

# Of how much concern are the ‘least concern’ species? Distribution and conservation status of bonnet macaques, rhesus macaques and Hanuman langurs in Karnataka, India

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**Abstract** We assessed the distribution and conservation status of bonnet macaques (*Macaca radiata*), rhesus macaques (*Macaca mulatta*) and Hanuman langurs (*Semnopithecus entellus*) in the state of Karnataka, India. Karnataka is situated in southwest India with an area of 191,791 km<sup>2</sup>. A total of 9697 km of vehicular survey was made from November 2001 to July 2004. We also visited 107 temples/tourist spots to determine the presence of primates. Bonnet macaques and Hanuman langurs were widely distributed, whereas rhesus macaques were not found in the state. However, bonnet macaques were absent in a few districts in the northern plains and Hanuman langurs were absent in some districts of the southern plains. A total of 205 groups of bonnet macaques and 139 groups of Hanuman langurs were sighted. The relative encounter rate of both species differed across biogeographic zones. Bonnet macaques were largely encountered in the Western Ghats and the Southern Plateau whereas Hanuman langurs were abundant in the Western Ghats and Northern Plains. We found that bonnet macaques have been eliminated from about 48% temples/tourist spots where they occurred in the recent past. The Hanuman langur population of Dharwar–Haliyal Road was assessed during April 2003, and we found that the present population size was

about 38% of a previous survey in 1961. Habitat change, hunting/trapping and translocation were the major factors causing a decline in the langur population.

**Keywords** Common species · Bonnet macaque · Hanuman langur · Distribution · Conservation status

## Introduction

India is a home to a large number of primates, including at least 17 species and about 30 subspecies. These 17 species are accorded different conservation status (Molur et al. 2003). Among them, rhesus macaque (*Macaca mulatta*), bonnet macaque (*Macaca radiata*) and Hanuman langur (*Semnopithecus entellus*) (with several species/subspecies including *S. e. achates*, *S. e. hypoleucos*/*S. hypoleucos*, *S. e. priam*/*S. priam priam*) are considered ‘least concern’ species in India (IUCN 2003), since they occupy geographically vast areas (Fooden 1980; Prater 1993) and exploit diverse habitats from thick forests to human-dominated landscapes. Such species are usually considered as “not at serious risk” (Wolfheim 1983; Choudhury 1988).

The status and demography of common species have been surveyed in India, and there is evidence of negative impacts on their populations that might be of concern for wildlife management, for example, human interference in population of Hanuman langur and rhesus macaque in Shimla (Ross et al. 1993), decrease in Hanuman langur population in West Bengal due to conversion of forestlands into agricultural fields (Das-Choudhuri and Roy 1989), changes in group size and decline in population size in bonnet macaques around Mysore (Singh and Rao 2004) and a sharp decline in primate populations in certain regions of the Western Ghats due to hunting (Kumara and

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Singh 2004). Sugiyama (1964) assessed the status of Hanuman langurs in Dharwar in 1961, and later found a decline in the number of groups present in the same study sites (Sugiyama and Parthasarathy 1978). Taken together, these surveys suggest that the status of species thought to be common is, in reality, not entirely secure.

To provide a comprehensive picture of the conservation status of a widely distributed species, periodic monitoring is necessary to identify emerging threats in different pockets of their distributional range (Eudy 2008). For example, bonnet macaques primarily inhabit human-dominated landscapes and their density in designated wildlife reserves such as National Parks is extremely low. For example, in a prime wildlife habitat, the Rajiv Gandhi National Park in the state of Karnataka which arguably harbors the highest mammalian biomass in India (Karanth and Sunquist 1992), the encounter rate of bonnet macaques was just 0.03 groups/km (Swapna 2004) as against 1.01 groups of Hanuman langurs per km (Thangal 2004).

Since bonnet macaques are mostly found outside of wildlife reserves, not much attention is paid to study this species. However, since they mostly interface with humans, there is all the more necessity for species population dynamics and conservation prospects to be regularly monitored. The main objective of the present study was to assess the population status of bonnet macaques, rhesus macaques and Hanuman langurs in areas outside notified wildlife reserves.

## Methods

The present study was carried out in the state of Karnataka located between 11°31'–18°45'N and 74°12'–78°40'E with a total area of 191,791 km<sup>2</sup> (Fig. 1). On the basis of physical features of the land and patterns of the rainfall, Karnataka has been divided into four bio-geographical zones that include Coastal Karnataka with primarily mangrove forests, Hill Region (the Western Ghats) with rainforests and moist deciduous forests, Southern Plateau with deciduous forests and Northern Plains with deciduous forests, scrub forests and open grasslands (Prasad et al. 1978).

We carried out the present study between November 2001 and July 2004. During this period, we traveled across all 26 districts<sup>1</sup> of the state. We conducted a vehicular (jeep/motorcycle) road survey of 9697 km covering all districts. The vehicle was driven at a speed of <20 km/h. Once the primates were spotted, the vehicle was stopped and data on details on location and habitat type were collected. We were not able to repeat the surveys because the

survey was done in a large spatial area, and the results are presented per 100 km. We surveyed temples/tourist spots to assess their current status, since commensal bonnet macaques largely prefer temples/tourist spots where they receive handouts from people (Singh and Rao 2004). We gathered information on the presence/absence and number of groups in a temple in the recent past through informal interactions with temple authorities and people living around temples.

We assessed the Hanuman langur population status on Dharwar–Haliyal road in April 2003 for 14 days, covering the road 18 times. We employed the census method used in 1961 (Sugiyama 1964) and 1976 (Sugiyama and Parthasarathy 1978). We searched for Hanuman langurs for 50 m on either side of the Dharwar–Haliyal road between the points 3 km and 29 km from Dharwar city. The data were collected by repeatedly driving a motorcycle at a speed of ~15 km/h between 0800 to 1100 h and 1600 to 1830 h. During the survey, we also walked twice on the same road to increase the sighting rate efficiency and for reliability of drive-counts. On repeated counts, location, group size and age-sex structure of each group were used for individual identification of groups. The data collected during this survey were compared with the earlier census (Sugiyama 1964; Sugiyama and Parthasarathy 1978).

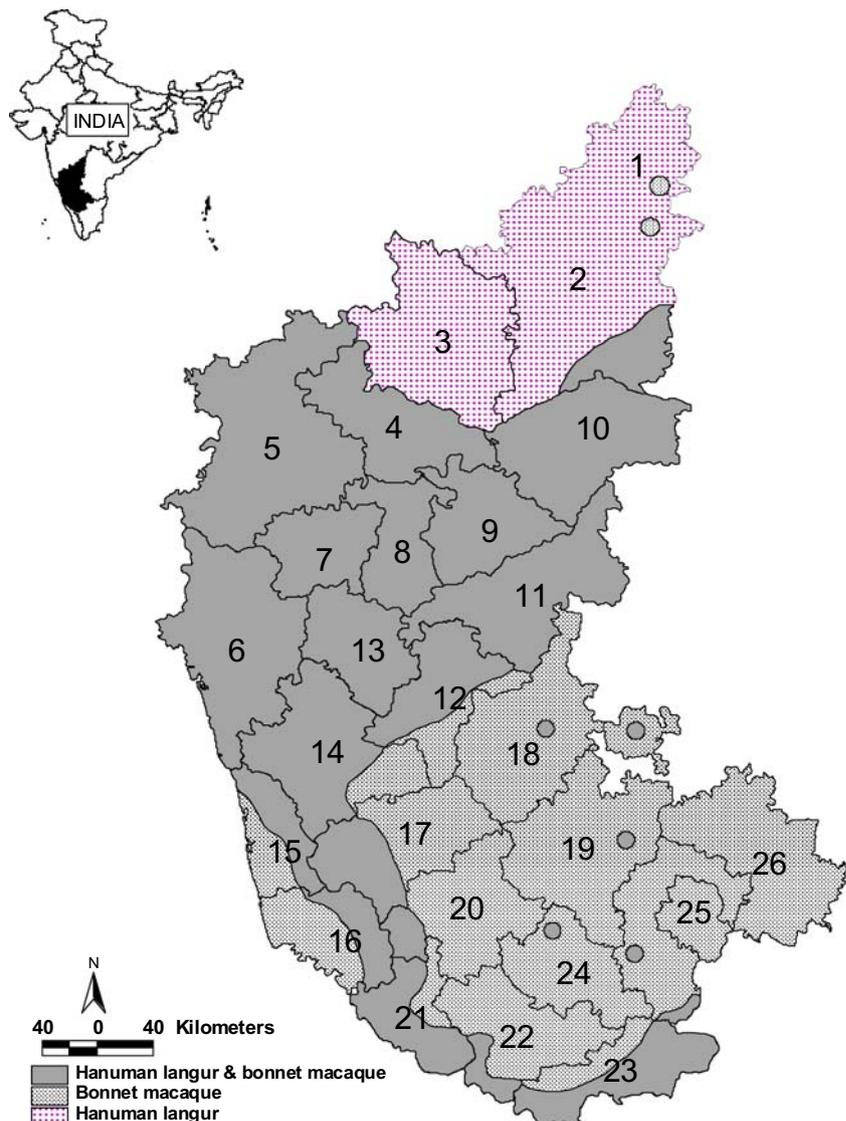
## Results

Previous intensive surveys have not found rhesus macaque in Karnataka (Fooden et al. 1981; Koyama and Shekar 1981). Likewise, during the present survey, rhesus macaque was not sighted and no information could be collected on their presence. Barring a few districts, bonnet macaque was found throughout the state (Fig. 1). The mean encounter rate was 2.10 groups/100 km, and the encounter rate differed significantly across the biogeographic zones ( $G = 107.32$ ,  $df = 3$ ,  $p < 0.001$ ). The encounter rate of bonnet macaque was higher in the Western Ghats and Southern Plateau than the Coastal and Northern Plains zones (Table 1).

A total of 107 temples/tourist spots were surveyed (Table 2). Bonnet macaque was found at 37 locations (34%) and elimination was reported in 51 locations (47%). Hanuman langurs in Karnataka largely do not inhabit temples/tourist spots, hence we excluded them from this analysis. The occurrence and elimination of bonnet macaques in temple/tourist spots varied significantly among three regions viz. Coastal Region, Western Ghats and Southern Plateau ( $G = 19.85$ ;  $df = 2$ ;  $p < 0.01$ ) and ( $G = 8.55$ ;  $df = 2$ ;  $p < 0.01$ ). The Coastal Region recorded over 90.32% elimination compared with the two other regions, i.e. Western Ghats (53%) and Southern Plateau

<sup>1</sup> A district is a revenue jurisdictional unit of 8,000–10,000 km<sup>2</sup>.

**Fig. 1** Map of the state of Karnataka with distribution of bonnet macaques and Hanuman langurs. Numbers indicate districts (1 Bidar, 2 Gulbarga, 3 Bijapur, 4 Bagalkot, 7 Dharwad, 8 Gadag, 9 Koppal, 10 Raichur, 11 Bellary, 12 Davangere, 13 Haveri, 18 Chitradurga—northern plains, 5 Belgaum, 6 Uttara Kannada, 14 Shimoga, 17 Chikmagalur, 20 Hassan, 21 Kodagu—Western Ghats, 15 Udupi, 16 Dakshina Kannada—coastal, 19 Tumkur, 22 Mysore, 23 Chamarajnagar, 24 Mandya, 25 Bangalore, 26 Kolar—Southern Plateau). In the southeastern region, populations of Hanuman langurs appearing as circles indicate stray populations



**Table 1** Bonnet macaque and Hanuman langur encountered during the road survey in different bio-geographic regions of Karnataka

| Region           | Kilometres traveled | Bonnet macaque |               | Hanuman langur |               |
|------------------|---------------------|----------------|---------------|----------------|---------------|
|                  |                     | No. of groups  | Groups/100 km | No. of groups  | Groups/100 km |
| Coastal          | 390                 | 3              | 0.77          | 2              | 0.51          |
| Western Ghats    | 1895                | 60             | 3.17          | 59             | 3.11          |
| Southern Plateau | 2644                | 107            | 4.05          | 9              | 0.34          |
| Northern Plains  | 4768                | 35             | 0.73          | 69             | 1.45          |
| Total            | 9697                | 205            | 2.11          | 139            | 1.43          |

(36%) (Table 2). In certain districts such as Chitradurga, bonnet macaque has been totally eliminated from temples and tourist spots. In contrast, in Kolar they were found in most of the temples and no reports of elimination were available.

Langurs were primarily restricted to forests in the Coastal Region, the Western Ghats and the Southern Plateau, whereas in the Northern Plains langurs were found in forest as well as in urban habitats. Shikaripur of Shimoga District divided the major distribution pattern of langurs.

**Table 2** Occurrence of bonnet macaques in temples or tourist spots in different regions of Karnataka

| Region           | No. of temples/<br>tourist spots | No. of temples/tourist spots<br>with bonnet macaque (%) | No. of temples/tourist spots where<br>bonnet macaques have been eliminated (%) |
|------------------|----------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------|
| Coastal          | 31                               | 1 (3.20) <sup>a</sup>                                   | 28 (90.32) <sup>a</sup>                                                        |
| Western Ghats    | 15                               | 4 (26.67)                                               | 8 (53.33)                                                                      |
| Southern Plateau | 41                               | 25 (60.98)                                              | 15 (36.59)                                                                     |
| Northern Plains  | 20                               | 7 (35.00)                                               | Elimination reports were not available                                         |
| Total            | 107                              | 37 (34.58)                                              | 51 (47.66)                                                                     |

<sup>a</sup> Percentage of the total number of temples and tourist spots in each region

South of this area, langurs were found mostly in forests, whereas north of this, the langurs were found on roadsides and in villages and towns. A total of 139 sighted groups yielded a rate of occurrence of 1.43 groups/100 km; however, the encounter rate differed significantly across the biogeographic zones ( $G = 62.585$ ,  $df = 3$ ,  $p < 0.001$ ) (Table 1). The Western Ghats had the highest encounter rate (3.11 groups/100 km) followed by Northern Plains (1.45 groups/100 km); the encounter rate was very low in the other two regions.

A total of 17 groups of Hanuman langurs were sighted on Dharwar–Haliyal Road, which included 12 troops and 5 all-male groups (Sugiyama 1971), with a total of 242 langurs (Table 3). The average troop size was 16.33 and the average size of the all-male groups was 9.8. The troops had a total of 17 adult males and 84 adult females, the ratio being 4.94 adult females per adult male. The average troop composition was 1.4 adult males, 7.0 adult females and 7.9 immatures, whereas the average party composition was 4.6 adult males, 1.8 sub-adult males and 2.8 juveniles. On Dharwar–Haliyal Road, the first 14 km from Dharwar was open land/crop fields, and the next 12 km was deciduous forests towards Haliyal. Further, from Darwar the first 9 km of open land did not have many trees, and we sighted no groups of Hanuman langurs in that area. However, seven groups of Hanuman langurs were recorded in the remaining 5 km of open land. After a gap of 3 km, ten groups of Hanuman langurs were recorded in the next 12 km of forest road towards Haliyal, making the two subpopulations discontinuous. Five Hanuman langur groups were sighted in the first 3 km of forest, and these groups formed a continuous population with those in the open land. However, only two groups of Hanuman langurs were recorded in the middle forest stretch (about 7 km) while the last 3 km of forest had four groups. In 1961, a total of 43 groups with 626 langurs (24.1 langurs/km) were recorded in the above region (Sugiyama 1964). In 2003, we found only 17 groups with 242 langurs (9.3 langurs/km) (Table 3). The population from 1961 to 1976 declined at an intrinsic rate ( $r$ ) of  $-0.043$ , and continued to decline from 1976 to 2003 with  $r = -0.011$ . The Hanuman langur

population has been declining from 1961 to 2003 with  $r = -0.023$ , and has decreased by 38.66% in 45 years. However, we found no difference in mean troop size, male-to-female ratio and troop composition compared with previous reports.

## Discussion

Bonnet macaques and Hanuman langurs are widely distributed in the state of Karnataka, probably due to the adaptation to live in a wide array of habitats from plains to 2100 m asl in the Western Ghats (Simonds 1965; Kurup 1981). Bonnet macaque has been reported to have an inherent tendency to move towards human habitation and to live a terrestrial life (Simonds 1965; Sugiyama 1971; Kurup 1981). The fact that both bonnet macaque and Hanuman langurs are commensal with humans leads to the conventional view that both species are very common in their entire geographical range. However, it was observed during the present study that the relative encounter rate for these species varied across regions.

Many Asian primates including bonnet macaques and Hanuman langurs of south India are thought to enjoy traditional and religious protection (Southwick and Siddiqi 1994). Unfortunately, this protection is true only in a few regions. For instance, bonnet macaque has been eliminated from almost the entire Coastal Region, including temples. Similarly, in Aligarh District of north India, Southwick and Siddiqi (1977) reported a sharp decline in rhesus macaque populations, primarily due to loss of traditional protection. The widespread trapping of crab-eating macaques for supplies to laboratories and as food has resulted in a significant decline in the populations even in legally protected areas, raising the question of paying conservation attention to so-called ‘least concern’ species (Eudy 2008). Bonnet macaques have been considered pests outside the protected areas, where in fact most of their populations are found. Surprisingly, bonnet macaque is often found at higher density in marginal and unprotected habitats than they are in protected forests. For example, in the highly protected

**Table 3** Characteristics of the Hanuman langur population on Dharwar–Haliyal road

| Population parameters                       | 1961 <sup>a</sup>           | 1976 <sup>b</sup>          | 2003 <sup>c</sup>         |
|---------------------------------------------|-----------------------------|----------------------------|---------------------------|
| No. of groups (troops—all-male groups)      | 43 (37–6)                   | 22 (20–2)                  | 17 (12–5)                 |
| No. of langurs (troops—all-male groups)     | 626 (555–71)                | 327 (305–22)               | 242 (196–46)              |
| Intrinsic rate $r$                          |                             | –0.043                     | –0.011                    |
| Overall $r$                                 |                             |                            | –0.023                    |
| No. of adult males (troops—all-male groups) | 126 (66–60)                 | 37 (20–17)                 | 40 (17–23)                |
| No. of adult females                        | 305                         | 161                        | 84                        |
| Adult male to adult female ratio in troop   | 1:4.62                      | 1:8.05                     | 1:4.94                    |
| Mean troop size                             | 15.00                       | 16.00                      | 16.33                     |
| Mean troop composition (Ad M–Ad F–Imm)      | (1.6–7.8–5.3)               | (1.1–8.4–6.7)              | (1.4–7.0–7.9)             |
| Mean all-male group size                    | 11.8                        | 11.0                       | 9.8                       |
| Roadside density (open land–forest)         | 24.1 (13.4–34.8) langurs/km | 13.1 (5.5–20.7) langurs/km | 9.3 (5.6–13.7) langurs/km |

*Ad M* adult male, *Ad F* adult female, *Imm* immature

<sup>a</sup> Sugiyama (1964)

<sup>b</sup> Sugiyama and Parthasarathy (1978)

<sup>c</sup> Present study

Rajeev Gandhi National Park, Karanth et al. (2001) estimated 0.89 animals/km<sup>2</sup>. On the other hand, Chamundi Hill, a minimally protected forest outcrop near Mysore City, harbors seven groups of bonnet macaques with 43.4 animals/km<sup>2</sup> (Singh and Rao 2004). Kumara and Singh (2004) and Kumara (2007) have also reported a low encounter rate of bonnet macaques in several protected areas of the Western Ghats. The lower abundance and absence of bonnet macaques in Northern Plains may be due to aridness of the region, and the resulting nonavailability of large fruit trees for roosting, the presence of a single crop in most of the region and very few food crops.

Bonnet macaques raid crops and hence regular translocation is a common process in the villages, primarily in Southern Plateau. Singh and Rao (2004) believe that the bonnet macaque population has been eliminated over time in some regions due to increasing conflict with people. During the crop season, bonnet macaques are trapped, taken to far-off places and released in forest areas. Crop-raiding bonnet macaques are also shot and killed. During the majority of these releases, forest officials, subject experts and scientists are not involved. During this process many individuals get killed and/or the groups released often have highly skewed sex ratios since the entire group is hardly ever trapped and most of the males get trapped trying to gain access to the resource provided in a trap. Further, bonnet macaque is released into a habitat that may not be suitable for them, for example, it is our personal observation that bonnet macaques trapped from village were released into high-altitude rainforest, from where they moved back towards human settlements. The trapping and translocation of bonnet groups therefore is likely to be a

major factor resulting in high variability in relative abundance across regions.

There seems to be no obvious reason why Hanuman langurs are absent in certain regions of the Southern Plateau and why they are commensal only in the Northern Plains. Although it remains to be established as a fact, our personal observation is that there is low availability of large trees in the Northern Plains, which receive much less rainfall than the Southern Plateau. The population of Hanuman langurs on Dharwar–Haliyal Road was contiguous in 1961 (Sugiyama 1964). Our survey during 2003 revealed the disappearance of many groups, resulting in the formation of a few unconnected clusters of groups. We suspect that the loss of trees along the road, the existence of large monoculture plantations (teak and eucalyptus) in the forest area, agricultural expansion into forest area, and hunting and trapping for meat have contributed to the decline in the Hanuman langur population. Since the Dharwar–Haliyal population of Hanuman langur is the only primate population monitored over a long period in south India, the findings of this study are important and reflect the population status and trend of an iconic, common species. This study also reveals that such common species are decreasing progressively and may become locally extinct in the near future.

In recent years, there have been two reports that revise the taxonomy of Hanuman langurs of south Asia (Groves 2001; Brandon-Jones 2004). Although these two taxonomic revisions resulted in more uncertainty in recognizing species and subspecies, the presence of three species viz. *S. hypoleucos*, *S. hector*, *S. priam* (Groves 2001) or four subspecies viz. *S. e. achates*, *S. e. anchises*, *S. e. hypoleucos*, *S. priam*

*priam* (Brandon-Jones 2004) of Hanuman langurs is apparent in Karnataka. There is, however, uncertainty about the exact geographical area occupied by each taxa due to lack of field surveys. Many of the langur taxa have a highly restricted geographical distribution (Molur et al. 2003), and the local extinction of a population is a serious concern since it may hasten the extinction of a little known species/subspecies.

We suggest that the management plan of each division/district should include guidelines for the management of common species, such as bonnet macaques and Hanuman langurs, in an effort to retain their common status. It is, therefore, necessary that a periodic assessment of the status of such species be carried out and conservation measures, if necessary, undertaken before they also reach endangered status. Such a management step would require ensuring population contiguity, which in turn would provide sustainable population size and avoid population clusters that usually result in increased human-monkey conflict.

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