

9. FEEDING BEHAVIOUR

9.1. INTRODUCTION :

Study of feeding behaviour is essential to understand ecological adaptations of a species to its environment. It is also an important factor in analysing ecological and behavioural problems. Association and dissociation of members of a social group might be influenced both by the quality and condition of vegetation and to the amount and distribution of food resource . This type of study is necessity in order to frame out plans to develop their habitat so that perpetuation of the species is ensured.

This chapter deals with food species , food habits, estimation of plant parts eaten and to determine food selection technique of the species. Drinking behaviour of rhesus is also discussed here.

9.2. METHODS :

Feeding behaviour of rhesus monkey was conducted by observing the animals at specific feeding sites in the course of feeding and also by direct observation of the plant species consumed by the animals. The part of the plant species consumed and the manner it was consumed was recorded. No recording was made when the rhesus was not in clear

members of the groups were very shy and often moved away immediately on encountering me. The more time I spent at the study site and observed the activity of the groups, they became more and more tolerant of my presence. As a result soon the monkeys became used to my presence and their activity and behaviour were no longer disturbed. At the beginning of the study, I was tolerated only by several monkeys. This can be cited as an example of habituation (T. Maruhasi, 1980), which by definition, is learning not to respond (Thorpe, 1956).

9.2.2. Food Species Identification :

Careful observations were taken during feeding of rhesus in order to determine plant species and parts eaten. I was able to identify several plant species and parts eaten by direct observation through binoculars on the spot. All unknown food plants observed to be eaten by rhesus during focal animal sampling or at other times were collected for future identification. An unknown plant-food was temporarily recorded with a code number. In sorting out the plant species the local names were used for those plants whose local name were known and numbers were assigned to others which had no local names, for ready reference. Herbarium sheets were made with the collected plants following standard methods. The herbarium sheets were then sent to The Central National Herbarium, Botanical Garden, Shibpur, Howrah for identification.

9.2.3. Estimation of Plant Parts Eaten :

The food species and plant parts eaten were recorded by time sampling method (Altmann, 1974). Feeding bouts were randomly recorded whenever the animals were seen feeding on something. Data of feeding behaviour from March to December, 1988 were collected systematically. The recording method used was to note at 5 minutes intervals the food species and plant parts eaten by all the animals seen feeding in one glance. In each 5 minutes scan, I included both the feeding animals immediately visible and those which came into the range of vision (Clutton and Brock, 1975). Scanning was recorded every 5

minutes at any time when the animals were directly observed. The following typology of parts of food plants was adopted : (i) fruit : a juicy fruits, nuts and seeds (ii) leaf : all new and mature leaves, (iii) stem : all stems and twigs, (iv) flowers : all flowers, (v) bark : thick dead or partially dead surface of the trunk, (vi) other plant parts : roots , buds and petioles (Maruhashi 1980).

A total of 415 hours of observation on feeding behaviour was made during the study period which included 9097 bouts of feeding .Feeding records were analysed by summing the total number of records of each food species and expressing these as percentages of the total number of feeding records collected. These proportions were regarded as estimates of the proportions of time which the animals spent on feeding of each food species or parts.

9.2.4. Food Selection Ratio :

Most animals are selective regarding food items in their natural habitat. Selection usually depends on taste or on the nutritive value of the food items. Selected species are those which are proportionately more frequent in the diet of an animal than their availability in the environment (Petrides, 1975) . Sampson (1952) used the term "Like-ability" of the forage species and Stoddart and Simth (1955) used the term 'Choice and animals makes' for this purpose. There are several techniques used by different workers to determine food preference such as : (i) faecal matter analysis (Clutton and Brock, 1977),(ii) tracer sample analysis (Wilson et al., 1977) . Faecal matter analysis is more suitable for wild primate populations(clutton - Brock, 1977) . Tracer sample analysis is of much promise but requires adequate facilities and at the same time operational hazzards can not be ruled out.

The method followed here was a scanning method as done by Altmann (1974) in red colobus and black-white colobus in East Africa. Maruhashi (1980) has also used this method in Japanese monkeys.It is rather simple and appropriate because of the advantage that it is easily replicable. It provides an estimate of the proportion of time which animals

spent on feeding of each food species or plant parts. It should be noted that it will not give a good estimate of amount of different foods ingested since feeding rate and observability vary between food-items, as Hladik (1977) pointed out. The process involves selecting an experimental plot in the forest where the major food plants are present. Accordingly one plot at Saraswatipur block was selected to determine food selection ratio of rhesus monkey. In order to survey quantitatively and qualitatively, plants over 2 metres in height were recorded in a sample strip (50m X 100m = 5000 m²).

Total number of feeding bout on each species and total number of trees of each species were counted in the sample plot and converted into percentage time spent on feeding of each species (PTF) and abundance of each species (PA) respectively. The selection ratio(r) was then determined dividing percent time spent in feeding by percent abundance ($r = \text{PTF}/\text{PA}$). This ratio gives a measure of the limit to which the monkeys selected the different plant species as food. The selection ratio for different species emphasized the strength of selectivity. Some of the plant species found at a high density were irregularly selected where as some tree species with low density were selected regularly.

9.2.5. Total Food Intake :

Number of plucks per unit time were recorded for different age-sex classes of rhesus. Wet weight of green shoots taken by a single pluck was also determined by comparison with an adjacent unplucked area. Then multiplying the amount taken in a single pluck by number of plucks per unit time, the amount consumed during that time period was determined. This was then, again multiplied by average number of hours of feeding by different age-sex classes of rhesus.

9.3. RESULTS AND DISCUSSION

9.3.1. Mode of Feeding :

Rhesus monkeys are largely vegetarian. Its diet includes leaves, flowers, fruits

berries, and seeds of many species of plants, grass and grains and algae. As for mode of feeding when a large tree of a major food species with sparse distribution with in the home range ^{of the} group had a good crop as well as other plant parts, almost all the members of a group engaged themselves in feeding on fruit, leaves, stalk and other parts of the plant (Plate - 9.1). On arriving at such a tree, the members of the group exhibited a great deal of excitement for a few minutes, but soon the members got on to the job of feeding following adjustment of inter-individual distances among one another. In some cases, the dominant male exhibited a branch shaking display during the initial excitement period. The members carried on feeding calmly for about 15 to 45 minutes. Young individuals were often found to feed at the terminal fruiting branches (Plate -9.2) whereas older and heavier ones were not found to feed at those spots. Lindburgh (1971) observed this type of feeding in northern India. Fruits and berries are picked up with the hand and brought to the mouth or a branch is pulled to the mouth with the hand and the berries are plucked. While sitting on the branches, animals fed on fruits, leaves, stems of plant species and filled their cheek pouches with food and then sat in a safe place with alert position and continued chewing (Plate - 9.3). On the ground, animals fed on a grass, herb, dropped nuts and fruits (Plate - 9.4). Feeding on ground comprised of 15% of their feeding time but this varied seasonally. During winter, feeding at the ground is much more higher than that of summer, when green leaves and fruits are easily available. Besides, plant species, rhesus monkeys were seen to feed on unidentified insects from the soil. Lindburgh (1971) and Krishnan (1972) noted insect feeding of rhesus.

9.3.2. Food Species Analysis :

Altogether 47 plant species belonging to 41 genera under 21 families constituted food of rhesus at the present study site (Table - 9.1). Almost 19% of food plants belonged to the family Leguminosae, while 15% and 11% of food plants belonged to the families Poaceae and Moraceae respectively. Families Euphorbiaceae, Myrtaceae accounted for 9% and 6% food species respectively. Only 4.2% each belonged to the families Rhamnaceae, Verbenaceae and Anacardiaceae. The remaining 27.2% belonged to other

13 families, such as Apocyanaceae, Bombacaceae, Combretaceae, Cruciferae, Dilleniaceae, Dipterocarpaceae, Flacaurtiaceae, Lauraceae, Meliaceae, Rubiaceae, Rutaceae, Cyperaceae, and Pandanaceae. All the food plants listed in Table - 9.1 were, however, not eaten equally; only several species such as *Azadirachta indica*, *Ficus racemosa* (Plate - 9.5), *F. hispida*, *Psidium guajava*, *Syzygium formosum*, *S. cumini*, *Zizypus mauritiana*, *Artocarpus heterophyllus*, *A. lacucha*, *Baccaurea sapida*, *Emblica officinalis* (Plate - 9.6), *Dillenia indica* (Plate - 9.7) were observed to be consumed in large quantities. As such these food species may be regarded as 'principal food', of rhesus as used by Petrides, (1975). The other food species which were found to be eaten in smaller quantities were termed as 'auxiliary foods'. The latter type of food were consumed during movement from resting sites to feeding sites and vice versa. The list of food items indicates that rhesus monkeys are wide spectrum feeder.

9.3.3. Food Selection :

The important aspect of feeding adaptation is selectivity in which some food items are chosen in preference over others. Frequent feeding on certain species may be due in part to abundance in availability, but availability is not the whole story since many commonly available food items were little eaten. The 20 most common tree genera are listed in Table - 9.2, which shows their abundance within broad vegetation area. Percent abundance does not represent abundance in the total range, because the total area is made up of unequal proportion of habitat types. Food selection ratios were done in the experimental area where 24 plant species were selected during the period from May to June, 1988. The experimental plot was situated near Swaraswatipur block and although dominated by *Shorea* (PA = 16.5%), *Tectona* (PA = 10.3%) and *Dalbergia* (PA = 9.4%), showed lower rate of feeding, i.e., 0.13%, 0.13% and 0.10% respectively (Table - 9.2). Some of the other tree species found at moderately high density were irregularly selected. But some species with low density were regularly selected, i.e., *Syzygium cumini*, *S. formosum*, *Artocarpus lacucha*. It is notable that trees with intermediate density had a intermediate selection ratio, i.e., *Anthocephalus chinensis*, *Azadirachta indica* etc.

Besides selection ratio on trees, 10 most common shrub, grass and herbaceous genera were collected for identification as important source of food sources. Table - 9.3 shows 3 grass genera, 4 herb genera and 3 shrub genera. *Digitaria* was found as most important food source among three common genera of grasses. *Oryza* and *Zea* were found as important food source among the four herb genera. Similarly among the shrubs, *Citrus*, *Erythrina* were important.

9.3.4. Diet and Seasonal Variation :

The diet of rhesus includes fruits, leaves, flowers stems, barks, roots, buds, petioles and many unidentified plant parts and soil. Among 21 families, the monkeys utilized some plants of the families, Moraceae, Myrtaceae and Rhamnaceae most probably because these families have large number of fruiting trees. Fruiting trees of other families were also utilized. Lindburgh (1971) noted that rhesus consumes mainly fruits, nuts, berries and seed. The animals also consume a number of grass species as noted by Mukherjee and Gupta (1965) and Lindburgh (1971).

Rhesus groups were observed to feed on 47 species under 21 families from March, 1988 to December 1988, excluding rainy season (July-August). The study was divided into two halves : (i) Spring and early summer (March-June), (ii) Autumn and early winter (September-December). The records of different parts eaten were randomly collected to analyse diet quantitatively (Table - 9.4, and Table - 9.5).

Table - 9.4 shows that in the spring - summer months i.e., March - June the monkeys spent about 90% of their feeding time on fruits and leaves. On the other hand they spent similar proportion of time on leaves and stems in the Autumn - Winter months (September - December, Table - 9.5). Over all the monkeys fed predominantly on fruits in the spring - summer months and on leaves in the Autumn-winter months. Percent time spent on other plant parts in the two seasons varied from item to item. Similar seasonal

difference in plant part consumption has also been reported by Roonwal (1956) and Lindburgh (1971).

The diet of rhesus is similar that of *M. radiata* (Bertrand, 1969), *M. assamensis* Fodden (1970), and *M. silenus* (Sugiyama, 1971). Unlike these species *M. fascicularis* (Fodden, 1971), and *M. nemestrina* (Corner - 1941, Bertrand - 1969) are reported to be omnivorous rather than predominant vegetarians. The diet of *Macaca fuscata yakui* (Maruhasi, 1980) is essentially fruits and is close to that observed in the present study.

9.3.5 Total Food Intake :

From Table - 9.6 it is found that among mothers (females with infants) both intensity of feeding and time spent in feeding are highest and as such they consumed maximum amount of food i.e., 123.28 gms per hour during the feeding period. Higher rate of consumption by mothers was possibly required for regaining health after birth of the young and for milk production. The food consumption of adult males were considerably lower than that of adult females with infants. The food consumption of adult males were lower (96.6 gms/hour) than that of adult females without infants (104.88 gms/hour). It may be mentioned that the infants suckled their mother's milk besides their diet of fruits, leaves, shoots and grass in relation to their body weight. It is well known that animals with smaller body size requires more energy per unit of body weight as compared to the large bodied animals.

9.3.6 Drinks :

Rhesus monkeys at Baikunthapur Forest have been observed to drink from all kinds of water sources such as rivers, streams, pools, ditches and even from irrigation channel. No particular period of the day can be pointed as their "drink time", however, they have been found to drink at the early morning and late afternoon and also in the mid-day. Often they were observed to drink during intervals between feeding bouts when water

sources were available in the vicinity (Plate - 9.8).

Drinking pattern depended on the kind of water sources they were drinking from. While crossing the rivers they drank standing at knee-deep water. At other times when they drank from rivers, streams and pools their forelimbs were in the water bodies but the hindlimbs were on the bank. Again when they drank from small water bodies they just lowered their shoulder leading the mouth into the water source while maintaining their position on the hind limbs at the bank. They immersed their lips into water and sucked up water. Most often they drank for only few seconds at a time. On occasions they drank continuously for about 30 seconds. Drinking generally lasted 12 to 30 seconds in adults, 7 to 15 seconds in juveniles and 5 to 9 seconds in infants (Table - 9.7).

They were always observed to drink clear mud-free water. Authorities differed regarding drinking activity of rhesus. Mukherjee (1969) is of opinion that rhesus drink at least two to three times a day. It may, however, be assumed that during the hot months they drink more often. It was also observed that, almost all the members of several groups drank water daily whenever they came in contact with a large water body such as river or jhoras.

Table - 9.1 : Food species of rhesus

Sl. No.	Food Species	Family	Percent of Food Species
1.	<i>Bauhinia malabarica</i>	Leguminosae	19.0
2.	<i>Bauhinia purpurea</i>	"	
3.	<i>Acacia catechu</i>	"	
4.	<i>Erythrina variegata</i>	"	
5.	<i>Cassia fistula</i>	"	
6.	<i>Butea monosperma</i>	"	
7.	<i>Albizzia lebbeck</i>	"	
8.	<i>Dalbergia sisso</i>	"	
9.	<i>Pea sativum</i>	"	
10.	<i>Dendrocalamus hamiltonii</i>	Poaceae	15.0
11.	<i>Cynodon dactylon</i>	"	
12.	<i>Zea mays</i>	"	
13.	<i>Oryza sativa</i>	"	
14.	<i>Imperata cylindrica</i>	"	
15.	<i>Saccharum spontaneum</i>	"	
16.	<i>Digitaria sanguinalis</i>	"	
17.	<i>Fiscus recemosa</i>	Moraceae	11.0
18.	<i>Artocarpus lacucha</i>	"	
19.	<i>Fiscus hispida</i>	"	
20.	<i>Artocarpus heterophyllus</i>	"	
21.	<i>Fiscus benghalensis</i>	"	
22.	<i>Emblica officiflora</i>	Euphorbiaceae	09.0
23.	<i>Baccaurea ramiflora</i>	"	
24.	<i>Trewia nudifolia</i>	"	
25.	<i>Baccaurea sapida</i>	"	

Contd.....

Table 9.1 Contd.

Sl. No.	Food Species	Family	Percent of Food Species
26.	<i>Syzygium formosum</i>	Myrtaceae	06.0
27.	<i>S. cumini</i>	Myrtaceae	06.0
28.	<i>Psidium guajava</i>	"	
29.	<i>Zizypus mauritiana</i>	Rhamnaceae	04.2
30.	<i>Hovenia acerba</i>	"	
31.	<i>Tectona grandis</i>	Verbenaceae	04.2
32.	<i>Gmelina arborea</i>	"	
33.	<i>Mangifera indica</i>	Anacardiaceae	04.2
34.	<i>Spondias pinnata</i>	"	
35.	<i>Alstonia scholaris</i>	Apocyanaceae	02.1
36.	<i>Bombax ceiba</i>	Bombaceae	02.1
37.	<i>Terminalia bellirica</i>	Combretaceae	02.1
38.	<i>Brassica rapa</i>	Cruciferae	02.1
39.	<i>Dillenia indica</i>	Dilleniaceae	02.1
40.	<i>Shorea robusta</i>	Dipterocarpaceae	02.1
41.	<i>Flacourtia indica</i>	Flacourtiaceae	02.1
42.	<i>Cinnamomum tamala</i>	Lauraceae	02.1
43.	<i>Azadirachta indica</i>	Meliaceae	02.1
44.	<i>Anthocephalus chinensis</i>	rubiaceae	02.1
45.	<i>Citrus grandis</i>	Ruteaceae	02.1
46.	<i>Cyperus rotundus</i>	Cyperaceae	02.1
47.	<i>Pandanus fascicularis</i>	Pandanaceae	02.1

Table - 9.2 : The abundance of some food species and their selection ratio (Area = 100m X 50 m) at the Baikunthapur Forest.

Name of the species	PTF	PA	Selection ratio PTF/PA
<i>Acacia catechu</i>	1.26	4.59	0.27
<i>Albizia lebbek</i>	3.35	6.81	0.49
<i>Anthocephalus chinensis</i>	4.76	2.81	1.69
<i>Azadirachta indica</i>	8.75	6.81	1.28
<i>Bombax ceiba</i>	2.44	4.80	0.50
<i>Cassia fistula</i>	1.06	2.16	0.49
<i>Dalbergia sisso</i>	1.04	9.46	0.10
<i>Fiscus racemosa</i>	7.65	4.17	1.83
<i>F. hispida</i>	5.12	3.35	1.67
<i>Gemelina arborea</i>	0.93	6.71	0.13
<i>Psidium guajava</i>	6.66	2.06	3.23
<i>Shorea robusta</i>	2.30	16.54	0.13
<i>Syzygium formosum</i>	5.34	1.10	4.86
<i>S. cumini</i>	7.32	1.10	6.65
<i>Tectona grandis</i>	1.37	10.35	0.13
<i>Terminaliabellirica</i>	2.91	1.32	2.20
<i>Zizypus mauriliana</i>	7.10	3.22	2.20
<i>Dillenia indica</i>	2.27	1.42	1.59
<i>Emblica officinalis</i>	2.21	1.34	1.61
<i>Artocarpus lacucha</i>	5.12	1.13	4.53
<i>A. heterophyllus</i>	6.33	2.81	2.25
<i>Bauhinia malabarica</i>	2.58	1.69	1.52
<i>B. Purpurea</i>	3.57	1.57	2.27
<i>Baccaurea sapida</i>	8.42	2.87	2.93

Index : PTF = Percent of time spent feeding on each species ;

PA = Percent of abundance of each species.

Table - 9.3 : Percent time spent on feeding of some of the most common genera of grasses, herbs and shrubs in the study area.

Name of Genus	Type	Percent time spent in feeding
<i>Cynodon</i>	Grass	17.5%
<i>Digitaria</i>	Grass	48.0%
<i>Imperata</i>	Grass	34.5%
<i>Brassica</i>	Herb	10.2%
<i>Dendrocalamus</i>	Herb	23.7%
<i>Oryza</i>	Herb	38.8%
<i>Zea</i>	Herb	27.3%
<i>Citrus</i>	Shrub	35.7%
<i>Erythrina</i>	Shrub	45.0%
<i>Pandanus</i>	Shrub	19.3%

Table - 9.4 Percent time spent on feeding of plant parts irrespective of species in spring-summer months in 1988.

Month	Plant Parts						
	Fruit	Leaf	Stem	Flower	Bark	Seed	Others
March	75.6	13.4	5.3	2.7	0.2	1.9	0.9
April	82.7	10.3	4.5	1.0	0.5	0.7	0.3
May	78.8	13.2	3.8	0.2	0.7	2.6	0.7
June	62.4	24.6	6.2	0.8	0.4	4.5	1.1
Average	74.9	15.4	5.0	1.2	0.4	2.4	0.7

Table - 9.5 Percent time spent on feeding of plant parts irrespective of species in Autumn - Winter months in 1988.

Month	Plant Parts						
	Fruit	Leaf	Stem	Flower	Bark	Seed	Others
Sept.	5.0	60.4	25.6	5.7	2.0	0.3	1.0
Oct.	6.7	55.3	27.5	7.8	1.2	1.0	0.5
Novem.	8.5	52.5	28.2	8.8	1.5	0.2	0.3
Dec.	15.0	42.7	32.5	6.9	1.0	0.5	0.5
Average	9.2	52.5	28.6	7.3	1.4	0.5	0.5

Table - 9.6 Total intake of food (green leaves) in gms. Per hour by different age - sex classes.

Age- sex classes	No. of plucks per hour (N)	Average wet weight of single pluck	Amount of green leaves eaten per hour (A) = N x W
Adult Male	1050	0.092gms	96.6gms
Adult Female (with infant)	1340	0.092gms	123.28gms
Adult Female (without infant)	1140	0.092gms	104.88gms
Juvenile	875	0.076gms	66.5gms
Infant	450	0.042gms	18.4gms

Table - 9.7 : Duration of Drinks (in seconds) in different age - classes.

Age - Class	No. of sightings	Minimum	Maximum	Average
Adult	170	12	30	21.0
Juvenile	80	7	15	11.0
Infant	65	5	9	7.0

Plate - 9.1 : An adult feeding on top of a tree during early morning period of the day.

Plate - 9.2 : An infant of early stage feeding on terminal branches of a tree.

Plate-9.3 : An adult male chewing food materials on the ground showing prominent cheek pouch. Arrow shows bananas.



Plate - 9.1



Plate - 9.2



Plate - 9.4 : Ground feeding of different age-sex classes of a group at morning of the day.

Plate - 9.5 : *Fiscus racemosa*, an important food species.

Plate - 9.6 : *Emblicu officinalis*, another important food species.



Plate – 9.4

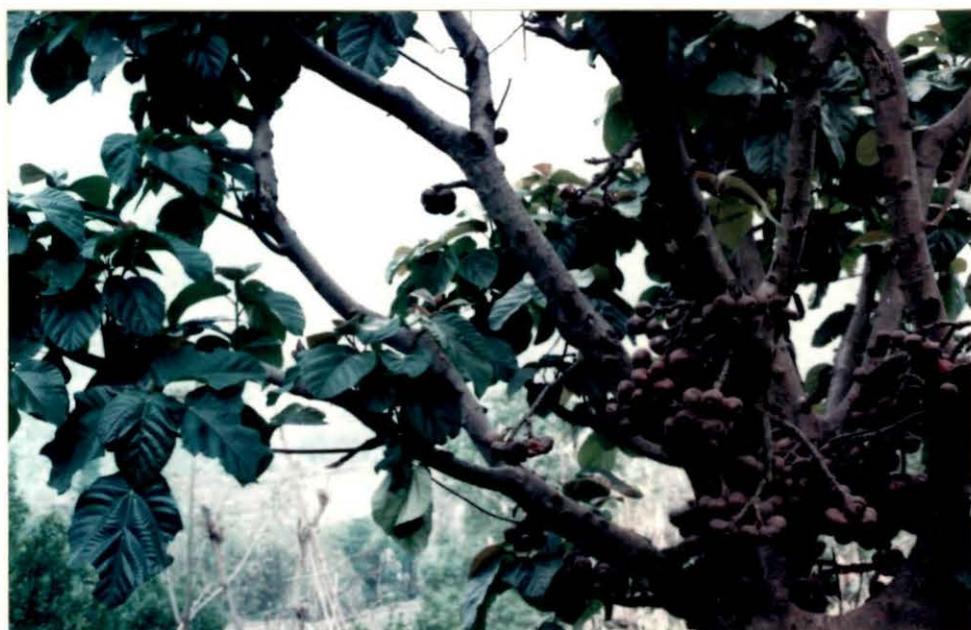


Plate – 9.5

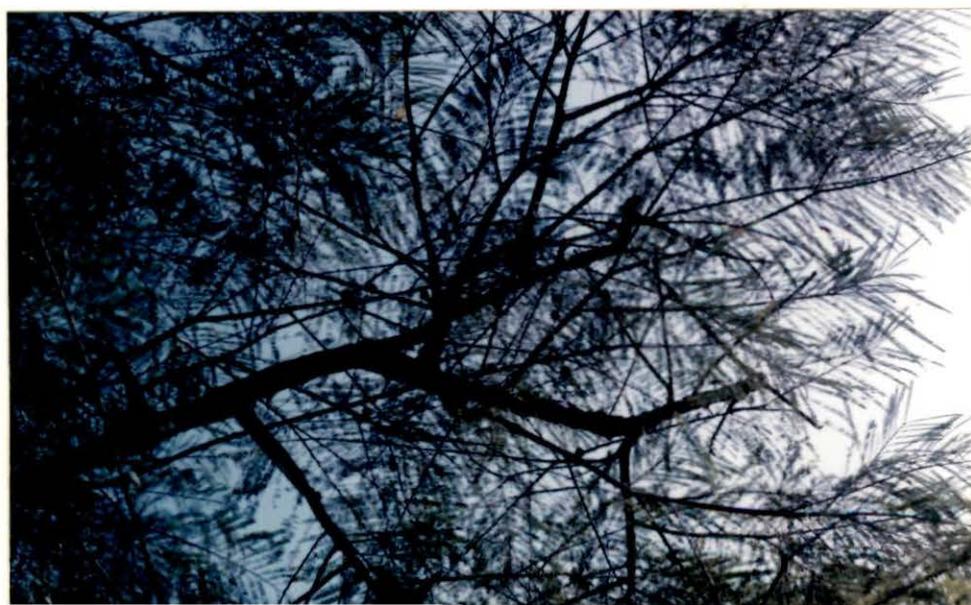


Plate – 9.6

Plate - 9.7 : *Dillenia indica*, an important food species.

Plate - 9.8 : Two adult males drinking water from water-filled holes during dry season. Arrow shows an infant drinking water whose mother holds its tail.



Plate – 9.7



Plate – 9.8