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HABITAT UTILIZATION BY LARGE MAMMALS IN TEAK PLANTATIONS AND NATURAL FORESTS

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CONTENTS

INTRODUCTION

A considerable area (about 1300 km^2) of natural forests of Kerala state has been converted to plantations of different species out of which teak *(Tectona grandis)* occupies about 52%, eucalyptus 21%, softwood 15% and others 12% (Govt. of Kerala, 2987). Plantation activities in the Parambikulam area commenced in the year 1912. At present about 100 km^2 are under teak plantations out of 235 km^2 of sanctuary area.

The Parambikulam region has long been recognized as a well known area for wild animals. Construction of three reservoirs from 1959 to 1968 and creation of extensive plantations has no doubt affected the habitat of wild animals and caused their local movement. The area was declared as a wildlife sanctuary in 1962. Clearing forest for making new plantations has been suspended from 1981. The objective of the study was to examine the habitat utilization pattern by animals in teak plantations and adjoining natural forests. Damage from wild animals to the plantations was also examined.

STUDY AREA

The primary consideration in selecting Parambikulam Wildlife Sanctuary was the availability of plantations of different age and natural forest in close proximity. The study area is located in the Anappady region of the sanctuary at about 10^{o} 27' N and 76^{o}48'E. Transects were laid out in the teak plantations of one to 62 year age and adjoining moist deciduous type natural forest. Common trees of *the* area are *Tectona grandis, Anogeissus latifolia, Terminalia chebula, Lagerstroemia microcarpa, Phyllanthus emblica,* etc. Shrubs include *Helicteres isora, Xeromphis spinosa, Cassiafistula,* etc. Ground flora include *Brachiaria remota, Chromolaenaodorata, Desmodium triangulare, Sida rhombifolia, Urena lobata, Cassia tora, Cassia hirsuta,* etc. The Parambikulam wildlife sanctufaty harbours most of the representative animals of Peninsular India. Major animals of the sanctuary are elephant *(Elephas maximus),* gaur *(Bos gaurus),* sambar deer *(Cervus unicolor)* spotted deer *(Axis axis),* barking deer *(Muntiacus muntjak)* , mouse deer *(Tragulus meminna),* wildpig *(Sus scrofa),* wild dog *(Cuon alpinus),* panther *(Panthera pardus),* tiger *(Panthera tigris),* bonnet macaque *(Macaca radiata),* Nilgiri langur *(Presbytes Johni),* etc. The area is rich in bird life and Vijayan (1978) has recorded 133 species of birds.

Teak plantations are raised after clearing and burning of forest. Teak stumps are planted at two meters interval during monsoon. There would be 2500 plants in one hectar area. These plantations are subjected to mechanical thinning at the age of four years (all alternate diagonal lines of plants are removed) and eight years (all alternate rows are removed). This reduces the stand density to about one fourth. This is followed by first, second, third and fourth silvicultural thinnings wherein malformed trees are removed. A total of 2500,,1788, 968, 635, 348, 244, 215 and 175 plants are expected at the time of planting. 4, 8,13, 22, 34,40 and 60 years respectively. The final felling in the study area is at 60 years. Even though the 62 year old plantation was marked for felling, it was not carried out during the study period. The density in three year old plantion was 1722 plants/ha and in 16 year old plantation, 728 trees/ ha. The 62 year old plantation had a density of 312 trees/ha.

One, three, 16 and 62 year old teak plantations and natural forest were selected for the study. The one year plantation was made in 1983 after clear-felling the 1322 teak plantation. The three year old plantation had similarly been made in 1980 after clearfelling the 1919 plantation. A tarred road and a canal separate the natural forest from the one, three and 62,year old plantations. This was not considered a major handicap because of the low vehicle traffic, presence of a jeepable bridge across the canal and continuity of natural forest and plantations around the selected sites. The Sungam plantation (16 year old) being close to an elephant camp though bound to have inereased incidence of damage from the tamed elephants was chosen as there was no other plantation of that age available close by. Only comparisons of canopy coverage, shelter availability, undergrowth estimation, etc. are attempted with this plantation.

METHODS

Studies were carried out on two aspects. 1) Estimation of resource availability in the plantations in terms, of abundance of grass, herbs, shrubs, trees, extent of visit and damage by animals (Cairns and Telfer, 1980). 2) Selection of preferred plants by different animals by feeding trials on captive animals (elephant, sambar and spotted deer). The study sites were fairly uniform in plant composition, animal visit and other parameters. The only major difference was a gentle slope.Therefore transects were made across the slope. A transect Consisted of 250m. Data were coliected around points situated at 10m intervals. The plants were grouped into four categories based an their height. The different classes were plants less than one meter, one to two meters, two to three meters, three to five meters and more than five meters. In the case of grasses and forbs (group I), a radius of lm around the point was sampled, Two,three and five meter radius was used tor herbs,

shrubs and trees (groups 11, I11 and IV) respectively. The cumber of teak plants and their damage within 5m radius was also recorded.

Observations were taken in September 1983, March 1984, June 1984, September 1984 and March 1985. Grasses and small herbs which were too numerous were recorded as the percentage area occupied. Herbs were countea and the number recorded. Shrubs and trees were counted and recorded. The number of trails, faecal groups and digging of animals or their sighting was also recorded. Number of birds sighted and the species were recorded. Shelter availability was grouped into 11 categories. Damage to plants was classified into no damage, bark or branch broken, main stem broken and uprooted or severely damaged The data were recorded on proforma sheets and analysed using a 16 bit microcomputer.

Feeding trials were done on captive spotted deer, sambar and elephant The trials were mainly aimed at finding out the most preferred foragingplants of these animals. All grasses and herbs from an area of one meter radius were cut to the ground level and each species was separated land weighed. They were again mixed and given to the animals which were maintained at Topslip by Tamil Nadu Forest Department. The animals were allowed to feed on the plants for a constant amount of time of one hour and the plant species were again separated and weighed to find out the quantity of plants consumed. Drying was found to be substantial during the feeding trials and to account for this a control was kept to find out the weight loss due to wilting. Another trial was also conducted to find out the feeding preference of the animals on different species of plants. In this trial equal quantities of several of the available plants were fed and the feeding preference recorded.

RESULTS

Availability of fodder

Among the grasses and forbs (group I), three plants namely *Brachiaria remota, Mimosa pudica* and *Commelina* sp. accounted for the majority of plants in all plantations (Fig. la). *Brachiaria remota* was the most abundant plant. This was followed by *Mimosa pudica* and *Commelina* sp. Few other species like *Themeda sp., Tridax procumbens, Cyperus sp Setaria intermedia,* etc. were also present.

Plants belonging to group II show definite pattern in abundance between plantations and season, Plants like *Stictocardia tiliaefolia, Cassia tora* and *Acacia* sp. are more abundant in younger plantations (Fig. Ib). Plants like *Helicteres isora* and *Xeromphis spinosa* were more abundant in older plantations

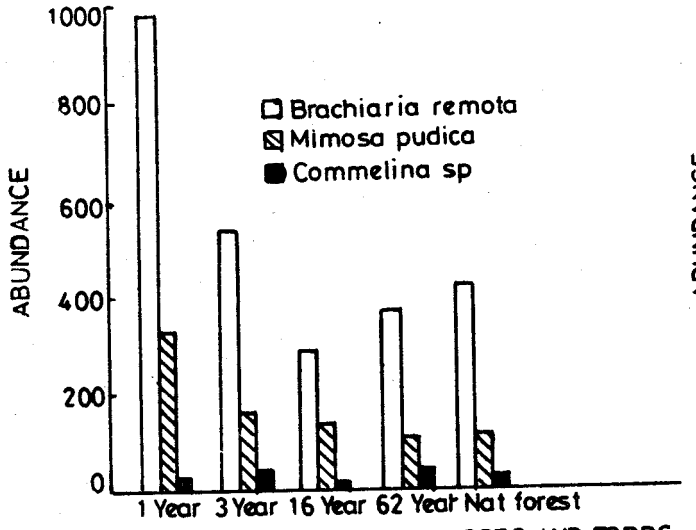

Fig 1a ABUNDANCE OF GRASSES AND FORBS

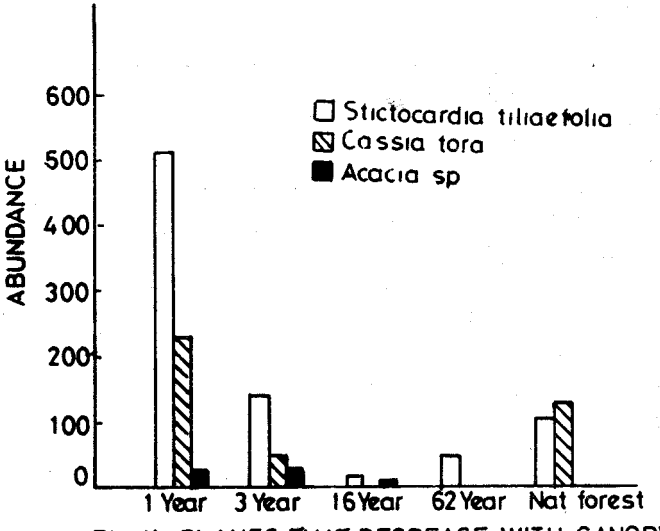

Fig 1b PLANTS THAT DECREASE WITH CANOPY COVER

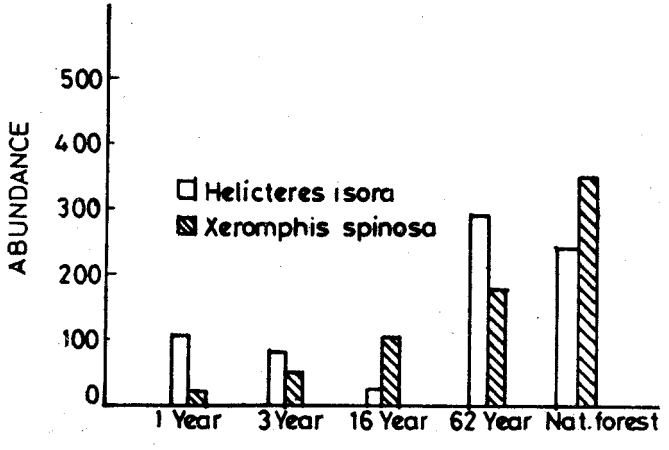

Fig 1c. PLANTS THAT INCREASE WITH CANOPY COVER

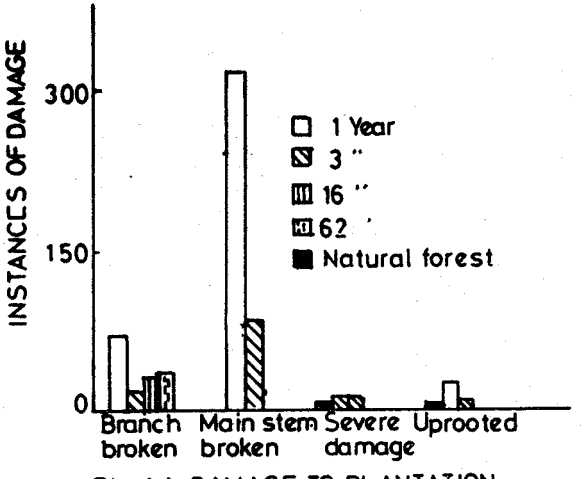

Fig 1d DAMAGE TO PLANTATION

and natural forest (Fig. lc). Plants like *Chromolaena odorata, Cassia fistula, Zizyphus oenoplia, Costus speciosus, Psuedarthria viscida, Urena lobata, Sida rhombifolia, Desmodium triangulare, Cassia tora,* etc. are present in good numbers in all plantations (Fig. 2 a, b).

Shrubs (gro up 1II) like *Chromolaena odorata, Helictcres isora, Cassia fistula, Xeromphis spinosa and Zizyphus oenoplia* were the common ones. The teak plantations in general have only few other trees because almost all trees are removed before planting teak. Valuable timber species like *Dalbergia sissoides* are retained. From the first silvicultural thinning at about 13th year onwards other trees are usually retained in the study area.

Abundance of animals

The most frequent animals were gaur, elephant, sambar, spotted deer, wild pig, rodents, bonnet macaque, Nilgiri langur, etc. (Fig. 2c). Elephants were found in all plantations. Gaur was maximum in one year old plantation followed by three year old plantation and natural forest. Deer was present in almost all the areas. Barking deer was recorded mostly from 62 year old plantation and natural forest. Wild pigs were maximum in natural forest followed by 16 year old and 62 year old plantations. Rodents were more in natural forest followed by one year old plantation. Digging by pangolin was noticed in two places in the one year old plantation and in the natural forest. Birds were seen maximum in natural forest and 62 year old plantation. Shade was maximum in 62 year old plantation. Three year old plantatiou had thickets suitable for deers, pigs, etc.

Fodder consumption by animals

Sambar deer and spotted deer showed preference for grasses (table 1). In the case of sambar deer the preferred plants were grasses, *Bambusa arundinacea, Commelina* sp., *Desmodium triangulare, Mimosa pudica and Solanum torvum.* Grasses, *Desmodium triangulare, Moleneria finlaysonia, Zizyphus oenoplia* and *Bambusa arundinacea* were the preferred species for the spotted deer. In the case of elephants, plants such as *Helicteres isora, Bambusa arundinacea, Sida rhombifolia, Xeromphis spinosa,* grasses, *Urena lobata, Commelina* sp., *Solanum* sp., *Zizyphus* sp., *Desmodium triangulare, Cassia hirsuta, and Mimosa* sp. were tried. Though it consumed most of the plants, it did not prefer *Helicteres isora* and *Sida rhombifolia.*

Table 1. Feeding preference of sambar and spotted deer.

Name of plant	Sambar % diet	Spotted deer % diet
1 Grasses	43.15	45.92
2 *Desmodium triangulare*	10.00	2.08
3 *Pseudarthria viscida*	8.60	8.40
4 *Mimosa pudica*	7.80	5.77
5 Climber	3.94	2.62
6 *Sida cordifolia*	3.50	2.00
7 *Solanum torvum*	3.16	6 70
8 *Sida rhombifolia*	2.76	4.96
9 *Commelina sp.*	2.76	7.78
10 *Bambusa arundinacea*	2.46	1.88
11 *Cyperus sp.*	2.02	—
12 *Xeromphis spinosa*	1.73	2.84
13 *Urena lobata*	1.63	0.52
14 *Chromolaena odorata*	1.54	0.68
15 *Hemidesmus indicus*	1.27	0.40
16 Unidentified	1.06	—
17 *Herretia sublobata*	1.05	2.48
18 *Labiatae*	0.86	0.45
19 *Cassia hirsuta*	0.67	0.40
20 *Ipomea* sp.	—	0.28
21 *Diascorea* sp.	—	0.08
22 *Molineria finlaysonia*	—	0.60
23 *Urena Iobata (red)*	—	1.20
24 *Zizyphus oenoplia*	—	0.86
25 *Curcuma sp.*	—	0.08
26 *Scoparia dulcis*	—	0.52

Damage to plantations

In the one year plantation the survival of the planted teak seedlings was very low, In three year old plantation there was extensive damage, ie. as many as 425 plants/ha.Out of this,in about 70 plants/ha branch was broken,in 319 p1ants/ha main stem was broken and about 14 plants/ha were severely damaged(Fig. 1 d). Maximum elephant damage was observed in three year old plantation. All the four types of damage were observed in this plantation. The main type of damage in 16 year old plantation was breaking branches and tip

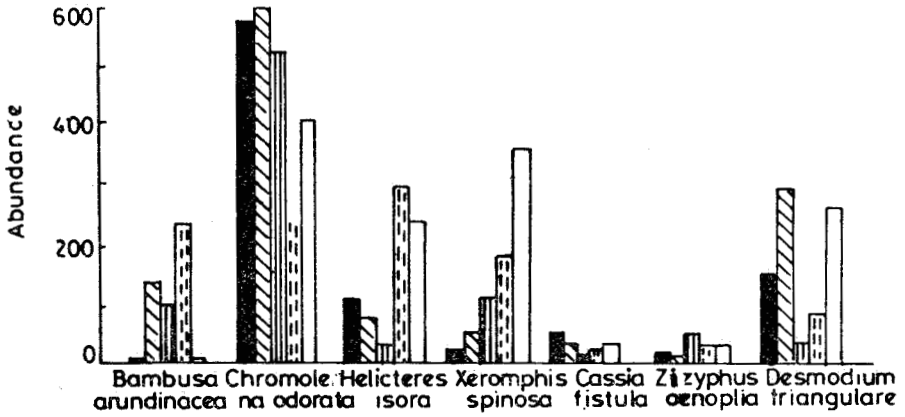

Fig. 2a ABUNDANCE OF PLANTS OF GROUP I

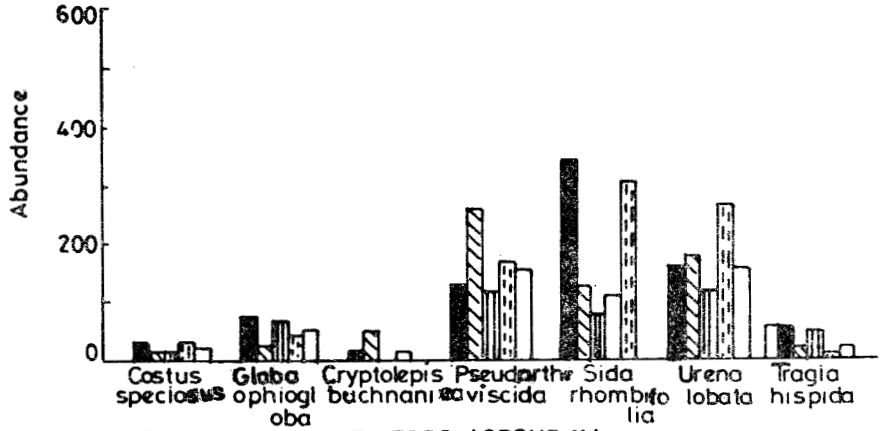

Fig 2b ABUNDANCE OF HERBS (GROUP II)

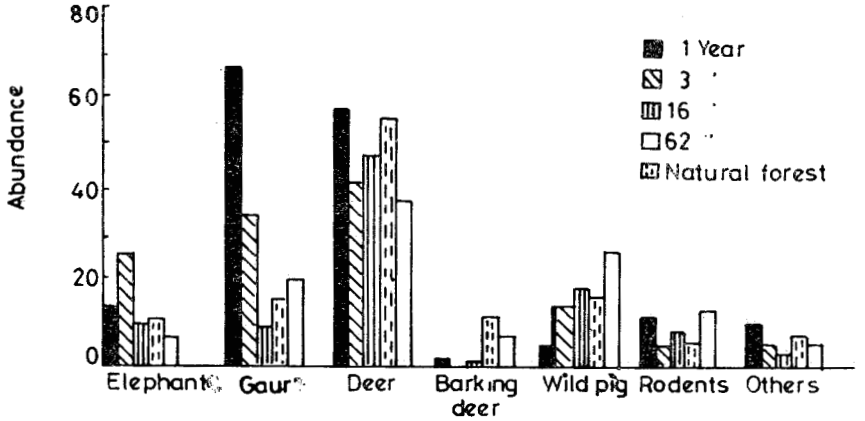

Fig 2c. ABUNDANCE OF ANIMALS

of the trees. Only few trees were uprooted or severely damaged. In 62 year old plantation the elephants consumed bark mainly from the stem and broken branches. Uprooting was not recorded in this plantation. In the natural forest, elephants usually preferred to consume the bark of various trees. Breaking of branches was also observed.

DISCUSSION

Grasses and forbs (group I) found more in younger piantations were much grazed by animals. Plants of group I1 could be divided into three types based on abundance. Species like *Helicteres isora* and *Xeromphis spinosa* are more abundant in older plantations. On the other hand plants like *Stictocardia tiliaefolia, Acacia tora* and *Acacia* sp. were more abundant in younger plantations. Orher species were more or less equally distributed. Of these *Helicteres isora,* a heavily browsed species occurs mostly in the older plantations. Plants *Desmodium triangulare, Urena lobata, Truimphetta* sp., *Cassia hirsuta, Sida rhombifolia, Pseudarthria viscida,* etc. preferred by animals were present in all plantations. *Chromolaena odorata,* a noxius weed was found in all plantations, the least in 62 year old plantation followed by natural forest. *Desmodium triangulare* was heavily grazed by gaur and sambar deer. *Pseudarthria viscida, Sida cordata, Solanum torvum* were preferred species for sambar deer. *Psuedarthria viscida, Solanum torvum , Sida rhombifolia* were the species preferred by spotted deer.

The less number of *Helicteres isora* and *Xeromphis spinosa* in younger plantations is probably due to the fact that these plantations are cleared off of all plants and burned before planting teak. Abundance of *Stictocardia tiliaefolia, Cassia tora* and *Acacia* sp. can be explained in terms of their light loving nature. The total number of species of plants found in different plantations and natural forest were similar. Examining different plantations and natural forest for exclusive occurrence of plants reveals that there is no major plant species confined to any of the plantations or natural forest. In general herbs are fairly abundant in natural forest and younger plantations.

Sixty two year old plantation had maximum abundance of shrubs (group 111). This was followed by natural forests. The less abundance of shrubs in younger plantations could be due to the initial clearing, burning and subsequent weeding operations. The older plantations had few trees.

Maximum abundance of elephants was in the three year old plantation where they pulled out many teak plants. The 16 year old plantation also suffered considerable damage from elephants. Sixty two year old trees were too big to be pulled down by elephants. Gaur was maximum in one year old plantation followed by three year old plantation and natural forest. Deer was present in good numbers in all the areas. Barking deer was recorded mostly

from 62 year old plantation and natural forest. Wild pigs were maximum in natural forest followed by 16 year old and 62 year old plantations. Rodents were more in natural forest followed by one year old plantation. Animals sighted include bonnet macaque in three year old plantion, sloth bear *(Melursus ursinus)* and giant squirrel *(Ratufa indica)* in 62 year old plantation and wild pigs and Nilgiri langur in natural forest. Birds were seen maximum in natural forest and 62 year old plantation. The one year old and three year old plantations had only few common birds. All plantations except one year old provide good shelter for animals.

Small branches and bark of plants were damaged in all Plantations. The damage to teak plantations is mainly from elephants. Teak is an important fodder species for the elephants. Deers occasionally remove bark of young plants by rubbing their antlers. Damage was more to three year old plantations. The main stem of many of the plants were damaged (319 trees/ha). In the 16 year old plantation also there is breakage of main stem (238 trees/ha). In 62 year old plantation there was only breaking of branches or removal of bark.

Teak is planted at an interval of 2 m. In the three year old plantation the density at the time of the study was only 1788.3 plants/ha instead of the expected 2500 plants/ha (F R. I., 1970). This shows that the plantation is understocked, and first mechanical thinning may not be necessary. The present density is only as much as would be expected after the first thinning. Reasons for the less number is damage by animals and drying in summer. The main type of damage is breaking of the main stern. In three year and 16 year old plantations 319 plants/ha and 238 plants/ha respectively were damaged. About 14 plants/ha were badly damaged (main stem broken or severely damaged or uprooted) by animals in three year old plantation. This damage is not very considerable as about 50% trees will be removed in first mechanical thinning in a normal plantation. The 16 year old plantation contained 728 trees/ha. The number expected after 2nd silvicultural thinning at 22 years is 348. About 10% trees were badly damaged. However this could be because of the nearby elephant camp. The 62 year old plantation contained 312 teak trees/ha. The number expected is about 175 trees/ha. Number of plants damaged per hectare in different plantations is shown in table 2.

Table 2. Number of plants damaged/ha in different plantations.

Type of damage	3 year	16 year	62 year	Natural forest
Bark or branch broken	70.3	47.5	39.5	57.7
Mainstem broken	318.8	237.7	1.3	1.7
Severely damaged	14.3	35.7	0	1.7
Uprooted	27.5	30.6	0	1.7

Elephants showed preference for *Bambusa arundinacea,Brachiaria remota, Solanum torvum*, *Zizyphus oenoplia, Psuedarthria viscida,Xeromphis spinosa Cassia fistula,* etc. It is notable that the elephants did not consume *Sida rhombifolia* which is a preferred species by the deers. Most of the other plants it consumed were eaten by other animals also.Deer showed high preference for *Stictocardia tiliaefolia, Desmodium triangulare, Commelina* sp. and grasses. In the case of spotted deer, *Curcuma* sp., grasses, *Molineria finlaysoinia, Scoparia dulcis, Sida rhombifolia, Solanum torvum* and *Zizyphus oenoplia* were some of the more preferred species. Of these only grasses were available in plenty. However when we analyse the percentage of plants in the diet of both these deers (Table I), the importance of different plants becomes evident. In the case of sambar, grasses form the most important fodder species (43.20%). This is followed by *Desmodium triangulare* (10.%), *Pseudarthria viscida* (8.6%), and *Mimosa pudica* (7.8%). Spotted deer also consumed grasses most (45.9%). Other species were *Pseudarthria viscida* (8.4%), *Commelina* sp. (7.8%), *Solanum torvum* (6.7%,), *Mimosa pudica* (5.8%), and *Sida rhombifolia* (5.0%). *Pseudarthria viscida, Mimosa pudica* are more or less equally consumed by both deers. Sambar fed more on *Desmodium triangulare* compared *to* the spotted deer. Spotted deer fed more *Commelina* sp. compared to sambar

All the above plants are common to all the plantations and natural forest. From the point of view of fodder availability to sambar, spotted deer and elephant, teak plantations of different ages and natural forests had little difference. In general the different plantations and natural forest had their own peculiarities. If one had more of forbs and grasses the other had more of shrubs and trees. Animals showed varying degree of affinity to the different plantations. Even though extensive monoculture has many drawbacks these are mitigated to some degree in the study area because

1 The species planted is teak, a species naturally occurring in the region and readily consumed by animals like elephants
2 The adjacent plantations are of different age classes and hence provide more diversity with regard to plant availability and shelter. In case of vast stretches of plantations of uniform age, the conditions could be different and quite unfavourable to many animals.

Since the different plantations and natural forest occur side by side, animals could easily move from one habitat to another.Because of this reason the animals' preference for a habitat may be obscured. The study shows that animals use teak plantations and natural forest extensively and the adverse effects of monoculture plantations can be reduced if there are stretches of adjoining natural forests and plantations of different ages are intermixed. Damage caused to plantations by animals in the study area is not extensive and can be easily adjusted in the thinning intensity.

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