

FAUNAL COMPONENT IN THE DIET OF LION-TAILED MACAQUE. KUMARA, H.N., SINGH, ME., SHARMA, A.K., SINGH, MR. AND ANANDA KUMAR, M.

Key words: Lion-tailed macaque, diet, faunal component

Abstract

The paper reports the information on the faunal component in the diet of wild lion-tailed macaques. The faunal component accounts for about 19 per cent of the total diet. There is more intake of faunal items during the dry months from December to May when fruit availability is low, as compared to the wet months from June to November. The faunal intake at different times of the day and by different age-sex classes does not differ. Invertebrates constitute the largest portion of the faunal diet. The smaller animals are captured and eaten by all age-sex classes, whereas the larger vertebrates are usually caught and eaten by adult animals, especially males. The method of capturing the prey and the parts of the body eaten are reported.

Introduction

Food is the most important preoccupation in an animal's life. Diet accounts for most of the ecological and behavioral differences among primate species. More attention has been paid to the study of diet than any other aspect of ecology and behavior in free living primates. Since the Order Primates includes a wide range of biological systems ranging from tree shrews to anthropoid apes, it is also characterized by a diversity of diets. Primate diets generally include fruits, leaves and fauna, and accordingly, they could be referred to as frugivorous, folivorous and faunivorous (FLEAGLE, 1988). FLEAGLE (1988) further points out that the primate species that tend to forage more on insects are smaller in size, and the larger size species usually tend to feed on leaves. The significance of body size influencing the mechanism of resource partitioning in insectivorous primates has also been emphasized by TERBORGH (1983). The dietary patterns may also influence several other behavior patterns such as ranging. Since it is difficult to exactly classify animals into categories according to dietary preferences, EISENBERG (1981) suggests that characterization be made in terms of modal strategies.

The lion-tailed macaque (*Macaca silenus*) is a habitat specialist (SINGH et al., 1997) inhabiting only the climax rainforests of Western Ghats in southern India. Since the species is endangered, it is essential to document its complete range of dietary items in order to formulate effective conservation and management plans for the species. The lion-tailed macaque is primarily a frugivorous species, but its diet also includes a variety of fauna (GREEN and MINKOWSKI, 1977; KUMAR, 1987). The species can, therefore, be classified as frugivorous/faunivorous with a bimodal dietary strategy. Whereas in the previous studies, a detailed description has been provided regarding the plant species whose fruits are eaten by the lion-tailed macaques, a detailed species-wise description of faunal consumption is still not available. We report in this paper partial records of such details gathered over the past few years.

Study Area, Subjects and Methods

The information was gathered from three groups of lion-tailed macaques inhabiting Andiparai Shola (n=23), Iyerpadi Shola (n=13) and Puduthotam Estate Forest (n=45) in Anaimalai Hills, Western Ghats, south India. These three habitats differ in terms of degradation and human interference (SINGH et al., 1998). The data were gathered through systematic scan sampling between July 1994 and January 2000. Although the information was gathered for feeding on all types of items, this paper includes only the faunal component in the diet of lion-tailed macaques. A total of 20863 scans were made on the three groups. The data reported in Table 5 is from the Puduthotam Estate Forest group only. The seasons in this paper are defined as Winter (December-February), Summer (March-May), Monsoon (June-August), Autumn (September-November), Dry (December-May) and Wet (June-November).

Results and Discussion

Feeding and faunal component

Table 1 presents the data on the overall faunal component in the diet of lion-tailed macaques. On the whole, feeding was observed in 29.56 per cent of the total scans. The animal component in the diet of these macaques was 18.91 per cent of the total diet. Although these three habitats differ in terms of food availability and dispersal of resources etc. (SINGH et al, 1998), there was no difference either in the per cent scans for feeding ($\chi^2=0.21$; $df=2$; $p=0.90$) or for per cent scans for faunal component in the diet ($\chi^2=1.53$; $df=2$; $p=0.46$) among the three groups. Therefore, in the further analysis, the data for all the three groups were combined.

Table 1: Scans for total and faunal feeding.

| Group | Observation scans | Feeding scans | % feeding scans | Faunal diet in scans | % scans for faunal diet |
|---------|-------------------|---------------|-----------------|----------------------|-------------------------|
| AP | 10400 | 3214 | 30.90 | 578 | 17.98 |
| IP | 3799 | 1125 | 29.61 | 172 | 15.29 |
| PT | 6664 | 1828 | 27.43 | 416 | 22.76 |
| Overall | 20863 | 6167 | 29.56 | 1166 | 18.91 |

Seasonal variation in faunal feeding

Table 2 presents the data on seasonal variation in the faunal component in diet. The difference among the seasons for the per cent scans for faunal feeding was significant ($\chi^2=10.86$; $df=3$; $p=0.01$). The faunal component was highest in Winter (26.49 %) and lowest in Autumn (7.54 %). Further, when the data were clubbed for Dry and Wet seasons, the difference was found to be significant ($\chi^2=5.37$; $df=1$; $p=0.02$). The intake of faunal component in the diet was much higher during the dry period (24.30 %) than the wet period (10.61 %).

Table 2: Seasonal variation in faunal feeding.

| Season | Feeding scans | Faunal items in scans | Faunal items in % scans |
|---------|---------------|-----------------------|-------------------------|
| Winter | 1321 | 350 | 26.49 |
| Summer | 2415 | 558 | 23.10 |
| Monsoon | 693 | 127 | 18.33 |
| Autumn | 1738 | 131 | 7.54 |
| Dry | 3736 | 908 | 24.30 |
| Wet | 2431 | 258 | 10.61 |

Diurnal variation in faunal feeding

From Table 3, it appears that there was a slightly less intake of faunal component in the food during the early morning hours, but the data subjected to statistical analysis showed no significant variation ($\chi^2=4.85$; $df=5$; $p=0.43$) for different times of the day.

Table 3: Diurnal variation in faunal feeding.

| Time | Feeding scans | Faunal items in scans | Faunal items in % scans |
|-----------|---------------|-----------------------|-------------------------|
| 0600-0800 | 236 | 23 | 9.75 |
| 0800-1000 | 1011 | 183 | 18.10 |
| 1000-1200 | 1432 | 317 | 22.14 |
| 1200-1400 | 1504 | 272 | 18.08 |
| 1400-1600 | 1148 | 219 | 19.08 |
| 1600-1800 | 836 | 152 | 18.18 |

Faunal component in the diet of age-sex classes

Table 4 presents the data on the intake of faunal food by various age-sex classes. A perusal of the data and the statistical analysis ($\chi^2=0.58$; $df=5$; $p=0.99$) indicate that there was no difference among various age-sex classes for the per cent values for faunal component in the diet.

Faunal items, substrate of catch and parts eaten etc.

The information on the per cent of various animals in the food, and the additional information regarding the substrate from where these animals are caught, and parts of the body eaten are presented in Tables 5 and 6 respectively. Most of the faunal component in the diet of lion-tailed macaques constitutes of invertebrates. In the following section, we present the information on the faunal items in the manner of natural history.

Table 4: Faunal component in the diet of age-sex classes.

| Age-sex class | Feeding scans | Faunal items in scans | Faunal items in % scans |
|---------------|---------------|-----------------------|-------------------------|
| Ad M | 1118 | 196 | 17.53 |
| Ad F | 3063 | 672 | 18.67 |
| Sub-Ad M | 230 | 48 | 20.87 |
| Sub-Ad F | 391 | 76 | 19.44 |
| Juvenile | 1063 | 221 | 20.79 |
| Infant | 302 | 53 | 17.55 |

Ad M - Adult male; Ad F - Adult female; Sub-Ad M - Subadult male; Sub-Ad F - Subadult female

Table 5: Scans for various faunal items.

| Items | Scans | % diet |
|----------------------------------------------------|-------|--------|
| Vertebrates | 11 | 0.60 |
| Butterfly; Dragonfly; Moth | 10 | 0.55 |
| Cricket; Cicada; Beetle | 25 | 1.37 |
| Spider | 60 | 3.28 |
| Termite | 15 | 0.83 |
| Caterpillar | 58 | 3.17 |
| Leafhopper; Leaf insect; Stick insect; Grasshopper | 155 | 8.48 |
| Larvae; Maggot; Insect eggs | 35 | 1.91 |
| Unidentified insects | 47 | 2.57 |

Table 6: Additional information on faunal food.

| Food item | Age-sex class feeding | Feeding substrate | Parts eaten | Parts rejected |
|--------------------------------------------------------|-------------------------|-------------------------------------------|-------------|---------------------------------------------|
| Grasshopper; Leaf insect; Stick insect; Praying mantis | All | Leaf litter & tree foliage | Total | None |
| Spider | All | Communal webs; Leaf tubes | Total | None |
| Moth; Butterfly; Cicada; Dragonfly | All | Leaf litter; Flying; Stem; Foliage | Body | Wings and legs |
| Hymenoptera; Isoptera | All | Nests | Total | None |
| Caterpillar | All | Mud; Leaf litter; Bark; Leaves; Dead wood | Body | Extradermal stings |
| Frog and Frog nests | All | Trees; Nests; Bush | Nest eaten | Jaws and some skin |
| Calotes | Adult and Subadult male | Trees; Leaf litter | Selective | Skin scales; Skull; Jaw; Digits; Hard bones |
| Bird and nestlings | Adult and Subadult male | Trees; Bush | Selective | Wings; Feathers; Hard bone; Legs; Beak |

Grasshopper, leaf insect, stick insect and praying mantis

These organisms are caught from the ground litter to the tree foliage, and are consumed by all age-sex classes. The organisms may be caught in any random manner and in most of the cases, the entire body is eaten. However, in two cases, it was observed that the monkey removed the stomach content from the stick insect and ate rest of the animal. The same was also observed for caterpillars of moths and butterflies.

Spiders

As far as feeding on a variety of spiders is concerned, we have observed three different methods of capture which are based on the nature of the web of the spiders. Spiders are also eaten by all age-sex classes.

- Some spiders make communal webs and more than 100 spiders can be seen together, especially at the hollows of trees. In such a case, the monkeys first chase the spiders and scatter them around. Later, each spider is individually picked up and totally eaten.
- Some other spiders make tubular structures out of leaves and live inside them. In this case, the monkeys use their hands to open up these leafy tubes and eat the spiders directly with their mouths.
- Some spiders make tubular webs, especially in the bushes. The monkeys simply insert their hands inside these tubes, pick up the spiders and consume them.

Moths and butterflies

Moths and butterflies are captured from their dorsal sides and also from their wings. The monkeys invariably eat the head first, and then eat the rest of the body. However, wings and legs are almost always rejected.

Cicada and dragonfly

Whereas feeding on cicada is common, feeding on dragonflies is only occasional. The methods of capture and feeding, head first and body later, is almost similar to the method used for moths etc. However, cicadas are often followed by the monkeys. In addition to the wings, the legs are also sometimes rejected.

Feeding on winged Hymenoptera, and Isoptera

This kind of feeding is observed during the rainy season when the potential queens and males of Hymenoptera emerge from their nests for their mating flights. The monkeys of all age-sex classes almost mob the nests and vigorously feed on the emerging insects. Inter-individual aggression is also often observed at such times. All parts of the body, including wings, are eaten. Sometimes, the monkeys even remove stones as heavy as half kilogram to expose the nests of the Hymenoptera. The nests are also often dug up. The flying insects are caught from the air by standing on two legs. The most interesting, although only occasional, observation has been the insertion of fingers into the nests of these insects and licking, or directly feeding with mouth, the insects stuck on the fingers. The saliva probably helps sticking these insects on the fingers of monkeys. The behavior may be construed as a primitive form of "termite fishing" in chimpanzees.

Caterpillars of moth and butterflies

Caterpillars of both moths and butterflies are commonly eaten by all age-sex classes. However, the monkeys employ different methods of feeding on them. In the case of caterpillars of moths which have stings on the dorsal surface of the body, the caterpillar is slowly pushed to a hard surface, either ground or a bark. It is then gently rubbed by using only palms of both hands alternatively to remove the stings. The monkeys also often rub their hands against barks to remove stings from their palms. If the caterpillar is thin, the entire body is eaten. However, if it is thick, the stomach content is squeezed out and the rest of the body is eaten. In the case of caterpillars of butterflies, there are no stings on the body. However, they sometimes do have colorful protrusions on the lateral surface. These protrusions are always removed by rubbing and then the caterpillar is eaten. In both cases, it may be noted that the care is taken to remove only the extradermal parts.

Larvae of different insects from mud, leaf litter, bark, leaves, root or dead wood etc. are commonly caught by all age-sex classes and eaten. Whenever, when the foliage or litter is disturbed, several species of flies are caught in the air and are totally eaten. This type of feeding is a routine activity in lion-tailed macaques.

Frog nests and arboreal frogs

Arboreal frogs of the Genus *Rhacophorus* build their nests on leaves above the small water bodies in the forest. The nest is built by secretions containing enormous proteins. The frogs then lay eggs in these nests. We have observed two instances in the Andiparai forest where lion-tailed macaques raided these nests and ate the entire nests including secretions and eggs.

We have now a total of 18 instances of lion-tailed macaques feeding on *Rhacophorus*, the arboreal frogs of two different species. The frogs are eaten only from bushes or from trees of medium height of about 10-15 meters. The frog is caught from its dorsal side, and immediately the head of the frog is taken into the mouth. The neck is broken and the head portion is then swallowed. Rest of the body is slowly eaten without rejecting any parts taking about 4 minutes. The monkey then takes out the stuff from its pouch and carefully rejects jaw, some skin and a part of the head. All age-sex classes feed on the frogs.

Calotes

We have 11 instances of monkeys feeding on green *Calotes*, once again from bushes or from trees of medium height. Except in one case by a sub-adult male, all other instances of feeding on these lizards were by adult males only. In one of the instances clearly seen by us, a sub-adult male caught a green *Calotes* on a tree of about 30 feet. When he was about to bite the head, the *Calotes* slipped from his hand and fell to the ground. The *Calotes* ran and started to climb another tree when he was noticed by an adult male. This male rushed to it, and caught it from its dorsal side. He immediately bit the neck and ruptured the green pouch. The head of the *Calotes* was taken into the mouth and the neck was broken. The head part was immediately swallowed. Rest of the body was taken to a branch and eaten. He selectively rejected (a) entire body skin with scales neatly without any flesh on it, (b) skull, jaw with teeth and full skin were also rejected, and (c) from the legs, only the flesh was eaten, and the external skin scales with digits were rejected.



Fig. 1: Reptiles like the Calotes tree dragon (*Calotes calotes*) represent faunal components in the diet of lion-tailed macaques. (Photo: C. Knogge)

Draco

A draco (*Draco dussumieri*) was caught by an adult female from a height of about 25 feet on a tree. The female took the head of draco in her mouth and broke the neck. The animal was then taken to a height of about 80 feet and the feeding process later could not be sighted.

Bird nestling and birds

A sub-adult male in the Andiparai shola group caught two nestling from the nest of a bird species not identified. The head of the nestling was taken into the mouth and the neck was snapped. The head was severed and swallowed. Later, the rest of the body was also swallowed. This was being done while he was holding the second nestling in the other hand.

Feeding on adult birds by lion-tailed macaques is rare and we have observed only two instances. In one of the instances, a small green barbet entered into a newly made hole in a tree at about 20 feet height. An adult male kept staring at the hole from a distance of about 30 feet. The bird flew out for a few minutes and entered the hole again. The adult male rushed to the hole, put his hand in, and caught the bird. Immediately, the head portion of the bird was taken into the mouth and the neck was broken. The broken head of the bird was actually hanging on a side when the male carried it to a branch closeby. He first ate the head. Then slowly the wings with

feathers were removed and rejected. The rest of the body was rubbed clean on a branch and then swallowed. After a few minutes, the monkey started to masticate and rejected beak, some portion of the tip of legs, some skin with feathers and a few pieces of bone. He took less than a minute to kill, about a minute to swallow and about 12 minutes to masticate.

Bats

We have observed two cases of lion-tailed macaques feeding on bats. Both kills were made by adult males. The patagia are removed first to make the bat unable to fly. The head of the bat is taken into mouth and the neck snapped. Some parts of the bone and skin are rejected and rest of the body is eaten. In one case, the feeding was made by adult females and juveniles also.

Fawn of a mouse deer

We have observed only one, but a rather significant, case of attack by lion-tailed macaques on the fawn of a mouse deer in Andiparai Shola. A very young fawn was spotted by the monkeys and immediately attacked by 2 sub-adult females, 2 juveniles, one low ranking male and a few other animals that could not be identified in the bushes. The deer was badly injured. In the meantime, the alpha male rushed to the deer with aggressive barks. It is not possible to decipher whether these barks were directed at the deer or at other monkeys. However, all other monkeys moved away and the deer first managed to escape. The alpha male chased it and attacked it. After a short battle, the injured fawn again managed to escape and run into the bushes. The alpha male chased it for about 50 meters but returned to the group after a few minutes. Even after a thorough search of the area, the injured deer was not found. This is a significant case because (a) of the size of the animal, and (b) the animal is not a competitor to the lion-tailed macaques. More such instances would throw light on the fact whether such large size mammals also constitute a component of the diet of lion-tailed macaques.

Placenta of a cow

It is a practice by the local people to wrap the fresh placenta of a cow in a cloth and tie it to a *Ficus* tree branch. Several such bundles, new and old, can be seen in a single tree. In one of the instances, an adult female particularly selected a bundle with fresh placenta, ripped it open and ate the entire placenta.

Few facts emerge out of this information:

- The animals do constitute a significant component in the diet of wild lion-tailed macaques,
- there is a wide diversity of animal component including insects, lizards, birds and mammals in their diet, the mode of attacking and eating different types of animals is highly specialized,
- except for small prey, most of the feeding on larger animals is done by adult animals, and
- the feeding on animals is done more during winter and summer i.e. from December to may when the fruit availability is less.

The information above presented above may be sketchy but it is important for two reasons:

- It is for the first time that such details have been recorded regarding the animal component in the diet of lion-tailed macaques, and
- the information is critical for an appropriate management of these animals in wild as well as in captivity.

Acknowledgments

This research was supported by the Ministry of Environment and Forests, Government of India, Indo-US Primate Project, and the Zoological Society of San Diego. We are grateful to Tamil Nadu Forest Department for permissions and assistance in the field. H.S. Sushma, Cornelia Bertsch, and Ajith Kumar helped us at various stages.

References

EISENBERG, J.F.: The Mammalian Radiations. Chicago: The University of Chicago Press (1981).

FLEAGLE, J.G.: Primate Adaptation and Evolution. San Diego: Academic Press Inc. (1988).

GREEN, S. and MINKOWSKI, K.: The lion-tailed macaque and its south Indian rainforest habitat. In: BOURNE, G.H. and RAINIER, PRINCE CHARLES (eds.): Primate Conservation. New York: Academic Press (1977): 283-337.

KUMAR, A.: The Ecology and Population Dynamics of the Lion-Tailed Macaque (*Macaca silenus*) in South India. Ph.D. Thesis, University of Cambridge (1987).

SINGH, M., SINGH, M., KUMARA, H.N., KUMAR, M.A. and D'SOUZA, L.: Inter- and intra-specific associations of non-human primates in Anaimalai Hills, south India. *Mammalia* (1997) 61, n01: 17-28.

SINGH, M., SINGH, M., KUMAR, M.A., KUMARA, H.N., D'SOUZA, L. and ANANTHA KRISHNA SHARMA, B.A.: Behavior of lion-tailed macaque (*Macaca silenus*) in vulnerable and relatively secure habitats of Western Ghats, India. *Tigerpaper* (1998) 25(4): 16-25.

TERBORGH, J.: Five New World Primates. Princeton: Princeton University Press (1983).

Corresponding address:

M. Singh: Biopsychology Laboratory, University of Mysore, Mysore – 570 006. India.
E-mail: mewaw@vsnl.com