases

directly involved only the single adult male of each troop. Typically, each of these males would sit on a high tree branch, open his mouth exposing his lower incisors and emit a continual low-pitched buzz which sounded like a creaking door (creaking mentioned by Poirier 1968a). This would be answered by the other male from about 25 metres away or more. The males may also give a quick movement of the head upwards while keeping their mouth open and closing it slightly as if biting the air. This is similar to behaviour exhibited by both males and females toward human intruders. Then one male would run toward the other often giving whoops, grunts, hiccups, or hahhah (hoho) calls (see Poirier 1968a) which are all indications of an excited state in the langurs as all of these calls were heard as an alarm response to a human intruder. One male would chase the other into its territory only to be chased immediately back to its own territory. A similar chase exchange occurs in South Indian Common langur one-male heterosexual groups (Yoshida 1968). After the confrontation, the Nilgiri troops then moved in opposite directions into their respective territories. A specific indication of a territory overlap from these troop interactions is seen in Fig. 1c at the top right which was due to the violation of Troop 2 territory by Troop 1 male during these interactions.

As noted in Fig. 1c, except for this area of territorial disputes, cohabitation of an area is rare. However, between Troop 3 and the lone male who could be recognized by the missing middle finger on his left hand, there was considerable overlap. This male was thought to be a young adult male who was displaced from the troop by the dominant male of Troop 3. This is based on: (1) his close association with Troop 3, (2) great amount of male to male aggression in Nilgiri langurs (Poirier 1969; 1970a; 1970b) and (3) lone male Nilgiri langurs and Common langur non-group males show scars on faces and bodies as a result of fighting, which may indicate their displacement from the troop (McCann 1933; Yoshida 1968). This scarred male performed all activities alone and was forced into the evergreen areas by the movements of the main Troop 3. He kept clear of the main troop most of the time. In comparing Fig. 1a and b with Fig. 1c one can see that the areas of overlap were not part of the lone male's areas of main usage. Similarly, in the North Indian common langur, non-group males which overlap the range of the bisexual troop will avoid using the overlapping areas when the troop is nearby (Jay 1965).

The only times the lone male approached Troop 3 was on three occasions in which he seemed interested in establishing friendly contacts with the young juvenile males in Troop 3. This is another indication that he was probably a member of Troop 3 at one time. In all observations of all troops it was only the males which seemed to stray from the main troop to any degree. The adult male would occasionally

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move a distance from the troop in order to feed from a particular tree. In one case, Troop 2 male seemed to lose his troop and upon noting it directly across the road from him where no tree pathways existed, he raced about 365 metres in 10 minutes, up one side and down the other side of the road in the tree pathways to rejoin the troop, pausing to stop on a number of occasions. The three juvenile males of Troop 3 were also seen to wander a short distance away from the troop on three occasions; on two of these they were joined by the lone male. During these periods the lone male approached the juveniles, giving coughs, uh-uh sounds, and a musically modulated sound expressed phonetically as eh-uh-ol. The juveniles seemed to pay him very little attention but would move away when he came too close. In the third instance the lone male was seen eating near three juvenile males but he made no attempt to join them and later moved away. This may be a possible rudimentary beginning of an all-male troop formation which exists in Nilgiri langurs (Poirier 1970a), common langurs (Ripley 1967; Jay 1965; Nolte 1955), and *Presbytis cristatus* (Furuya 1961-62).

Food Utilization and the Changing Diet

The main areas utilized for feeding and resting were the deciduous areas since it is at this time of year that the vegetation changes radically. During the study periods new buds, leaves, and flowers of the deciduous plants were emerging and the general food habits changed with the plant growth. Table 2 shows the general transition in feeding that took place. During late March and early April the tender new leaves of *Pterocarpus marsupium*, *Grewia tiliacifolia*, *Stereospermum* sp., and *Dalbergia latifolia* were eaten along with leaves and leaf midribs of *Tectona grandis* and *Ficus* sp. as well as fruits of *Artocarpus hirsuta* and *Actinodaphne madraspatana*. By mid April the main diet had narrowed to just teak (*Tectona grandis*) leaves, Aini (*Artocarpus hirsuta*), fruits of *Actinodaphne madraspatana* and a return to older leaves of *Pterocarpus marsupium*. These langurs seem to show a greater variety of foods eaten than common langurs in Ceylon, which, during any one point in the seasonal cycle, eat about 1 to 4 staple items plus 3 to 8 items in lesser quantities (Ripley 1970).

In general, tender leaves and buds, fruits, and often flowers were the preferred parts of the plants. In reference to individual plant species certain aspects of the plant were preferred and eaten when they emerged. Certain food preference progressions are very noticeable in Table 2, particularly in *Pterocarpus*, *Grewia* and Teak. *Grewia tiliacifolia* presents the best instance of seasonal progression of food preference in one plant species. The leaf buds were taken when they first developed March 27-29 after which the tender leaves were eaten from March 29-April 15. By this time the leaves were well developed and the

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langurs ate the flowers almost exclusively from April 13-26. Their interest in *Grewia* decreased until only occasionally were unripe fruits taken around April 25-26.

In regard to the fully developed tender leaves and older leaves of certain species only parts of the leaf were preferred. Indication of this can be seen in analyzing leaf fragments discarded by the langurs which were collected from the forest floor. Langurs preferred only the proximal stem end and the midribs of the teak leaf although they would eat the whole leaf occasionally. This part was tougher and tasted more sour and bitter to the observer than the softer blade of the leaf. Poirier (1970a) also noted that most food eaten had a distinctly bitter taste. Table 3 shows the part of the leaf eaten relative to the size of the leaf. These leaves were collected randomly from loose leaves under langur feeding spots.

Table 3 indicates that the larger teak leaves are the ones most frequently taken and eaten. Of these only the proximal stem tip is eaten

TABLE 3
AMOUNT AND SIZE OF TEAK LEAVES PREFERRED

Leaf size, length in mm	Amount of Leaf Eaten					
	untouched	ripped only	bitten	$\frac{1}{4}$ eaten	$\frac{1}{2}$ eaten	$\frac{3}{4}$ eaten
25	2	..	..	..	..	..
50-75	1	..	..	..	..	..
75-100	1	..	..	..	..	..
100-125	4	..	..	..	..	..
125-150	1	1	..	..	..	..
150-250	..	..	2	20	..	..
250	..	..	..	29	..	..

or the tip and the midrib are eaten. The leaf stem is held in the mouth and then one side of the leaf at a time is torn back and discarded or left hanging until $\frac{1}{2}$ - $\frac{3}{4}$ of the midrib is eaten and the uneaten part is then discarded. This whole process takes about 25-30 seconds per leaf to perform and is done continuously with 5-10 seconds between leaves. When eating the whole leaf the langur grasps the leaf in one hand which rolls the leaf together and the langur then takes a bite from the rolled leaf until it has either finished the leaf or lets the remaining part drop.

Table 4 shows similar preference in a species of *Ficus* which had leaves covered with reddish fuzz. Most of the leaves taken were 75-150 mm and the langurs seemed to prefer the 105-125 mm ones of

TABLE 4
AMOUNT AND SIZE OF *Ficus* LEAVES PREFERRED

Leaf size Length in mm	Amount of midvein consumed								Total
	untouched	ripped only	*tasted*	Stipules bitten and eaten	$\frac{1}{4}$ - $\frac{1}{2}$ ripped and eaten	$\frac{1}{2}$ eaten	$\frac{3}{4}$ eaten	$\frac{3}{4}$ eaten	
25	..	..	..	..	..	..	..	..	..
25-50	..	..	..	..	..	..	..	..	..
50-75	3	..	1	1	7	1	1	9	7
75-100	6	..	..	5	13	8	14	36	31
100-125	3	2	2	1	19	10	27	10	4
125-150	1	..	..	1	3	1	6	..	..
150-175	..	..	..	1	..	1	..	..	..

TABLE 5
AMOUNT OF THE ROSEWOOD LEAVES EATEN

Amount of the distal end eaten			
$>\frac{1}{2}$	$>\frac{1}{4}$	$\frac{1}{2}$	$>\frac{1}{4}$
1	7	13	28

which they consumed $\frac{1}{2}$ to all of the midvein. Table 5 shows that most of the rosewood leaf is eaten. That the distal part of the leaf is eaten probably merely means that no part is preferred and they eat whatever was easiest to reach. They eat these leaves by pulling branches of the small leaves toward them, then chew the leaves directly off the branches. This differs from the handling of teak, *Ficus*, and other large leaves which were pulled manually off the branch one at a time and then treated individually. Poirier (1970a) mentioned that branches were usually bent towards the monkey and held with a hand or foot while the other hand picked off the leaves. He found that they rarely took food directly into the mouth except for *Acacia mollissima* flowers.

SUMMARY AND CONCLUSIONS

Since Tanaka (1965) visited Periyar Sanctuary in Kerala, the three territory areas occupied by Nilgiri langurs on the southern part of the peninsula at Thekkady have remained the same, yet the troop sizes have changed considerably in two of the areas. This shows the lack of correlation of troop size to territory size. However, the core areas do change with the seasons, with a tendency for troops to remain in evergreen areas during March-May and a tendency to remain in deciduous areas in January-February. During this deciduous feeding period, the developing parts of the plants (buds and tender leaves) were predominantly eaten. Other foods were also eaten and different methods of handling were employed for different food types. Certain resting and sleeping areas, coincident with the feeding areas, were used but the troops were not constant to them. Rather, a certain probability of their usage existed. A lone male was observed which seemed to have been displaced from one troop and 'forced' into the evergreen areas during feeding of the main troop in adjacent deciduous areas.

ACKNOWLEDGEMENTS

I wish to thank the Kerala Forest Department and the Chief Conservator of Forests for extending the courtesy and permission to use Periyar Sanctuary for my studies. I also thank Mr. James Varghese, Wildlife Officer, and Mr. Balaraman, Assistant Wildlife Officer, for their general courtesy and help in the study. My special thanks to Dr. Cecil Saldanha for his aid in identifying the plant species involved. This work was done with the encouragement of Dr. Helmut K. Buechner, under the auspices of the Office of Ecology, Smithsonian Institution.

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