FEEDING ECOLOGY OF NILGIRI LANGUR (*TRACHYPITHECUS JOHNII*) IN SILENT VALLEY NATIONAL PARK, KERALA, INDIA

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Introduction

Nilgiri Langur (*Trachypithecus johnii*) is an endemic primate of the Western Ghats. Even though it is a primate highly adapted to different types of habitats like montane sholas, evergreen, semi-evergreen and moist deciduous forests, its status is endangered mainly due to anthropogenic activities that occurred some few decades back. Large-scale habitat destruction for plantation and agriculture and poaching severely affected the primate by causing periodic population decline. However, inclusion of extensive forest areas in the Protected Area Network in South Indian states and the implementation of the Indian Wildlife (Protection) Act, 1972 helped greatly to restore its population to some extent.

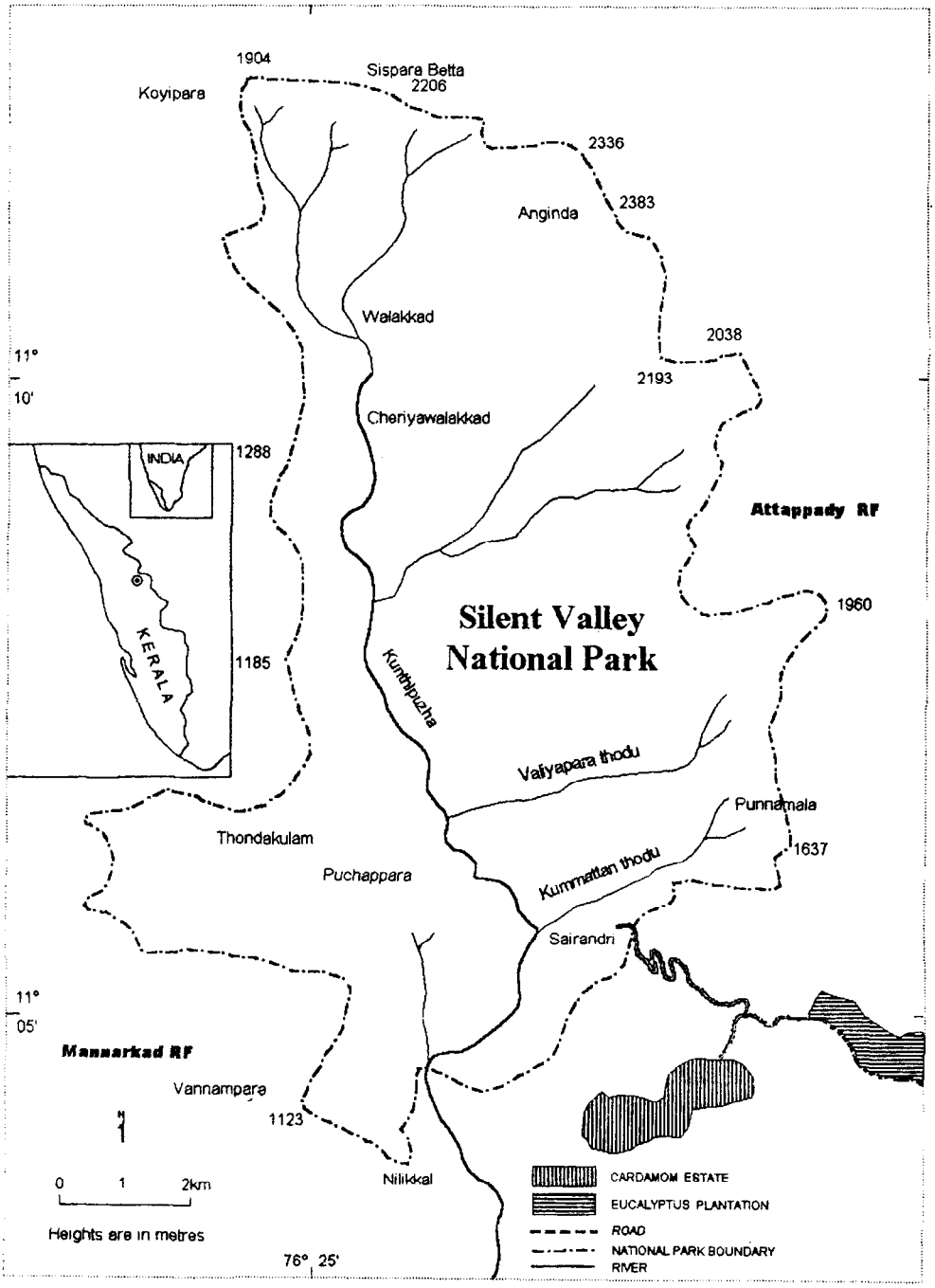
As it is not a habitat specialist, Nilgiri Langur thrives on a variety of plant species occurring in different types of habitats. Being a folivore, it feeds mainly on leaves, but the diet also includes flowers, buds, bark and stems of various plants. Many ecological studies regarding Nilgiri Langur were attempted in high altitude sholas (Poirier, 1968). However, some investigations were carried out in lower elevations bordering deciduous and evergreen forests (Horwich, 1972; Sunderraj and Johnsingh, 1993; Srivastava *et al.*, 1996). Ramachandran and Joseph (1997) recently found out that compared to any other forest types the population density of Nilgiri Langur is high at medium elevation (700 to 1500 m) evergreen forests. Detailed study about the ecological aspects has not been attempted at these elevations, which may be crucial for its long-term survival hitherto and proper management.

Study Area and Methods

Silent Valley National Park is situated in Palghat District of Kerala State and located at 10° 15' to 11° 25' N latitude and 76° 21' to 76° 33' E longitude (Fig. 1). The extent of the National Park is 90 km^2 and forms one of the core areas of the Nilgiri Biosphere Reserve. The terrain is quite undulating and the altitude varies from 650 m to 2383 m. Kunthipuzha, a tributary of the river Bharathapuzha, originating from the North-eastern hill ranges of the National Park, drains the area. Silent Valley forests remain one of the highest rainfall areas in the entire Western Ghats having an average rainfall of 6000 mm per year. The annual mean temperature is around 20°C. The vegetation is of tropical wet evergreen type.

Demography and feeding ecology of Nilgiri Langur were studied over a period of three years from 1993 to 1996. At least

Fig. 1



Silent Valley National Park and its adjoining areas

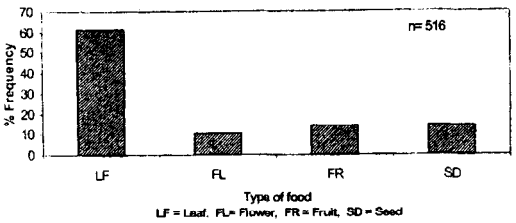
20 days were spent in the field each month and direct observations were taken when ever sightings were possible. Entire area of the National Park was repeatedly perambulated on foot to collect data on the number of troops and troop structure (Anon., 1981). Selected troops were followed from dawn to dusk and *in-situ* observations were done with Leitz 10 x 40 binoculars on the behavioural and ecological aspects on *ad libitum* basis in each month. Based on rainfall and temperature, four seasons were designated as summer, South-West monsoon, North-East monsoon and winter. Seasonal variation in the dietic composition was also estimated by pooling the monthly data. Statistical analysis was done for monthly sand seasonal variations using the computer program SPSS/PC+. Samples for plant food species were collected and herbarium specimens were made to know the identify of the species.

Results

Elements of the diet : A clear dominance of foliage was obvious in the diet of Nilgiri Langur, but other food items like fruits, seeds and flowers also occurred. In a total of 516 feeding observations (Fig. 2), frequency of occurrence of leaves was found to be 62 per cent, that of flowers; 10 per cent and fruits and seeds occurring at 14 per cent each. Occasionally, they were found feeding on petioles, bark and small twigs. Rarely, the Langurs fed on insects living under the dry bark of dead trees. They were also found to feed on mushrooms occurring on dry branches. On three occasions, they were observed descending down and feeding on soil from the ground.

Monthly variation in diet : Proportion of different food items varied considerably

Fig. 2

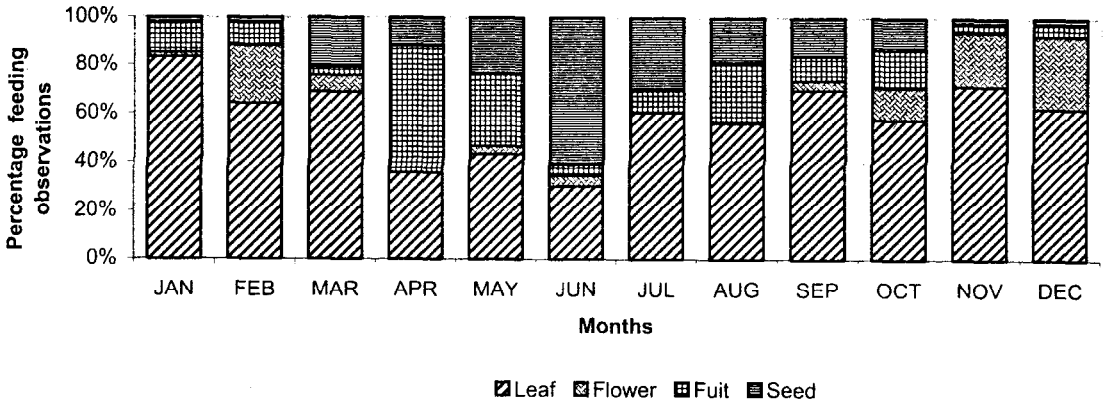


Frequency of occurrence of various food items in the diet of Nilgiri Langur

from month to month (Fig. 3). Leaf feeding was observed higher than any other diet in almost all months except in the months of April and June. The highest proportion of foliage in the diet was recorded during the month of January (83%), followed by November (72%) and the lowest was in June (30%). The monthly variation in the frequency of foliage feeding was statistically significant (χ^2 = 85, df-11 p <0.001).

Out of all the feeding observations, the highest percentage composition of flower in the diet was noticed in December (30%) followed by February (24%). Flower feeding was not observed in April, July and August. Significant variation occurred also in the frequency of flowers in the diet (χ^2 = 68, df=11 p<0.001). Fruit feeding occurred in all the months. In April, fruits dominated (52%) in the diet. The proportion of fruits in the diet ranged from 3.45% (March) to 52% in various months. The variation was statistically significant (χ^2 = 42, df-11 p<0.001). Dietic elements included seeds in all the months. Conspicuous variation was noticed in the proportion of the seeds in the diet. It varied from 2% in January, to 61% in June. The variation was statistically significant (χ^2 = 42, df=11 p<0.001).

Fig. 3



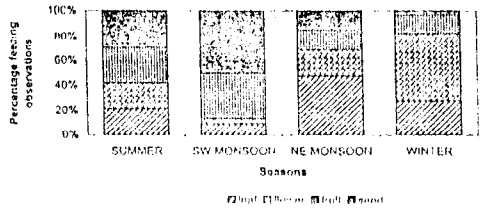
Monthly variation in the diet of Nilgiri langur

Seasonal variation in the diet : When months were combined into seasons the various elements of the diet showed variation in different seasons (Fig. 4). Percentage occurrence of foliage had a dominance over other food items in all seasons. It varied from 49% in South-West monsoon season to 70% in winter season. The variation was statistically significant (χ^2 = 56, df=3, p<0.001). Flower feeding also showed significant variation (χ^2=38, df=3, p<0.001) over different seasons. The frequency of feeding observations on flowers in the diet varied from 1.46% in South-West monsoon to 19% in winter. The North-East monsoon season also had a good proportion (13%) of flowers in the diet. Fruit feeding was more in summer season (28%) and less in winter (9%). The variation was found not significant (χ^2=3, df=3, p<0.05). The proportion of fruits in the diet gradually decreased from summer season to winter. Seed feeding was maximum in South-West monsoon season (37%) followed by summer (19%). The proportion of seeds in the diet was less in winter season (2%). Seasonal variation in the frequency of seed feeding was found statistically significant (χ^2=25, df=3, p<0.001).

Food species diversity : Nilgiri Langur was observed feeding on a variety of plant species during the study period. Table 1 shows various food species and their frequency of occurrence in the diet. Eighty-nine food species were identified from the *ad libitum* observations for a period of three years. They include 72 tree species, 7 shrubs, 7 lianas, 1 herb (*Impatiens* sp.), 1 reed (*Ochlandra* sp.), 1 plant parasite (*Helixanthera obtusata*) and a mushroom species.

The major food species of Nilgiri Langur were found to be *Cullenia exarillata, Palaquium ellipticum, Myristica dactyloides, Syzygium laetum, Bischofia javanica, Garcinia morella, Mesua ferrea, Ficus beddomei, Drypetes elata* and *Elaeocarpus tubercultatus*. The shrubs utilized for food include *Nilgirianthus* sp., *Leea indica, Ardisia stonii, Polygonum chinensis, Zizyphus rugosa, Ixora* sp. and *Lasianthus jackianus. Thunbergia mysorensis, Polyscias acuminata,*

Fig. 4



Seasonal variation in the diet of Nilgiri langur

Aristolochia tagala, Salacia fruticosa, Erythropalum populifolium, Piper nigrum and *Tetrastigma sulcatum* were the lianas utilized.

A total of 45 plant families were represented in the diet. Plants of Euphorbiaceae family was the most widely used (8 species), followed by species of Lauraceae (7 species), Clusiaceae and Myrtaceae families (5 species each). However, 27 families were represented by single species.

Discussion

Adaptive success of Asian colobines lies in their possession of a sacculated stomach which digests cellulose by bacterial fermentation, thereby allowing the exploitation of vegetation parts (Curtin, 1980). Nilgiri Langur, which has got a wider threshold of adaptation to different type of habitats, consumes the products of a variety of plant species. Almost all workers who observed the feeding habits of this primate in different type of habitats have virtually pointed out its folivorous nature (Poirier, 1968; Horwich, 1972; Sunderraj and Johnsingh, 1993; Ramachandran, 1995; Srivastava, *et al.*, 1996). The results of the present study also highlights the presence of foliage as the major dietic component for the species in the typical evergreen forests of Silent Valley.

Wet evergreen forests are characteristic in having year round foliage in different phases. It can be stated that the Nilgiri Langur is highly adapted to the evergreen conditions as the diet is having as much as 89 food species. Of these, a majority of them are middle elevation evergreen species (Basha, 1987). Very few deciduous tree species like *Terminalia bellirica* occur in the diet, but the major food species are *Cullenia exarillata, Palaquium ellipticum, Myristica dactyloides, Syzygium laetum* etc. which are evergreen.

Horwich (1972) listed 39 food plants in the diet of Nilgiri Langur for a period of three months in Periyar. Major food species included moist deciduous species like *Pterocarpus marsupium. Grewia tiliifolia, Dalbergia latifolia, Tectona grandis* etc. According to him a constant volume of evergreen forest is necessary for this arboreal Langur. Sunderraj and Johnsingh (1993) reported 54 food species during their study in the diet of Nilgiri Langur in Servalar gallery forests in Mundanthurai Wildlife Sanctuary. They reported species like, *Hopea parviflora, Terminalia bellirica, Albizia amara, Tamarindus indica, Syzygium cumini, Garcinia cambogia* etc. Ramachandran (1995) reported 13 food species like, *Myristica malabarica, Knema attenuata, Garcinia* sp., *Mesua ferrea, Vateria indica* etc from the Shendurney Wildlife Sanctuary. Recently Srivastava *et al.*, (1996) conducted a three month study in Periyar and described 29 food species and most of them are of typical moist deciduous nature.

Proportion of food items in primates

Table 1

Food species of Nilgiri Langur and their percentage frequency in the diet

S.No.	Species	Family	Frequency (%)
1	2	3	4
1	*Cullenia exarillata*	Bombacaceae	13.40
2	*Palaquium ellipticum*	Sapotaceae	7.00
3	*Myristica dactyloides*	Myristicaceae	5.20
4	*Syzygium laetum*	Myrtaceae	4.80
5	*Bischofia javanica*	Euphorbiaceae	3.80
6	*Garcinia morella*	Clusiaceae	2.80
7	*Mesua ferrea*	Clusiaceae	2.40
8	*Ficus beddomei*	Moraceae	2.40
9	*Drypetes elata*	Euphorbiaceae	2.40
10	*Elaeocarpus tuberculatus*	Elaeocarpaceae	2.20
11	*Litsea floribunda*	Lauraceae	2.20
12	*Calophyllum polyanthum*	Clusiaceae	2.00
13	*Cinnamomum malabatrum*	Lauraceae	2.00
14	*Macaranga indica*	Euphorbiaceae	2.00
15	*Syzygium cumini*	Myrtaceae	2.00
16	*Xanthophyllum flavescens*	Xanthophyllaceae	1.80
17	*Ficus nervosa*	Moraceae	1.60
18	*Syzygium mundagam*	Myrtaceae	1.60
19	*Olea dioica*	Oleaceae	1.60
20	*Dimocarpus longan*	Sapindaceae	1.60
21	*Symplocos cochinchinensis*	Symplococeae	1.60
22	*Turpenia malabarica*	Staphyleaceae	1.60
23	*Apodytes dimidiata*	Icacinaceae	1.20
24	*Gomphandra coriacea*	Icacinaceae	1.20
25	*Mangifera indica*	Anacaradiaceae	1.20
26	*Canarium strictum*	Busaraceae	1.00
27	*Antedesma menasu*	Euphorbiaceae	1.00
28	*Ficus microcarpa*	Moraceae	1.00
29	*Ochlandra* sp.	Poaceae	1.00
30	*Thunbergia mysorensis*	Acanthaceae	1.00
31	*Garcinia gummi-gutta*	Clusiaceae	0.80
32	*Actinodaphne bourdilloni*	Lauraceae	0.80
33	*Clerodendrum viscosum*	Verbanaceae	0.80

Contd...

1	2	3	4
34	*Elaeocarpus munroni*	Elaeocarpaceae	0.80
35	*Persea macrantha*	Lauraceae	0.80
36	*Litsea laevigata*	Lauraceae	0.80
37	*Syzygium munroni*	Myrtaceae	0.80
38	*Clausena indica*	Rutaceae	0.60
39	*Acronychia pedunculata*	Rutaceae	0.60
40	*Elaeocarpus glandulosus*	Elaeocarpaeae	0.60
41	*Fahrenheitia zeylanica*	Euphorbiaceae	0.60
42	*Maesa indica*	Myrsinaceae	0.60
43	*Neolitsea scrobiculata*	Lauraceae	0.60
44	*Nothopodytes nimmoniana*	Icacinaceae	0.60
45	*Salacia fructicosa*	Hippocrateaceae	0.60
46	*Terminalia bellirica*	Combretaceae	0.60
47	*Debregeasia longifolia*	Urticaceae	0.40
48	*Casearia esculenta*	Flacourteaceae	0.40
49	*Aphanamyxis polystachya*	Meliaceae	0.40
50	*Apollonias arnottii*	Lauraceae	0.40
51	*Cassine kedarnathi*	Celastraceae	0.40
52	*Eurya nitida*	Theaceae	0.40
53	*Holigarna nigra*	Anacardiaceae	0.40
54	*Impatiens* sp.	Balasaminaceae	0.40
55	*Drypetes oblongifolia*	Euphorbiaceae	0.40
56	*Knema attenuata*	Myristicaceae	0.40
57	*Lasianthes jackianus*	Rubiaceae	0.40
58	*Ligustrum perrottetii*	Oleaceae	0.40
59	*Piper nigrum*	Piperaceae	0.40
60	*Prunus zeylanicus*	Rosaceae	0.40
61	*Nilgirianthus* sp.	Acanthaceae	0.40
62	*Syzygium gardneri*	Myrtaceae	0.40
63	*Tetrastigma sulcatum*	Vitaeceae	0.40
64	*Vernonia arborea*	Asteraceae	0.40
65	*Zizyphus rugosa*	Rhamnaceae	0.40
66	*Ardisia stoni*	Myrsinaceae	0.20
67	*Aristolochia tagala*	Aristolochaceae	0.20
68	*Aglaia lawii*	Meliaceae	0.20
69	*Agrostistachys meeboldi*	Euphorbiaceae	0.20
70	*Allophyllus rheedi*	Sapindaceae	0.20
71	*Callicarpa tomentosa*	Verbenaceae	0.20

Contd...

1	2	3	4
72	*Canthium dicoccum*	Rubiaceae	0.20
73	*Chionanthes intermedia*	Oleaceae	0.20
74	*Dysoxylum* sp.	Meliaceae	0.20
75	*Erythropalum populifolium*	Olacaceae	0.20
76	*Erythropalum monogynum*	Erythroxylaceae	0.20
77	*Ficus tsjahela*	Moraceae	0.20
78	*Glochidion fagifolium*	Euphorbiaceae	0.20
79	*Hopea glabra*	Dipterocarpaceae	0.20
80	*Hydnocarpus alpina*	Flacourtaceae	0.20
81	*Ixora* sp.	Rubiaceae	0.20
82	*Leea indica*	Leeaceae	0.20
83	*Helixanthera obtusata*	Loranthaceae	0.20
84	*Meliosma pinnata*	Sabiaceae	0.20
85	*Poeciloneuron indicum*	Clusiaceae	0.20
86	*Polycyas acuminata*	Araleaceae	0.20
87	*Polygonum chinensis*	Polygonaceae	0.20
88	*Catunaregam spinosa*	Rubiaceae	0.20
89	Mushroom (1 species)		0.20

may vary in different months according to the food availability, phenological phases of the plants, and type of habitat. Stanford (1992) reported monthly variation in the diet of Capped Langur (*Trachypithecus pileata*), in which he described the dominance of mature leaves in the diet during winter months. Later in May to September the same troop switched on mainly to fruits in the same habitat. Horwich (1972) observed a change in the diet of Nilgiri Langur over different months. During March and early April, the diet contained tender leaves and fruits, while with the advent of mid-April mature leaves dominated the diet.

The present study reveals a marked differences in the proportion of various dietic elements in different months. Highest proportion of foliage in the diet was observed in January, probably due to the greater availability of young leaves. The relative abundance of young foliages and the petioles in the diet of Nilgiri Langur is explained due to the high ratio of cell sap to cell wall in these items and their high digestibility (Oates *et al.*, 1980). Higher proportion of seeds in the diet observed in June may be related to the abundance of mature seeds of *Cullenia exarillata*. Fruit feeding exceeded in April over other food items. Greater availability of *Ficus* and *Syzygium* fruits and less availability of the most preferred young foliages may contribute higher fruit feeding in April. Other folivorous Langurs also used to feed heavily on fruits in summer months (Stanford, 1992; Roonwal and Mohnot, 1977).

Nilgiri Langurs exploited greater

proportion of leaves in Silent valley in the winter season, which was exceptional in having young shoots and foliage. According to Horwich (1972), they were depended more on young leaves than the old ones. Flower feeding was also recorded high in the winter season. Flower feeding in winter season was pronounced with the intensive flowering of *Palaquium ellipticum* in February.

Horwich (1972) reported the preference of deciduous tree species in the diet of Nilgiri Langur in summer season. However, the present study describes no such preference in any season. Winter season is marked by greater foliage intake followed by South-West monsoon. This is probably due to greater availability of tree species with young foliage after the two monsoons. In summer season fruits of the food plants like *Syzygium cumini, Cinnamomum malabatrum, Palaquium ellipticum*, figs of *Ficus nervosa*, and *Ficus beddomei* are common and the Langurs thrive mainly on these species. As most of the food plants of Nilgiri Langur were observed belonging to the middle elevation evergreen forests, the protection and management of these areas deserve utmost importance for the long-term survival of the species.

Acknowledgements

We are grateful to Dr. Chand Basha IFS, and Dr. K.S.S. Nair, former Directors, Kerala Forest Research Institute, for their interest in this study. The study was financed by Wildlife Wing of the Kerala Forest Department.

SUMMARY

Feeding ecology of Nilgiri Langur has been studied in the rainforest ecosystem of Silent Valley from 1993 to 1996. Eighty-nine food species were identified through direct observations. A majority of them were typical evergreen species. Monthly and seasonal variations in the percentage frequency of feeding observations on different food items in the diet were observed. The need of conserving the evergreen habitats for the endangered Nilgiri Langur is discussed.

साइलेंट वैली राष्ट्रीय उपवन, केरल, भारत में नीलगिरी लंगूर (*ट्रैकिपिथेकस जॉनिआई*) की पोषण पारिस्थिकी

के०के० रामचन्द्रन व गिगि के० जोजेफ

साराशं

साइलेंट वैली की वर्षावन परिस्थिति-संहति में 1993 से 1996 तक नीलगिरी लंगूर की पोषण परिस्थिकी का अध्ययन किया गया । प्रत्यक्ष प्रेक्षणों से इसकी नवासी खाद्य जातियां पहचानी गई । इनमें अधिकाशं प्रारूपिक सदाहरित जातियां हैं । भोजन में विभिन्न खाद्य वस्तुओं के पोषण प्रेक्षणों की प्रतिशत बारम्बारता में होने वाली मासिक और मौसमी विभिन्नता का प्रेक्षण किया गया । संकटापन्न नीलगिरी लंगूर के लिए सदाहरित प्राकृतावास संरक्षित करने की आवश्यकता का विवेचन किया गया है ।

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