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# Of Concern Yet? Distribution and Conservation Status of the Bonnet Macaque (*Macaca radiata*) in Goa, India

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**Abstract:** The bonnet macaque *Macaca radiata*, endemic to peninsular India, is typically ignored in conservation initiatives as it is considered a common species, ubiquitously present across its distribution. Recent studies in southern India, however, report drastic declines in its populations. From March to May, 2012, we carried out a study to investigate its conservation status at the northern end of its range, in the state of Goa on the western coast of India. We recorded bonnet macaques in less than 40% of the locations we visited where they had previously been reported, and found that local residents living in close association with bonnet macaque populations were largely intolerant of the species' presence. Surveys and studies to monitor the population dynamics of such 'common' species as the bonnet macaque are urgently needed so that we can be better informed about their actual conservation status.

**Key Words:** Bonnet macaque, India, survey, distribution, human-primate conflict, conservation

## Introduction

Primate species that are characterized as 'common' on account of their wide distribution and ability to adapt to a range of habitats occupy the lowest position on the totem pole of primate conservation. Since conservation efforts by necessity are based on prioritization, this is understandable. However as Eudey (2008) warned in her assessment of the conservation status of *Macaca fascicularis*, excluding common primate species from protection initiatives has proved detrimental to their future. Although these species are highly adaptable, they are not neutral to various anthropogenic pressures such as habitat degradation, forest fragmentation and poaching. In addition, perceptions regarding their widespread distribution provide impetus for their indiscriminate use in biomedical research and commercial trade, further endangering their existence (Molur *et al.* 2003; Eudey 2008; Radhakrishna and Sinha 2011).

Of the eight macaques found in India, the rhesus macaque *Macaca mulatta*, the bonnet macaque *M. radiata* and the long-tailed macaque *M. fascicularis* are categorized as Least Concern as they are presumed to be widespread, tolerant to a range of habitats and found in large populations (IUCN 2012). Recently however, concerns have been raised regarding the

conservation status of the bonnet macaque in southern India (Kumar *et al.* 2011; Singh and Rao 2004; Singh *et al.* 2011). Studies monitoring demographic changes in their populations in southern India between 1989 and 2009 showed drastic reductions in both the number of groups (54 to 31) as well as the number of individuals (1207 to 697) (D'Souza and Singh 1992; Sharma 1998; Singh and Rao 2004; Singh *et al.* 2011). The bonnet macaque is also reported to be locally extinct in many regions in southern India (Kumara *et al.* 2010a). These studies reiterate the importance of collecting even baseline data on the present distribution and populations of the species in order to obtain a more accurate picture of its current conservation status.

The geographic range of the bonnet macaque extends across peninsular India, but studies on its ecology and distribution have largely focused on the species at the southern end. There have been surveys to assess the northern distributional limit of the bonnet macaque (Fooden 1981; Koyama and Shekar 1981; Kumar *et al.* 2011), but there has been no systematic attempt to study the distribution of the bonnet macaque in the northern part of its range (Sinha 2001). As a start, the aim of our study was, therefore, to obtain an understanding of the distribution of *M. radiata* in the state of Goa, towards the northern end of its distributional range. Trapping

and hunting of bonnet macaques as retaliatory measures against macaque crop-raiding has been a major factor for the decline of bonnet populations in India (Kumara *et al.* 2010a; Singh and Rao 2004). People's tolerance for crop-raiding and attitudes towards bonnet macaques therefore crucially determine the conservation status of the species. Hence an important secondary aim of our study was to document the attitudes and tolerance levels of the local residents towards *Macaca radiata* with the view that such knowledge aids in the appraisal of the actual human-macaque conflict situation (Nahallage *et al.* 2008), and thereby in formulating management strategies that aid the conservation of the species.

## Methods

We carried out our study in the state of Goa on the western coast of India (14°53'N to 15°40'N and 73°40'E to 74°21'E). Goa has 33.06% of its area under forest cover (Forest Survey of India 2011). Of this, 20.67% and 69.04% are classified as reserve forests and protected areas, respectively (forests under the jurisdiction of the State Forest Department), and 10.29% of the forest cover is considered “unclassified” (not under the aegis of the State Forest Department). The Protected Area network includes a national park (Mollem National Park) and six wildlife sanctuaries (Mhadei, Bhagwan Mahaveer, Netravali, Cotigao, Bondla, and Salim Ali) (FSI 2011).

We conducted surveys in both the districts of the state—North and South Goa—from March to May, 2012. Bonnet macaques occupy both forest and anthropogenic habitats, and we surveyed protected areas, privately owned plantations and estates, and roadsides. The protected areas included Mollem National Park, and Mhadei, Bondla, Cotigao and Netravali wildlife sanctuaries. The private estates were located in the villages of Shigao, Kalay and Nayawada (bordering the Mollem National Park and Bhagwan Mahaveer Wildlife Sanctuary) and the town of Poinguinim (near the Cotigao Wildlife Sanctuary). The roadside surveys were conducted along (a) national highways NH 4A, between the towns of Ponda and Anmod, and NH 17, between the towns of Canacona and Poinguinim, and (b) other roads that run between the town of Valpoi and Mollem village, between the villages of Collem and Mollem and in Siolim village (Fig. 1).

We selected the survey sites based on reports of bonnet macaques being present as stated by local people or forest department personnel, and that confirmed the presence of bonnet macaques based on direct sightings (Kumar *et al.* 2011; Singh *et al.* 2011). In the protected areas, we used paved roads, beat paths, and cattle trails for surveying the areas. We typically travelled these paths on foot twice a day; between 06:00 h and 10:00 h, and between 15:00 h and 18:00 h. Whenever a group was observed, the location was recorded using a hand held GPS unit, and note was made of the number of visible individuals in the troop. The same methods were employed for surveying the private plantations or estates. We used vehicles, driven at speeds of approximately 10 km/hr, to conduct our surveys of roadside macaque populations (Singh

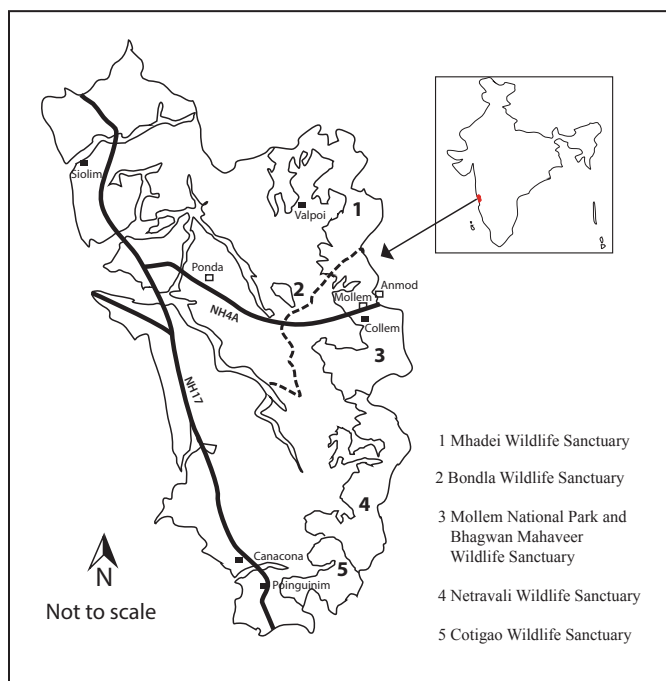


Figure 1. Locations surveyed in Goa (inset: Location of Goa within India).

and Rao 2004; Singh *et al.* 2011). We also used vehicles to conduct our surveys on some roads in the protected areas. We calculated the encounter rates of bonnet macaques as the number of macaque groups/km (Singh *et al.*, 2011).

During the course of our survey, we identified several bonnet macaque populations in the Mollem National Park and Bhagwan Mahaveer Wildlife Sanctuary. Hence in the second phase of our study, we conducted a questionnaire survey of the attitudes of local villagers towards bonnet macaques in 10 randomly chosen villages that are situated on the fringes of the Mollem National Park. The villages selected for the survey were Shigao, Kalay, Matojen, Souzamol, Bharipwada, Nayawada, Maidawada, Kumarmol, Tambdimol and Kondemol. As these villages are small with an average of 10 households each, we selected at random a total of five households from each for our questionnaire survey. We questioned respondents on the extent of wildlife-caused crop damage, frequency of macaque crop-raiding, their reactions to macaque crop depredations, and their attitudes towards retaliation measures against macaques. We also collected basic demographic and socio-economic data on all respondents, such as gender, religion, length of residence, level of education, and present employment status. We were accompanied by a local forest guard on all our interview visits. He introduced the purpose of our study to the villagers and acted as translator/interpreter when necessary.

We analyzed encounter rates of *M. radiata* groups in the different kinds of sites and percentages of participant responses to survey questions, and used non-parametric statistical tests to check if various categories were significantly different from each other (Zar 2010).



**Figure 2.** Bonnet macaque (*Macaca radiata*) mother and young, Goa, India. Photo by Asmita Sengupta.

**Table 1.** Bonnet macaque (*Macaca radiata*) groups seen in Goa. PA = protected area, RS = roadside, PE = private estate.

Location	Location type	No. of groups	Group no.	No of individuals seen
Mollem NP & Bhagwan Mahaveer Wildlife Sanctuary	PA	6	1	17
			2	16
			3	147
			4	12
			5	10
			6	26
Bondla Wildlife Sanctuary	PA	1	1	16
Mhadei Wildlife Sanctuary	PA	1	1	5
Cotigao Wildlife Sanctuary	PA	2	1	15
			2	5
Netravali Wildlife Sanctuary	PA	1	1	12
Kalay village	PE	1	1	12
Shigao village	PE	1	1	15
Poinguinim town	PE	1	1	5
National highways and other roads	RS	5	1	9
			2	12
			3	16
			4	4
			5	10

## Results

We traversed a total of 334.47 km during the course of the study—protected areas (PA) 148.81 km; roadsides (RS) 103.3 km; private estates (PE) 82.26 km—and surveyed 46 locations in all. We obtained direct sightings of *M. radiata* in only 18 locations. Of the 18 groups sighted, 11 were in protected areas, five along roadsides and two in private estates. We found two groups of *M. radiata* in North Goa district and 16 groups in the South Goa district (Table 1). In protected areas, the major vegetation type was moist, mixed-deciduous forest. All the private estates where bonnet macaques were encountered had banana, coconut, and rubber plantations. The encounter rate of bonnet macaques for the entire state was 0.05 group/km and encounter rates did not vary significantly across the different kinds of sites (PA: 0.07 groups/km, PE: 0.02 groups/km, RS: 0.04 groups/km; G-test:  $G = 3.007$ ,  $df = 2$ ,  $\alpha = 0.05$ ,  $p = 0.22$ ). The average group size of *M. radiata* was 19 (range: 5–147). The largest group (147 individuals) was found at the Dudhsagar waterfall and the smallest groups, each with five individuals, were encountered in Mhadei Wildlife Sanctuary and in a private plantation in Poinguinim.

We interviewed 50 villagers regarding their perceptions of macaque crop-raiding and on their attitudes towards *M. radiata*. They included 30 men and 20 women, and were predominantly in the age categories of 21–40 years (46%) and 41–60 years (48%), respectively. The large majority of the respondents practiced Hinduism (94%); very few of them were Christians. The larger majority of them were farmers (24%), housewives (24%) or employed in government services (24%); a smaller minority worked as laborers (16%) or were small-scale businessmen (6%).

Respondents listed six wildlife species as crop depredators – gaur (*Bos gaurus*), bonnet macaque (*Macaca radiata*), Malabar sacred langur (*Semnopithecus hypoleucos*), fox (*Vulpes bengalensis*), jungle cat (*Felis chaus*), and wild pig (*Sus scrofa*). They rated *M. radiata* as the second most frequent, destructive, and feared species, after *S. hypoleucos* (Table 2). People identified summer as the season when bonnet macaques visited their farms most often (87%), and most of them reported that macaque crop-raids were a daily occurrence (67%). Apart from crop-raiding, bonnet macaques were also reported to cause damage to household structures such as roofs, cowsheds and granaries (53%), and also raid kitchens (7%). All respondents claimed that they never killed any macaques in retaliation. While a significantly high percentage (73%) attributed this to fear of Forest Department officials, 13% claimed they would never kill macaques as they regarded them as God. The remainder reported that they had never felt the need for retaliatory killing (Chi-square test:  $\chi^2 = 10.8$ ,  $df = 2$ ,  $p = 0.004$ ). More than half the respondents (53%) reported that they shot stones at macaques from catapults to chase them from their farms; others chased away the macaques themselves (27%) or used their pet dogs (7%). A small percentage (13%) did not take any action.



**Table 2.** Comparative ranking of crop-raiding species.

Species	Most frequent		Most destructive		Most feared	
	Respondents (%)	Rank	Respondents (%)	Rank	Respondents (%)	Rank
Malabar sacred langur	54	1	50	1	60	1
Bonnet macaque	30	2	28	2	26	2
Wild pig	6	4	14	3	10	3
Gaur	2	5	-	-	2	4
Fox	8	3	-	-	-	-
Jungle cat	-	-	8	4	2	4

Most of the respondents (67%) opined that macaques should be translocated to the forests and never be allowed on their farms or into their households. A very small percentage (7%) responded that they had no objection to macaques raiding their farms if the Forest Department provided adequate compensation. About 26% reported that they had no problems with macaques being in their vicinity despite the damage they cause. Following Campbell-Smith *et al.* (2010), we classified the first group of respondents as “intolerant,” the second group as “moderately tolerant” and the third group as “highly tolerant.” The number of intolerant individuals was significantly higher than the other two categories (Chi-square test:  $\chi^2 = 8.4$ ,  $df = 2$ ,  $p = 0.01$ ).

## Discussion

It is generally believed that the bonnet macaque is ubiquitously present throughout its geographic range in India (Krishnan 1972; Roonwal and Mohnot 1977). In reality, however, little is actually known about the population status of the species in a number of parts of its range, particularly the northern (Sinha 2001). Goa is in the northern part of the Western Ghats mountain range, towards the north-west of the range of the bonnet macaque. Existing literature lists only Bhagwan Mahaveer Wildlife Sanctuary, Mollem National Park and Bondla Wildlife Sanctuary as locations where they are found in Goa (Kumar 2012; Molur *et al.* 2003). The results of our study indicate that bonnet macaques are found in many more locations and in diverse habitat types in Goa. We found more bonnet macaque populations in the southern part of Goa than the northern, but this is more likely due to a bias in our choice of survey locations than a reflection of the true status of bonnet macaques in Goa.

In the present study, the encounter rate of 0.05 groups/km is comparable to the encounter rate of 0.021 groups/km found in Karnataka (Kumara *et al.* 2010a). Although bonnet macaques are usually found at higher densities in marginal and unprotected habitats (Kumara *et al.* 2010b), in our study, the group encounter rate was higher (though not statistically significant) in protected forest areas. Also, the total number of bonnet macaque individuals was highest in forests, whereas in Karnataka, the number of bonnet macaques sighted was

highest in areas of human habitation and lowest in forests. The largest bonnet macaque group was found at the Dudhsagar waterfall in the Mollem National Park where they are provisioned by the numerous tourists visiting this region. This supports earlier observations on the bonnet macaque that they are typically found in higher numbers in areas where they live in close contact with humans and are provisioned regularly (Sinha 2001).

We saw bonnet macaques in less than 40% of the locations where they were reported to be present. In comparison, we encountered a total of 36 Malabar sacred langur (*Semnopithecus hypoleucos*) groups (range: 5 to 15 individuals) in the areas surveyed, and the encounter rate was twice that of *M. radiata* (0.1 groups/km). Although it is possible that we have underestimated bonnet macaque abundance in protected areas due to lower visibility, the larger number of bonnet macaque individuals sighted in protected areas (compared to the other habitats) suggests that our findings accurately reflect the current distribution status of the bonnet macaque in Goa. It is also instructive that we did not find any bonnet macaque groups along the western coast of the state. Unfortunately this appears to be a part of the definite pattern in the general decline of bonnet macaque populations in southern India. In the neighboring state of Karnataka, Kumara *et al.* (2010a) noted that nearly 91% of the coastal populations of *M. radiata* have been extirpated. Secondary information collected during the course of our study also indicated that bonnet macaques have long been extirpated from coastal towns such as Siolim.

Crop damage by various wildlife species, including primates, in areas in the vicinity of forests is a common occurrence in many parts of India (Chhangani and Mohnot 2004). The people in the villages bordering the Mollem National Park and Bhagwan Mahaveer Wildlife Sanctuary reported the bonnet macaque to be the second most feared, most destructive and most frequent of the crop depredating species, second only to Malabar sacred langurs. Previous studies have shown that the actual extent of damage by primates may be much less than what is perceived, the negative perceptions of people being driven mainly by the large body and large group sizes of the primate species (Nahallage *et al.* 2008). For example, in the northern periphery of the Dja Faunal Reserve, Cameroon, farmers perceived primates such as chimpanzees and

mangabeys as the worst pests in contrast to actual observations which showed squirrels and antelopes to be the animals inflicting most of the damage (Arlet and Molleman 2010). So in reality, the scale of damage by bonnet macaques may actually be comparable to the other crop-damaging wildlife species. It is also likely that respondent accounts of the heavy damage caused by bonnet macaques may have been exaggerations, influenced by the presence of the Forest Department guard who accompanied us on our visits, as villagers felt that the monetary compensation routinely awarded by the Forest Department for wildlife-caused crop damage was low and insufficient.

A study in Bangladesh on people's attitudes towards the Bengal sacred langur (*S. entellus*) documented that, despite the extensive and considerable crop and orchard damage that the species inflicts, 90% of the people interviewed were supportive of langur conservation (Khatun *et al.* 2012). In Goa, however, tolerance to primates was found to be generally very low as a significantly large proportion of the respondents demanded relocation of the animals. Interestingly, despite the lack of tolerance, all the respondents claimed that they had never hunted or killed bonnet macaques. This could be due to the Hindu belief in the sanctity of monkeys (as has been noted in other studies, for example, that of Sharma *et al.* [2011]) or, as suggested by our study responses, was more likely due to the presence of the Forest Department guard who accompanied us.

As evidenced in many parts of India (Mishra 1997; Ogra 2008, 2009; Radhakrishna and Sinha 2010), our study also throws light on the underlying tension between farmers and the Forest Department in contexts of wildlife-caused damage and the responsibility for conserving wildlife species, and reiterates the urgent requirement for studies that systematically estimate the exact amount and rate of damage by wildlife species. We also indicate the need for studies that regularly monitor the population dynamics of the bonnet macaque in other parts of its range as it clearly, even as a common species, stands in need of measures to preserve its 'Least Concern' status.

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