Interim Report of project (16567-1): Assessment of the risk of gastrointestinal parasite transmission from relocated commensal bonnet macaques to wild animals in southern India

Introduction

Parasites obtain their nourishment from host organisms. While not all host parasite relationships are damaging, typically those in which the parasite and host have not evolved a close relationship can be the source of severe infections leading to the death of the host, or a significant reduction in host immunity impairing its ability to fight off other diseases. Some endoparasites can cause severe blood loss, tissue damage, spontaneous abortion and congenital malformations in the host organism and or its offspring (Boyce 1990; Chandra and Newberne 1977; Despomsmier et al. 1995). Parasites and the complications caused by them play a major role in altering the host species diversity or a decline in population size, even driving a host species to extinction by altering parasite load and parasite species composition (Harvell et al. 1999, 2002; Jog and Watve 2005). The introduction of exotic parasite species can also be caused by human interventions such as, relocation of commensal animals to wild habitats (Griffith et al. 1993, Woodford and Rossiter 1993). It is believed that animals living commensally with humans and their domestic animals are highly exposed to such exotic parasites species and have a higher degree of parasite species diversity than animals in wild situations with little exposure to human made conditions (Weyher et al. 2006). The bonnet macaque is one such species, which lives commensally with humans.

Across southern India, bonnet macaques are one of the most common commensal species, occurring in all possible human habitations, ranging from urban areas to agricultural fields. Bonnet macaques are considered as pests since they often raid and damage crops, causing significant economic loss to farmers. Furthermore, bonnet macaques also often take food directly from people in towns, temples and tourist sites, making them a menace across their natural range. Since, the intensity of damage caused by bonnet macaques is so severe in these habitats, local farmers often employ crude methods to capture and relocate them to distant forested areas outside of their normal range. Also due to high public and political pressure, the forest department often relocates bonnet macaques from towns, villages, temples and agriculture areas to the interior forests. This is a quite regular practice particularly around the forests of the Western Ghats, an area that harbors many endemic and endangered species. Unusual deaths are reported in many indigenous mammal species from these forests, some of these

deaths have been attributed to parasite infection and other diseases. One of the major sources of these infections is considered to be relocated commensal bonnet macaques. The relocation of such commensal macaques is thought to be one of the prime reasons for the spread of exotic parasite species to wildlife populations. Thus, the present study aims to assess the prevalence of endoparasites in bonnet macaque occupying different habitat conditions, and elucidate this situation and provide information to wildlife managers.

Methodology

The Western Ghats region and the adjoining areas were systematically surveyed for the bonnet macaque. Once macaque group was located, the details of their location, habitat type, forest type, degree of provisioning from humans, and the rate of exposure to humans and livestock were recorded. The group was followed (one to three days) until a minimum of eight to ten samples per group are collected. Collected fecal samples were weighed (2 g/sample), immediately fixed in vials containing 10% formalin solution and stored in room temperature. Each vial was labeled with individual ID, date and sample number and the same was also recorded in a data book.

Samples were analyzed in laboratory using sedimentation and flotation concentration methods. A McMaster's counting chamber was used to quantify the number of eggs per gram of feces of each endoparasite species. For flotation concentration method, 2 g of the fecal sample was taken in new labeled 15 ml Torson centrifuge tube then 10 ml of distilled water was added, homogenized and mixed thoroughly using glass rod and vortex for 10 min respectively. The mixture was filtered through cheese cloth. The filtrate volume was increased up to 15 ml with distilled water and centrifuged at 1800 rpm for about 10 minutes. The supernatant was discarded and to the sediment 10 ml saturated Sucrose solution (1.28 g/ml) was added and thoroughly mixed, again the volume of the mixture increased up to 14.5 ml with sucrose solution. The mixture was centrifuged at 4000 rpm for about 10 minutes. The upper layer of the mixture was taken and deposited in one of the McMaster's chambers, allowed the eggs to float to the top and then the processed sample was observed under the microscope for eggs and larval forms, and their counts were made based on published identification keys under the supervision of subject expert. For sedimentation method 2 g of the fecal sample was taken in new labeled 15 ml Torson centrifuge tube then 10 ml distilled water was added, homogenized and mixed thoroughly using glass rod and vortex for 10 min. The mixture was filtered through cheese cloth. The filtrate volume was increased up to 15 ml with distilled water and centrifuged at 1800 rpm for about 10 minutes. The

supernatant was discarded and to the sediment 10ml soap solution (dilute soapy water i.e. 2-3 drops /100 ml) was added and centrifuged at 5000 rpm for five minutes. The supernatant was discarded leaving few drops of suspension on the sediment pellet. This sediment mixture was taken and deposited in one of the McMaster's chambers and was observed under the microscope for eggs and larval forms, and their counts were made based on published identification keys (Arcari et al. 2000; Bowman et al. 1999; Collet et al. 1986; Jessee et al. 1970).

Results

A total of 190 fecal samples of bonnet macaque were collected from 11 locations, and about 60 samples were collected from single group monitored for long-term study (Fig. 1). Out of them a total of 64 spatial samples were processed and analysed for the prevalence of endoparasites. The findings show that ten nematode species, three trematode species, five cestodes species and five protozonas (Table 1).

Figure 1 Sampling locations for collection of fecal samples of bonnet macaque

Table 1 Prevalence of endoparasites in fecal samples from different locations of bonnet macaque

No.	**Parasites**	Prevalence in number of Samples
	Nematodes	
1	*Strongylus spp.*	4
2	*Strongyloides stercoralis*	8
3	*Trichuris trichiura*	2
4	*Ancylostoma spp.*	6
5	*Bunostomum spp.*	10
6	*Haemonchus spp.*	2
7	*Ascaris spp.*	20
8	*Taxocara spp.*	2
9	*Enterobius vermicularis*	10
10	*Trichostrongilodes spp.*	4
	Trematodes	
1	*Fasciola hepatica*	4
2	*Schistosoma mansoni*	2
3	*Schistosoma Japanicum*	4
	Cestodes	
1	*Diphyllobothrium spp.*	14
2	*Moniezia spp.*	28
3	*Hymenolepis diminuta*	6
4	*Hymenolepis nana*	8
5	*Tenia spp.*	4
	Protozoa	
1	*Coccidia spp.*	16
2	*Balantidium coli*	12
3	*Entamoeba coli*	4
4	*Cyclospora spp.*	6
5	*Giardia spp.*	4
	Unidentified	4

Endoparasites were recorded in samples from all the study locations (mean parasite richness 2.90±2.64, N = 64), however, the mean parasite richness differed between the samples locations ($F_{6,57}$ = 8.134, p <0.001). The samples from Mettupalyam (6.66±3.14) and Near Pachame (6.33±2.25) had the highest species richness than in the other locations (Fig. 2).

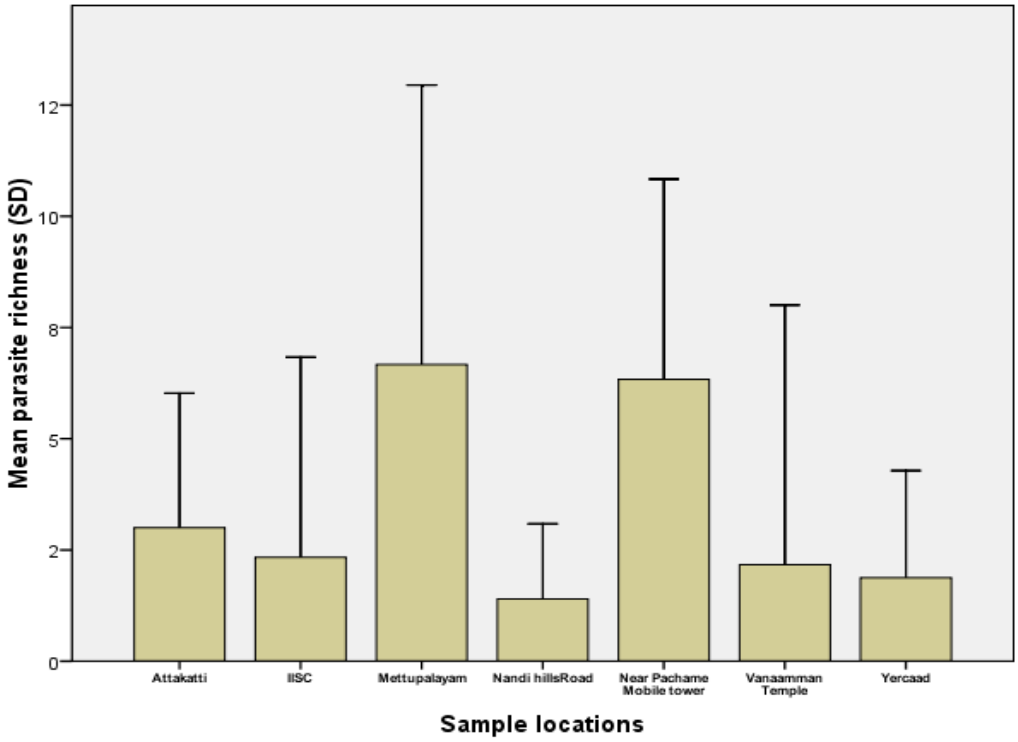

Figure 2 Gastrointestinal parasite richness in the bonnet macaques from different sampling locations ($F_{6,57}$ = 8.134, p <0.001)

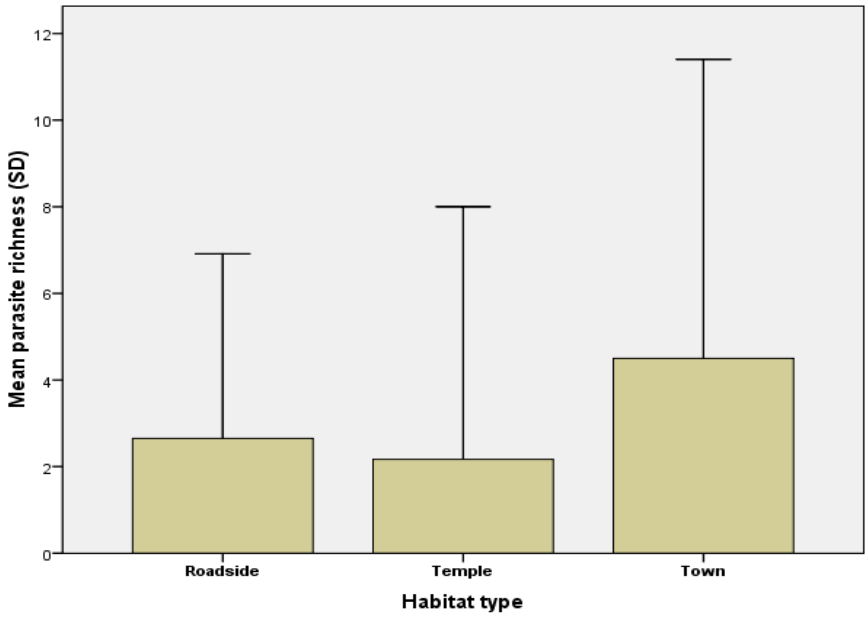

Figure 3 Gastrointestinal parasite richness in the bonnet macaques in different habitat types ($F_{2,61}$ = 3.012, p <0.05)

The mean parasite richness was significantly higher ($F_{2,61}$ = 3.012, p <0.05) in the town groups (4.50±3.45) than in the temple (2.16±2.91) and roadside groups (2.65 ±2.13). Further, the town (4.50±3.45) and village (3.55±3.32) groups had higher parasite richness ($F_{3,60}$ = 3.839, p <0.01)than in the forest groups (Dry deciduous forests: 2.25 ±1.39; Scrub forests: 1.40±0.84).

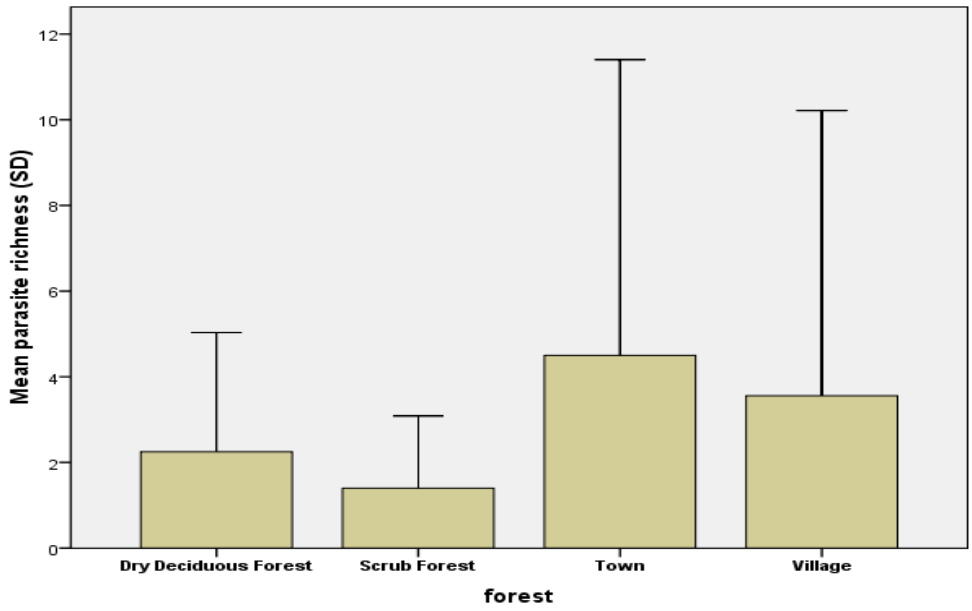

Figure 2 Gastrointestinal parasite richness in the bonnet macaques in different forest types ($F_{3,60}$ = 3.839, p <0.01)

Discussion

The analysis of samples for endoparasite prevalence is in progress. This is only a preliminary finding of the study, with partial analysis of data. The current findings is only for spatial sampling to understand the variation in the parasite richness across different locations in different habitat conditions and forest types with varying degrees of exposure to humans and livestock. This will help in understanding the relationship between endoparasites and the habitats that they occupy, and if they are relocated to the wild, in assessing the potential risk to other animals in the wild.

Limitations: The issuing of permission from the forest department took lot of time thus the, collection of samples from the forests and protected areas are in progress.

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