STATUS OF THE LION-TAILED MACAQUE (*Macaca silenus*) IN MALABAR, KERALA

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Introduction

The lion-tailed macaque is a non-human primate (Family Cercopithecidae: Subfamily Cercopithecinae) endemic to the rain forests of the Western Ghat mountain ranges of peninsular India. Before discussing its status in the Malabar area, I would describe briefly its past and present distribution, and the essential features of its life history and ecology since an understanding of these is necessary for a proper appreciation of the current conservation status of the lion-tailed macaque. The discussions on the distribution are based on reports from a number of studies (see below). The discussion on life history and ecology are based on a long term study from 1978 to 1984 at the Indira Gandhi Wildlife Sanctuary (previously Anamalai Wildlife Sanctuary). The first part of the study (1978 -80) was conducted with Dr. G.U. Kurup with funds from the Zoological Survey of India. The second part of the study was conducted with funds from WWF (India & US), and Wenner-Gren Foundation for Anthropological Research. The results also come from a survey conducted in 1987 -90 with funds from the Wildlife Conservation International of the New York Zoological Society.

Distribution

The southern Indian rain forests, to which the lion-tailed macaque is endemic, is presently confined mostly to the elevated areas of the Western Ghat mountain ranges. During the Cretaceous period, however, rain forest was fairly widely distributed in northern and central India and along the eastern or Coromandel coast of India as indicated by fossil records. A humid climate favouring rain forest prevailed over most of India during this period because of its more southern latitude. The drift to more northern latitude starting from mid-Tertiary, and the uplift of the Himalayas and the Western Ghats established the present day monsoon regime by late Pliocene. This let to a drier climate in the northern India as well as the Coromandel coast and in the replacement of the rain forest by deciduous forest.

Although the regression of rain forest to the Western Ghats was largely natural, its subsequent loss and fragmentation was a result of human activities. In little more than a century from 1840, vast areas of rain forest were cleared for coffee, tea, rubber and teak plantations. Most of the remaining forest were also selectively logged. These operations fragmented the remaining forest and also brought about large scale settlement of huge human work force near the fragments. At present, rain forest is primarily confined to upper elevations of Western Ghats. The present area of the remaining rain forest which harbour the lion-tailed macaque is estimated to be about 5,000 sq.km.

The first study which drew our attention to the declining population of the lion-tailed macaque was that by Sugiyama (1968). The first long term study, however, was by Green and Minkowski (1977). They reported the northern limit of the lion-tailed macaque as Sharavati River in Karnataka (14°N, Figure 1) and the southern most as Ashambu Hills. They estimated a population of about 600 animals, most of it in the Ashambu Hills in the southern end of the Western Ghats, and Silent Valley area. Kurup (1978) and Ali (1985) estimated a slightly higher population including significant populations outside the above two areas. Some isolated populations have also been reported north of Sharavati River (Bhat, 1984). The second long term study of the species was by Kumar (1987) in the Anamalai Hills, which was followed by a survey of the Western Ghats. These studies reveal that present distribution of the lion-tailed macaque range from the southern most point in the Ashambu or Agasthyar Hills to a few kilometres north of the Sharavati River (Figure 1). The present population is most probably between 3,000 and 4,000. Only two areas, the Ashambu Hills and the Silent Valley-New Amarambalam forests, have substantial extent of contiguous rain forests (more than 400 sq.km.) which support populations of about 400 animals each. In the other areas, the habitat has been severely fragmented into isolated patches of a few ha. to less than 100 sq.km. As much as 60% of the population might be confined to such small patches of less than 50 sq.km.

Life history

Like other macaques, the lion-tailed macaque also live in groups. The group size range from 7 to 41, with a mean of 18, and a median of 20. The number of adult males in a group vary from 1 to 3, and the subadult males vary from none to 5. Generally, the larger groups tend to have more adult and subadult males. The adult females always outnumber the adult males with a mean number of 8 females per group. Similarly, the immatures (the infants and juveniles) also outnumber adult males (mean =8). The proportion of adult and subadult males vary considerably between groups, whereas the proportion of adult females does not.

Notable features in the life history of the lion-tailed macaque are its high age at which the females give birth for the first

Table 1. The life history parameters of the lion-tailed macaque in the wild, estimated from the Anamalai Hills in 1978 -84

Births	
Age at first birth	6.6 years
Interbirth interval	2.5 years
Mean birth rate	0.38/ female/ year
Survival	
Infants (0 -1 year)	0.87/ year
Juveniles (1 -6 years)	0.90/ year
Adult females (> 6 years)	0.98/ year
Adult males (> 8 years)	0.92/ year

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time (mean =6.6 years), the long interbirth interval (2.5 years), low birth rate (0.38/ female/ year). The females in the wild do not give birth beyond 18 years of age. The very high survival rates of the different age/ sex classes in the wild are also striking (Table 1). These life history parameters show that the lion-tailed macaque is highly adapted to its stable rain forest habitat and has a very low population growth rate. It does not have the demographic capability to track rapid changes in resources, and to recover from population perturbations, for example, from diseases or hunting pressure.

Feeding Ecology

The lion-tailed macaque feeds exclusively on food items which are rich in simple carbohydrates (ripe fruit, seeds, nectar, gums and resins), and proteins (chiefly invertebrates, but also could include birds' eggs and nestlings, and giant squirrels). A group spends about 25% of the day time on foods of plant origin, and about 18% on foods of animal origin. A large number of plant species are used for food items. In the Anamalai Hills, over a 3 year period, the study group used 93 plant species belonging to 39 families for 97 food items. The number of plant species used each month varied from 8 to 25. Most of species (56% in the Anamalai Hills) are exploited only for the ripe fruit flesh. Some of these are drupes (e.g. *Mangifera indica*, *Gnetum ulae* and *Semecarpus travancoricus*), but majority are small berries with thin pericarp and many seeds. Many species (16.5% in the Anamalai Hills) are used for their seeds. Few species (e.g. *Artocarpus hirsuita* and *A. integrifolia*) are used for both the seed and the mesocarp, and few others for nectar (e.g. *Bombax malabarica*). Gums or resins of selected species are also used (e.g. *Gnetum ulae* and *Vepris bilocularis*). The only species exploited for its flowers is *Xanthophyllum flavescens*. Other plant food items include mushrooms, lichens, and moses. Feeding on leaves is negligible and confined to infrequent and short bouts of feeding on some grass species. The predominance of fruit flesh and seeds in the diet is more evident when the relative contribution of each plant part to the annual diet is considered (This is estimated as time spent on each part out of the total time spent on plant food). Nearly 91% of the annual diet is composed of fruit flesh and seeds.

The lion-tailed macaque derives most of its protein requirements from foods of animal origin, primarily invertebrates, but also include snails, birds' eggs and nestlings, and giant squirrel nestlings. It, therefore, spends considerable time looking for invertebrates (mean =27.4% of day time) and feeding on them (mean =18%). A number of substrate provide these invertebrates. Green leaves are, by far, the major source (77.2%), especially of caterpillars, pupae, insect eggs, spiders, preying mantis, etc. Other substrate are bark (6.2%), clusters of dry leaves including discarded nests of giant squirrels (8.7%), and dead wood (2.4%). The forest floor is rarely used as a source of invertebrates as the group spends very little time there.

Thus, the diet of the lion-tailed macaque is dominated by plants (fruit flesh, seeds, nectar and resins) which are rich in simple sugars or polysaccharides, but poor in protein. The lion-tailed macaque depend more on animal protein compared to other macaques. The availability of fruits and seeds, and green foliage throughout the year, therefore, is critical to the survival of the lion-tailed macaque. Only the very high diversity of plant species in the rain forests can insure the availability of fruits and seeds, and invertebrates through out the year. The same high plant species diversity also buffers against variations between years in the availability of fruits and seeds, and invertebrates.

Status in Malabar

The Malabar area, north of the Palakkad gap, once had extensive rain forests, but most of these have been lost. Presently, the best and most contiguous habitat of the lion-tailed macaque occurs in Silent Valley-New Amarambalam area (about 400 sq.km.). In all the other areas the habitat occurs as small patches, the largest of them being the Siruvani forests. Other patches of rain forest in Malabar with lion-tailed macaque are Nadukani, Manjeri-Kovilakam forests, Periyar and Kotiyor forests. The total population is about 600-700. Of this, about 80% is in Silent Valley, which is the largest population in Kerala and the second largest across its range after the population in the Ashambu Hills. The next best population is in Siruvani with about 3 -4 groups. In all the other areas there are most likely only 1 -3 groups.

Conservation Problems

The major problems of conservation of the lion-tailed macaque in the Malabar area are:

1. Habitat fragmentation: Most of the rain forest in the Malabar area has been lost. The remaining habitat occurs mostly as small patches with 1 -4 group each, except in Silent Valley-New Amarambalam area which has a population of 400 - 500. It is now well known that such small isolated populations face a high probability of extinction because of random variations in demographic parameters and food availability, and from inbreeding and catastrophes such as cyclone and diseases. A Population and Habitat Viability Assessment (PHVA) revealed that isolated populations of less than 60 animals have about 60% chance of extinction in the next 100 years from random variations in demography and environment alone. The chance of extinction would increase considerably if we also consider the effect of inbreeding and catastrophes. All populations of lion-tailed macaque outside the Silent Valley area are thus very extinction-prone, just because they occur as small isolated populations. The Silent Valley population is safe from extinction in the next 200 years.

2. Hunting: Hunting of wildlife is prevalent in the Malabar area, although infrequently. This is particularly true of areas like Kotiyor. Further north of Kotiyor, people from Kerala are known to go into forests in Karnataka state for hunting. Although hunting is not specifically for lion-tailed macaque, it is also taken if obtained. The PHVA revealed that even very low incidence of hunting (e.g. 3 adult females once in 2 years) can drive to extinction small isolated populations of up to 60 animals, in the next 30 -60 years. The analysis revealed that only the Silent Valley population can withstand the intensity of hunting that is now prevalent in the Malabar area.

3. Habitat degradation: Almost all the small patches of rain forests in Malabar area have already been degraded as a result of logging, cardamom planting, and by fuel and timber wood collection to meet the requirements of the human settlers which often surround the patches. The overall impact of habitat degradation is to reduce plant species diversity and

food availability, and to prevent regeneration of forests. The long term survival of the lion-tailed macaque in the small patches is thus seriously threatened also by habitat degradation.

Conservation Measures

Only the Silent Valley population is safe from extinction resulting from habitat fragmentation, hunting and degradation. The only threat to which the Silent Valley population is susceptible would be catastrophe which would reduce the current population by more than 30%. A reservoir in the area would be such a catastrophe. In the other areas, all the small populations are threatened and require immediate conservation measures.

1. Measures to stop hunting: As mentioned earlier, even low intensity hunting can cause extinction of small populations. It is therefore necessary that measure to stop hunting such as creation of public awareness be undertaken.

2. Measures to stop habitat degradation: Collection of fuel wood, small timber, reed etc. from small patches of rain forests should be discouraged. Similarly any further logging in these forests, including felling in cardamom plantations, should be stopped.

3. Long-term monitoring and management: The small populations would have to be monitored and managed on a long term basis, to prevent local extinction from random demographic variations (e.g. there being no adult males to breed), and environmental veriations (e.g. reduced food availability as a result of drought). If necessary management measures like introduction of more monkeys into patch or translocation out of a patch would have to be attempted. The impact of inbreeding on the long term survival of these small population need to be studied as part of the monitoring effort.

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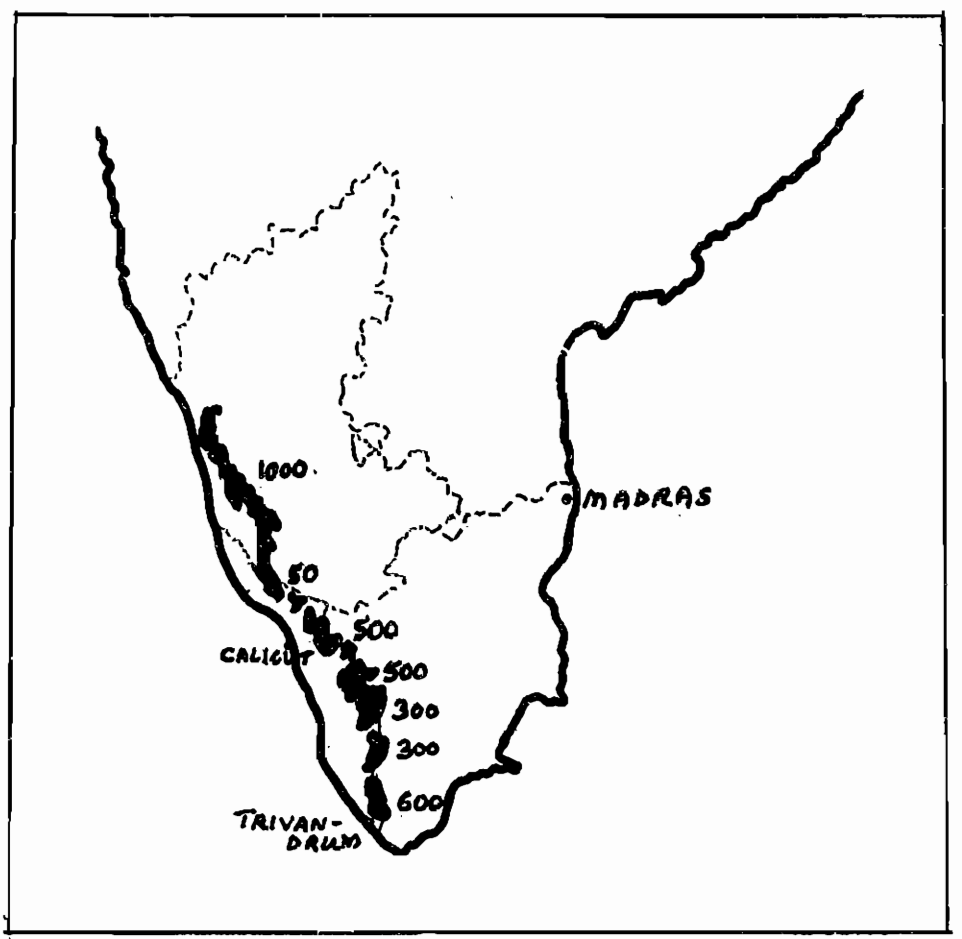
Figure 1. The distribution of the lion-tailed macaque along the Western Ghats. The numbers are the approximate population in each locality