Conservation Prospects for the Lion-Tailed Macaque (Macaca silenus) in the Forests of Sirsi-Honnavara, Western Ghats, India

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Conservation Prospects for the Lion-tailed Macaque (*Macaca silenus*) in the Forests of Sirsi-Honnavara, Western Ghats, India

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Abstract: The lion-tailed macaque (*Macaca silenus*) is one of the most threatened of the primates of the Western Ghats. Confirmation of its large metapopulation in a relatively unprotected area (a reserve forest) of Karnataka has marked an important step for the future of this population. The number of lion -tailed macaques estimated was 638 in 31 groups with an average group size of 20.6, excluding lone males. A review of the literature confirms that this is one of the larger known populations in the wild. This reserve forest faces a number of threats because of anthropogenic activities such as habitat fragmentation, encroachment and developmental projects. In an attempt to save and restore the northernmost habitat of the lion-tailed macaque, we proposed that the forests where they live be declared a wildlife sanctuary or conservation reserve, using them as an umbrella species for conservation. In response to this, the forest department of the Government of Karnataka notified the proposed area, with only minor modifications to the boundary, as the 'Aghanashini Lion-tailed Macaque Conservation Reserve'. We suggest some immediate management interventions to minimize further pressure on this highly threatened habitat.

Key words: Primates, protected area, umbrella species, conservation reserve, management intervention, Karnataka, lion-tailed macaque

Introduction

The hill ranges of the Western Ghats cover less than 6% of India's landmass but harbor more than 30% of the world's plant and vertebrate species (Das *et al.* 2006), and are thus considered a global biodiversity hotspot (Myers *et al.* 2000). About 12% of the mammal species present in the Western Ghats is endemic (Das *et al.* 2006). The IUCN Red List ranks the lion-tailed macaque (*Macaca silenus*) as Endangered (IUCN 2013); endemic to the narrow ranges of the southern and central Western Ghats. Molur *et al*. (2003) projected a total lion-tailed macaque population of about 3,500 individuals in 49 sub-populations in eight locations in the Western Ghats. They are locally threatened in most of the protected areas and reserve forests of the state of Karnataka (Kumara and Sinha 2009). Karanth (1985) reported about 3,000 individuals in 123 groups in 19 locations in Karnataka from the northernmost Kumta range to southern Brahmagiri Wildlife Sanctuary. Since then, however, there have been declines in numbers of about 69% to 90% in 14 of these forest reserves due to habitat loss and fragmentation and hunting, and hunting has eliminated them entirely from five reserves (Kumara and Sinha 2009).

In a study based largely on secondary information, Karanth (1985) reported few lion-tailed macaque groups in the forests of Sirsi-Honnavara. A short survey by Kumara and Singh (2004a), however, indicated a population of more than 250 individuals in the same forests; among the few large populations of this species in the entire Western Ghats (Kumara and Singh 2004a). The Sirsi-Honnavara lion-tailed macaques are, however, facing severe threats from encroachment of the forests and valleys for agriculture, developmental activities such as construction of roads, transmission lines, dams, hydroelectric power plants, and hunting (Kumara and Singh 2004a; Kumara *et al.* 2008). The problem is that reserve forests are not part of the protected area network. The forests are contiguous, and a conservation strategy is urgently need for the lion-tailed macaques there (Kumara *et al.* 2008; Kumara and Sinha 2009). This region also harbors many endemic and endangered species, including plants such as *Semecarpus kathalekanensis* (Anacardiaceae), *Madhuca bourdillonii* (Sapotaceae), and *Syzygium travancoricum* (Myrtaceae) (Chandran *et al*. 2008),

about 26 amphibians endemic to the Western Ghats (Kumara *et al.* 2008), 17 globally threatened large mammals (Kumara and Singh 2004b), and also unique '*Myristica* swamps' (Chandran *et al*. 2008). The study by Kumara and Singh (2004b) that reported on the large population of lion-tailed macaques there stressed the need for their conservation, but did not provide conservation measures, maps, boundaries or a protocol for population monitoring. In this study, we reassessed the current status of lion-tailed macaques using a sweep sampling method, mapped the population based on their locations, and developed the boundaries (based on village boundaries) for the management of the area. We discuss strategies for the conservation of the area, indicating the lion-tailed macaque as an umbrella species for the region.

Methods

Study area

The study site is in the central Western Ghats, in the district of Uttara Kannada, state of Karnataka, south India (Fig. 1), 14°23'N to 14°23'38"N and 74°48'E to 74'38"E. The legal status of the forest is "Reserve Forest," with mosaics of revenue lands interspersed around them (Kumara and Singh 2004a). The study site falls under the administrative jurisdiction of Kanara Forest Circle, represented by the Kyadagi and Siddapur forest ranges in the Sirsi Territorial Forest Division, and the Kumta, Honnavara and Gersoppa forest ranges in the Honnavara territorial forest division. The altitude ranges from 300 m to 800 m above sea level. The wet season is from May to October. It rains most in July; an average of 3,000 mm. Even though the region does not receive the north-east monsoons, the total annual rainfall is about 6,000 mm. The study site forms the northern limit of the evergreen forests of plains and low elevations (Pascal 1988). Forest in the study site has been classified as "west coast tropical evergreen forest" with low-level type floristics (Champion and Seth 2005). The vegetation type is *Persea macarantha – Diospyros* spp. – *Holigarna* spp., which has been replaced by the dominance of *Dipterocarpus indicus – Diospyros condolleana – Diospyros oocarpa* because of human interference (Pascal 1988). The major ethnic community in the area includes *Naika*, *Vokkaliga*, *Gowda*, *Harijana* and *Brahmin.*

Data collection and analysis

The survey was conducted from January to April 2008 for 63 days, using the sweep sampling method for total counts (NRC 1981) appropriate for rare and patchily distributed

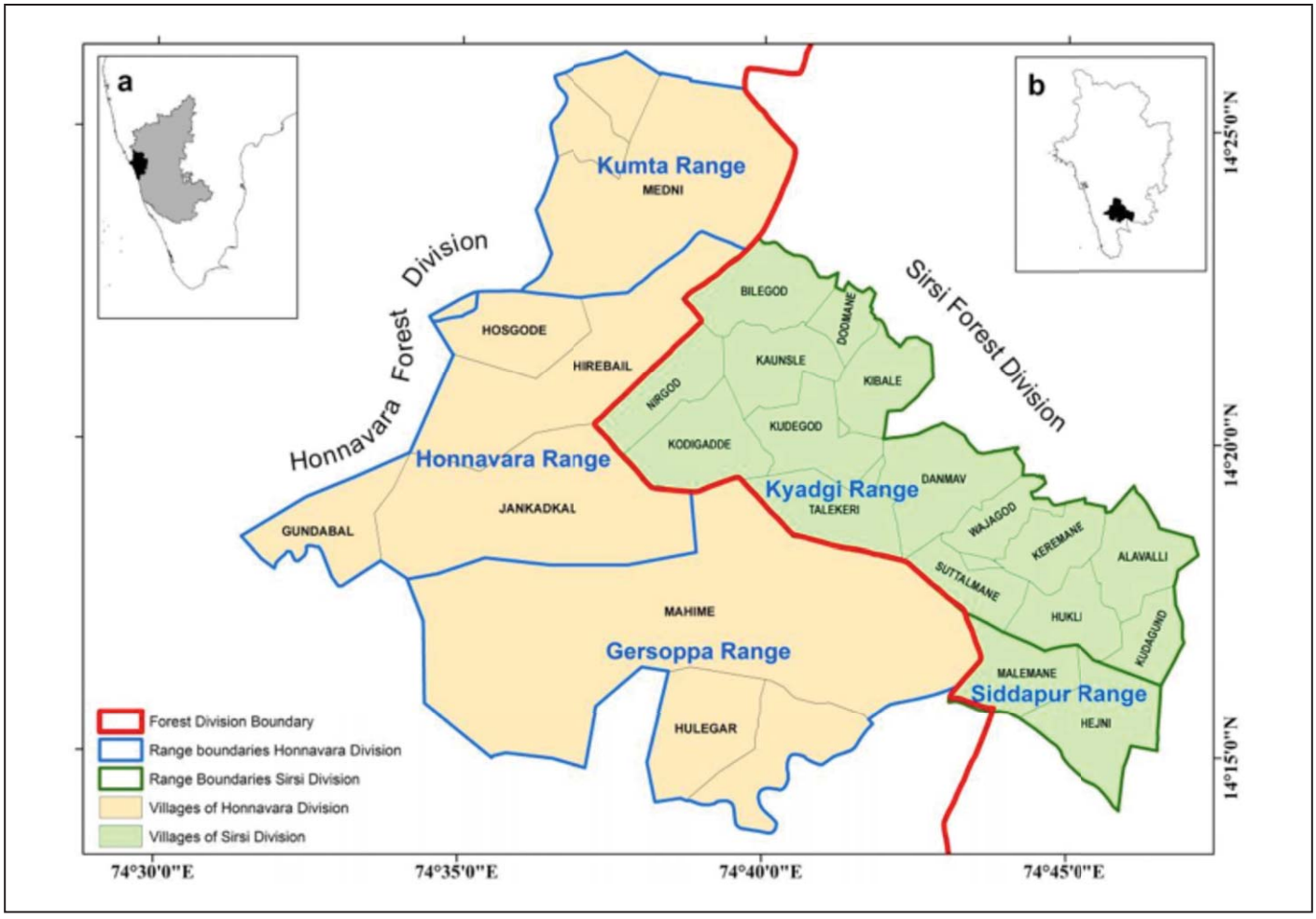

Figure 1. Different forest ranges of Sirsi-Honnavara divisions with village boundaries.

species (Whitesides *et al*. 1998; White and Edwards 2000). This method increases the probability of seeing the species, but counting the same group twice can be an issue if the group spread is large and they are moving. We avoided double counting by noting the sighting distance, location, time of the sighting and the direction of movement. Suitable habitat for the lion-tailed macaque was considered based on earlier surveys and group locations (Kumara and Singh 2004a). We plotted those group locations on a map, with a 2-km radius presumed to be equal to the maximum home range size of a lion-tailed macaque group (Green and Minkowski 1977). We considered those plots as the sampling area for sweep sampling. We set up predetermined lines for sampling in each such sampling area. A team of three trained observers walked each line for 3–4 consecutive days. The observers walked parallel to each other, maintaining an inter-individual distance of 100 m, to maximize the chances of finding lion-tailed macaque groups. We assumed that neither visibility nor detectability factors would bias the data since they remained constant throughout the study site, and all the observers were familiar with the species and its habits.

We conducted the surveys from 05:30 h to 12:00 h and 15:00 h to 18:00 h. Lion-tailed macaques are active and vocalize throughout the day (Kumar 1987). Geo-coordinates were recorded using handheld Garmin GPS60 and GPS72 for each group sighting, as were group sizes, generally from counts at common cross-over points, by spending sufficient time with the group (maximum 30 minutes). Previous studies have documented the home range of a group to be about 5 km² (Green and Minkowski 1977; Kumar 1987; Umapathy 1998). Hence, we considered each group sighting within a range of a 1.5-km radius from another sighting to be the same group, unless 1) the two groups were seen one very soon after the other, or 2) the group size and identity of each were confirmed as different. The surveys were carried out in a relatively short period, in the pre-monsoon season, to eliminate any bias caused by changes in ranging across the seasons. The intergroup distance was extracted on a GIS platform using ArcView3.2. We walked 1,056 km to sample Sirsi-Honnavara; including 546 km, 56 km, 87 km, and 354 km in the Kyadagi, Siddapura, Honnavara and Gersoppa ranges, respectively. We estimated the number of groups and the population size in the area on the basis of the location of sightings and group sizes. Complete group counts were used for calculating the average group size to estimate the minimum number of individuals. We also collected data on the human population and demography from all the villages, as well as other details on developmental activities in the area from the Karnataka Forest Department records (Kumara *et al*. 2008).

Results

Population estimate

We obtained a total of 49 sightings of lion-tailed macaque groups and, on three occasions, single lone males. The estimated number of groups for the region was 31 (Tables 1 and 2); 15, 2, 1, 2 and 11 groups in Kyadagi, Siddapura, Kumta, Honnavara and Gersoppa ranges, respectively (Fig. 2). Complete group counts were obtained for 24 groups, providing a mean group size of 20.5 individuals/group (Table 2). The group size varied from 12 to 35. About 63% of the groups had sizes of between 16 and 25 (Fig. 3). The estimated minimum population size in the study site was 638 monkeys in 31 groups, excluding the three lone males.

Boundary demarcation

Although the forests of Sirsi-Honnavara include semi-evergreen forests, moist-deciduous forests and various plantations, 27 lion-tailed macaque groups were located in the evergreen forests and only four were found in the semi-evergreen and semi-deciduous forests (Fig. 4). All the groups were restricted to the highly undulating terrain of the Ghats with slopes of more than 35% (Fig. 5). Officially, the entire habitat range of the lion-tailed macaques in Sirsi-Honnavara is a reserve forest. The boundary for the proposed protected area delimits 32,479 ha. However, the suitable habitat for lion-tailed macaques based on forest cover within the proposed area is rather less (27,519 ha). It encompasses 28 villages with a human population of about 15,041 (46.3 people/km²).

Discussion

The previous survey by Kumara and Singh (2004a) was based on single-observer sweep sampling, but the limitation of this method would be the possibility of an inflated abundance estimate due to counting the same groups twice (Struhsaker 2002). A conventional line-transect technique was difficult due to the hilly terrain. The multi-observer, sweep-sampling method was the best technique to estimate the abundance there. The limitations of this method include the fact that it may require many trained observers, and it does not overcome the problem of changes in group size when social groups are the unit of measure (Struhsaker 2002). To overcome these limitations, we had three observers trained before each survey to minimize error in recognizing and locating the macaques. Changes in group composition and size were few in the short period we surveyed.

Our survey demonstrated the persistence of a large population of lion-tailed macaques in the Sirsi-Honnavara forests (Table 3). Lion-tailed macaques have been extirpated further north in the Anshi, Kumbarawada, Varahalli, Janmane, and

Table 1. Sampling effort, lion-tailed macaque (Macaca silenus) groups sighted and groups estimated in different forest ranges of Sirsi-Honnavara.

Range	No. of km walked	No. of groups seen	No. of estimated groups
Kyadagi	546	27	15
Siddapura	56	2	2
Kumta	20	1	1
Honnavara	67	3	2
Gersoppa	367	16	11
Total	1056	49	31

Table 2. Details of lion-tailed macaque (*Macaca silenus*) groups found, with names, group size, geo-coordinates and altitude.

No.	Group name	Group size	Geocoordinates	Altitude (m asl)
1	Sannamane gudde	6*	14º18□48.1"N, 74º39□24.5□E	437
2	Maavinmarada savalu	9*	14º20□14.8□N,74º37□35.5□E	335
3	Hirebylu	12	14º24□18.5□N, 74º37□8.3□E	342
4	Chiksuli	17	14º21□4.2□N, 74º40□30.5□E	569
5	Krishnaghatta	24	14º21□10.9□N, 74º40□0.8□E	551
6	Hullingadde thota	7*	14º18□55.22□N,74º34□28.0□E	433
7	Hosthota	17	14º20□18.4□N,74º40□13.4□E	430
8	Sarvanthota	20	14º19□09.2□N,74º39□53.6□E	436
9	Salikanu	30	14º20□26.8□N,74º38□31.8□E	532
10	Dasur	26	14º19□19.9□N,74º40□26.4□E	460
11	Kudegod	22	14º19□38.0□N, 74º41□5.2□E	515
12	Hapregoli	15	14º18□ 25□N, 74º42□56.4□E	750
13	Kalegadde	20	14º18□19.8□N, 74º42□3 0□E	690
14	Galmav	15	14º17□54.5□N, 74º42□8.5□E	530
15	Suthlumane	19	14º17□36.4□N, 74º44□0.9□E	625
16	Doddgudde kaanu	19	14º17□31.9□N,74º43□37.2□E	698
17	Kotegudda	17	14º17□16.9□N,74º43□32.0□E	703
18	Hukkali	22	14º17□17.6□N, 74º45□0.7□E	744
19	Tormay	21	14º18□44.5□N,74º41□35.1□E	650
20	Hegdegadde halla	1	14º19□48.1□N,74º38□57.0□E	460
21	Malemane	35	14º17□16.7□N,74º43□20.4□E	644
22	Kathlekaanu	14	14º16□25.4□N,74º44□16.9□E	502
23	Kodgi-kerigadde	25	14º18□23.4□N,74º37□55.5□E	438
24	Kendikuli	9*	14º17□57.5□N,74º40□26.9□E	544
25	Mahime	0*	14º17□16.7□N,74º43□20.4□E	646
26	Sasiguli-1	13	14º17□15.1□N, 74º41□3.2□E	542
27	Sasiguli-2	33	14º17□25.2□N,74º41□12.7□E	508
28	Dundmaav-1	14	14º 17□11.1□N, 74º42□3.6□E	466
29	Dundmaav-2	23	14º17□45□N, 74º42□17.5□E	563
30	Matnigadde	21	14º16□53.9□N, 74º42□38.9□	540
31	Vatehalla	17*	14º16□15.72□N,74º42□56.8□E	542
32	Vatehalla	1	14º16□15.7□N,74º42□56.8□E	542
33	Vatehalla	1	14º16□15.72□N,74º42□56.8□E	542
34	Water falls	6*	14º16□36.4□N, 74º42□17□E	502

*Indicates groups for which complete group sizes could not be obtained

Honnavara ranges (Kurup 1978; Bhat 1982; Karanth 1985). The forests of Sirsi-Honnavara contain the northernmost population in its present range. The mean group size was slightly higher than in some populations but quite similar to those of others; for example, 16.3 in Indira Gandhi Wildlife Sanctuary (Singh *et al*. 1997), 19.6 in Silent Valley National Park (Joseph and Ramachandran 1998), and 33.2 in Theni (Kumara *et al*. 2011a). Sightings of several lone males in the present survey also indicate dispersal, ensuring gene flow. The mean group size of 20.5 is, however, lower than that found in the earlier survey of 2002–2003 (24.7 individuals/group) (Kumara and Singh 2004a). The difference in the group size between the study periods can be attributed to observer bias or to increased hunting, or mortality due to such as electrocution or snares set for other animals (Kumara and Singh 2004b). There is little direct hunting; >90% of the inhabitants are Hindus who believe in the monkey god Hanuman, and killing monkeys is taboo (Kumara and Singh 2004b). During our survey, however, we were told by many villagers that people from Kerala who have settled in neighboring *taluks* of the Shimoga district and people from coastal areas venture into the region using local hunters, to hunt primates, sambar and gaur. We deduce that this is increasingly damaging to the entire wildlife of the area, causing local extinctions of many of the large mammals. Such local extinctions and sharp declines in the lion-tailed macaque population have been reported in different parts of Karnataka (Kumara and Sinha 2009). Hunting should now be considered as one of the major threats prevalent in the area.

Table 3. Number of estimated groups of lion-tailed macaques in the forests of Sirsi-Honnavara between different studies.

Range	Karanth (1985)	Kumara and Singh (2004a)	Kumara et al. (2008)
Gersoppa	4	10	11
Siddapura	2	2	2
Kyadagi	1	17	15
Honnavara	0	3	2
Kumta	1	0	1
Total	8	32	31

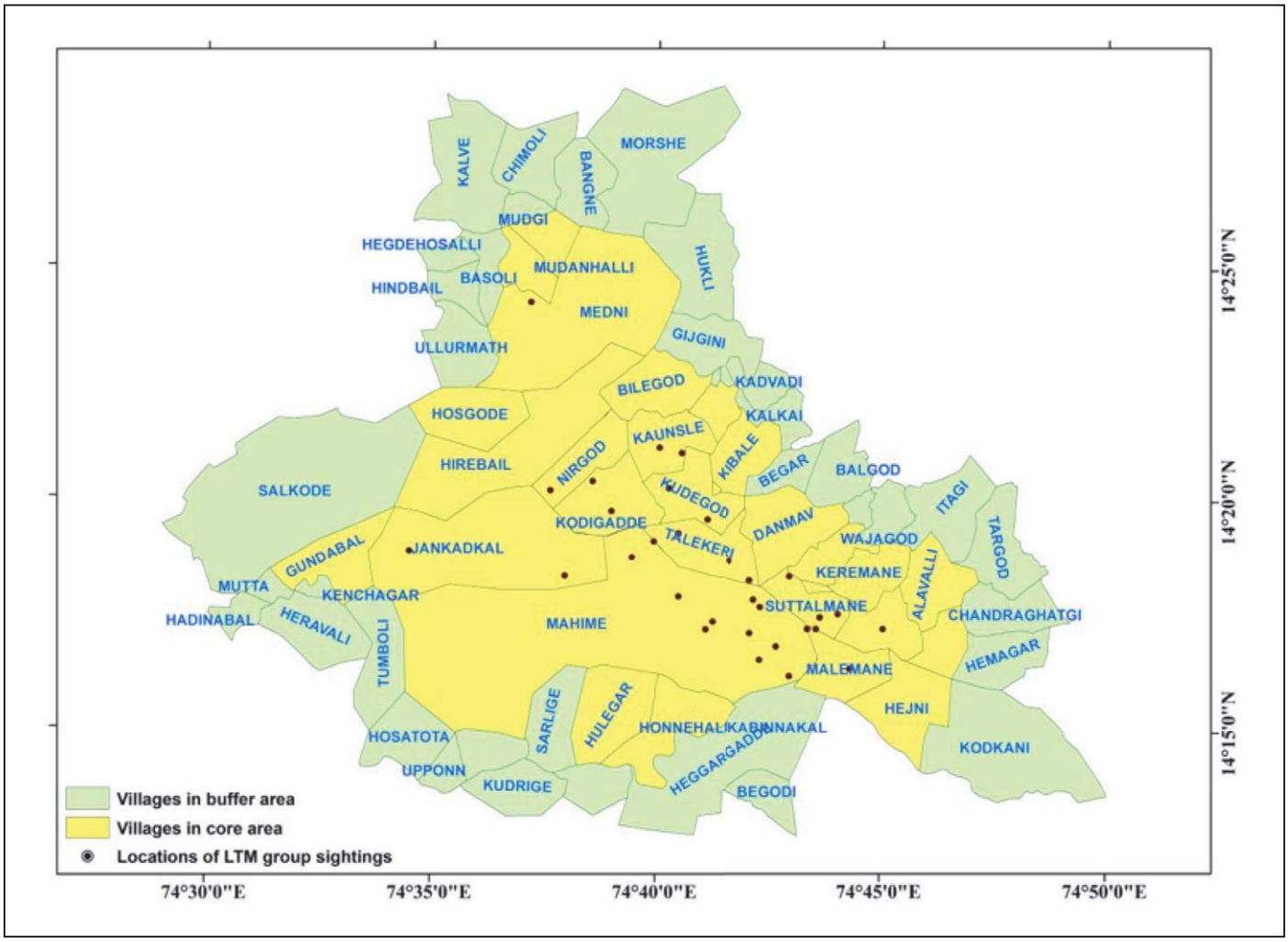

Figure 2. Proposed core and buffer areas on village boundaries based on the locations of lion-tailed macaque (*Macaca silenus*) groups in the forests of Sirsi-Honnavara.

The highly undulating terrain where there are evergreen forests is the most important habitat in the landscape for the lion-tailed macaques. The high human density has led local people to expand their agriculture and increase the area of settlements and villages. Forests are shrinking, especially evergreen forest, at a rapid rate—1.9% yearly leading to the loss of 11.5% just in the last decade (Kumara *et al*. 2011b).

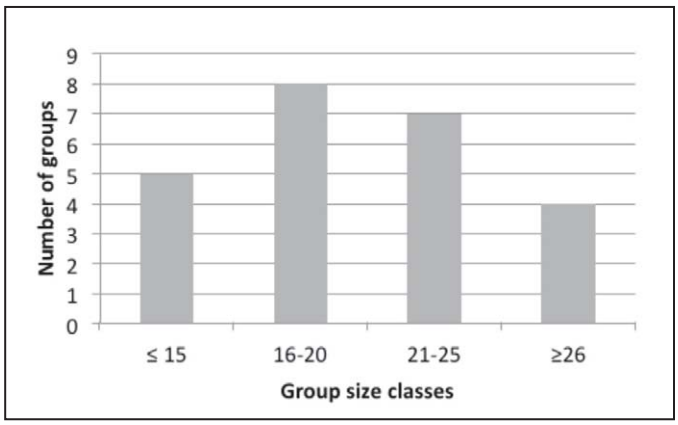

Figure 3. Number of lion-tailed macaque (*Macaca silenus*) groups in different group size classes in Sirsi-Honnavara forest divisions.

As a first step towards protection, we fixed the boundaries that should be notified as a protected area, considering the forests containing lion-tailed macaques with the village boundaries as core areas, and the adjoining village boundaries as buffer areas (Fig. 2) as was proposed by Kumara *et al*. (2008). In response to this, the forest department of the Government of Karnataka has notified the proposed area, with little modification, as the "Aghanashini Lion-tailed Macaque Conservation Reserve."

Until the conservation management plan is prepared, we suggest a few immediate interventions, such as avoiding cutting monoculture plantations within the habitat, since they act as a link between most forest stretches and also avoid development activities (building roads or laying electricity lines) and prevent further fragmentation of the habitat. Extension of the existing farmlands and further honey-combing of valleys for agriculture, uncontrolled timber extraction, and leaf-litter and green-manure collection (Kumara *et al*. 2008, 2011b) are some of the activities that are detrimental to the forests.

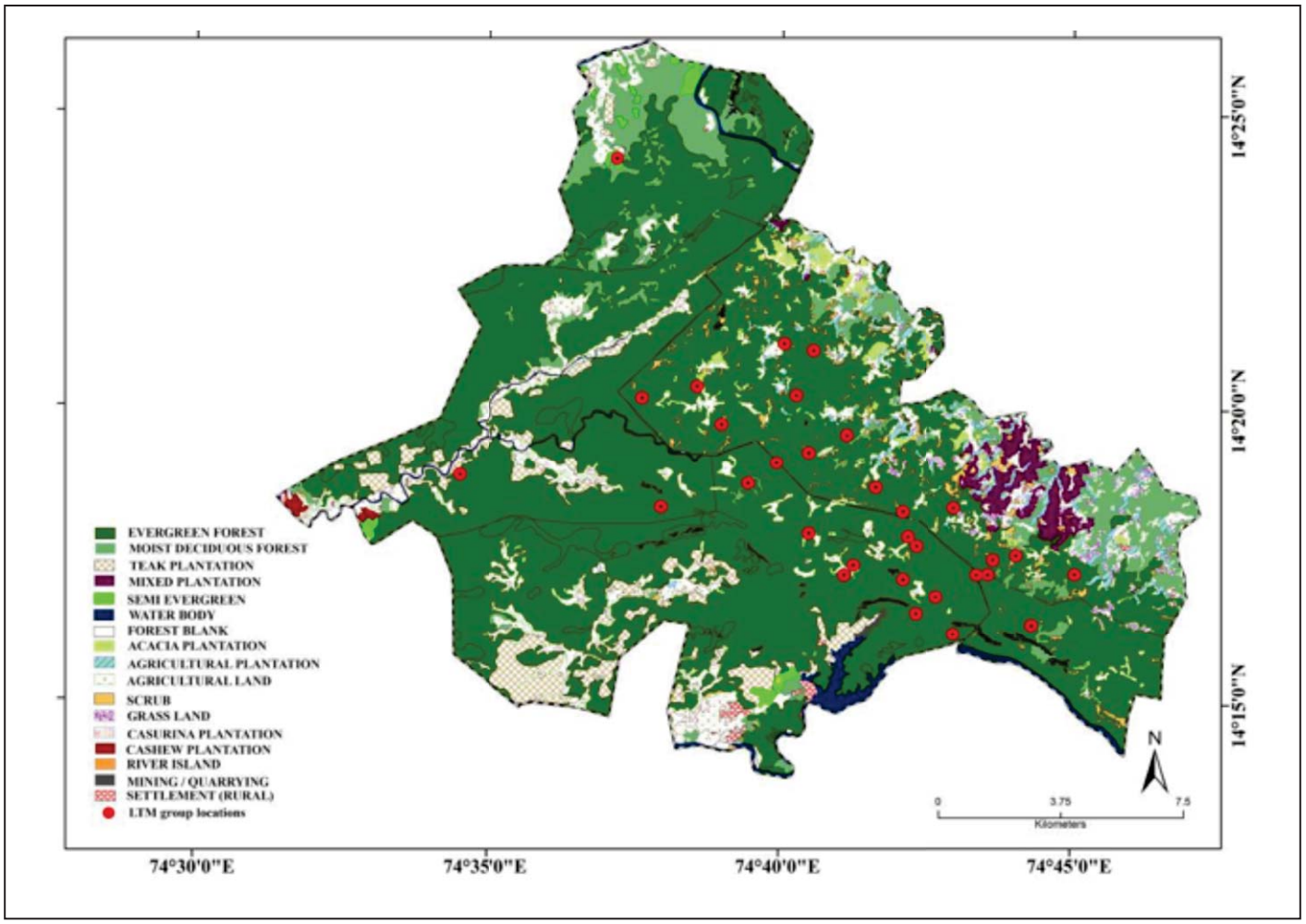

Figure 4. Forest types prevailing in the habitat of the lion-tailed macaque (*Macaca silenus*) in Sirsi-Honnavara forest divisions.

Management interventions against such threats should be taken seriously as an attempt to conserve the northernmost population of LTMs in its contiguous habitat.

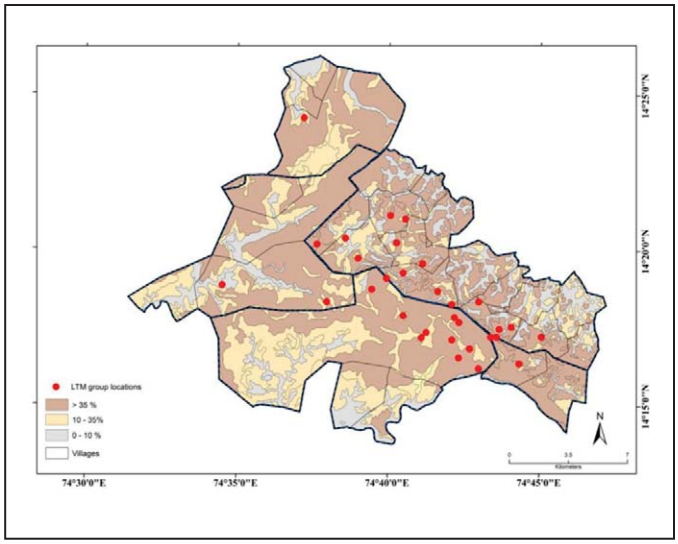

Figure 5. Slope gradients prevailing in Sirsi-Honnavara forest divisions with the locations of lion-tailed macaque (*Macaca silenus*) groups.

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