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Effects of deforestation on attitudes and levels of tolerance towards commensal primates (Cercopithecidae) in Sri Lanka

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Attitudes of people to wildlife, particularly to animals that live in close proximity to them, are an important element of conservation efforts and management. Attitudes may vary according to age and levels of conflict. We assessed the influence of proximity of forest on the attitudes of people towards two commensal primates, the purple-faced langur and the toque macaque. Data were collected in Sri Lanka by interviews in three villages where there is no continuous forest remaining and in three villages with adjacent forest. We found high levels of tolerance towards commensal primates, but significantly higher levels of negative perceptions in villages where forest was no longer present. Perceptions were not related to age or sex. The total disappearance of forest, with primates being dependent on fruit crops and living permanently on the village grounds, inevitably leads to conflict. These changing views have important management implications. Animals surviving in a human-dominated landscape may become more common, and the experiences in Sri Lanka may provide insight into what the future holds for other sites.

Keywords: conservation attitudes; crop raiding; ethical issues; human wildlife conflict; management

1. Introduction

Robert Knox, a British captive of King Rajasinghe II of Kandy in central Sri Lanka between 1659 and 1679, was probably the first to report on the conflict between monkey and man in Sri Lanka. In his 'An Historical Relation Of The Island Ceylon ...' published in 1681, he distinguishes among three types of monkeys, two (the purple-faced langur *Trachypithecus vetulus* (Erxleben, 1777) and the tufted grey langur *Semnopithecus priam* Blyth, 1844) that '*do little but mischief, keeping to the Woods, eating onely leaves and buds of Trees but when they are catched, they will eat anything*', and one (toque macaque *Macaca sinica* (L. 1771)) '[which] *are so impudent that they will come into their Gardens, and eat such Fruit as grows*'. Of the toque macaque he notes that '*... furthermore coming with such multitudes do a great deal of mischief to the Corn, that groweth in the Woods, so that they are fain all the day long to keep Watch to scare them out: and so soon as they are gone to fray them away at one end of the Field; others who wait for such an opportunity come skipping in at the other; and before they can turn, will fill both bellies and hands full, to carry away with them; and to stand all round to guard their Fields is more than they can do'*. Apart from guarding their fields, the farmers occasionally must have taken a more active role in protecting their crop as Knox notes '*The flesh of all these sorts of Apes they account good to eat*' (Knox 1681: 26).

In many parts of the world people and non-human primates have co-existed for thousands of years. Over the past 50 years or so there has been growing concern that increasing populations and the changing needs of humans have endangered our ability to live in close association with non-human primates, leading to the widespread implementation of conservation programmes to protect endangered primate species (Cowlishaw and Dunbar 2000; Hill 2002). Of the conflicts between humans and other primates, crop-raiding is one that has received the most attention to date (Strum 1994; Hill 1997, 2000; Pirta et al. 1997; Naughton-Treves et al. 1998; Saj et al. 2001; Chhangani and Mohnot 2004; Tweheyo et al. 2005; Agetsuma 2007; Riley 2007; Webber et al. 2007). The experience of individual farmers can vary from no damage to complete loss of an entire season's crop (Warren et al. 2007).

Crop raiding can greatly reduce farmers' tolerance towards wildlife. Cowlishaw and Dunbar (2000) noted that although the three predominant religions in Asia (Islam, Hinduism and Buddhism) proscribe the eating of primate flesh, hunting primates is as widespread in Asia as it is in Africa and South America. With hunting of primates for their parts to be used for medicinal purposes (Martin and Phipps 1996; Nijman 2005), the control of primates as agricultural pests is the most important source of primate mortality caused by

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hunting. Despite higher human population densities in rural areas, and more rapid conversion of forest to farmland, much less is known about crop-raiding in Asia than in Africa (Linkie et al. 2007; Priston 2009).

Several studies have found that proximity of the farm to the forest edge and the presence or absence of neighbouring farms best explains the likelihood of any farm sustaining crop damage from primates (Hill 2000; Saj et al. 2001; Linkie et al. 2007; Priston and Underdown 2009). With reference to Tantalus monkeys *Chlorocebus tantalus* (Ogilby, 1841) in Nigeria, Warren et al. (2007) noted that the only apparent certainty in predicting losses for farmers was that those farmers with fields closer to the forest are more likely to experience greater losses. Encroachment by farmers into forested habitats then is most likely to lead to conflict.

Few studies have looked into more extreme situations, i.e. where the forest has disappeared all but completely, and where the primates are largely dependent on crops (but see e.g. Waite et al. 2007). Here we report on the attitudes of villagers in Western Sri Lanka towards commensal primates. We focus on two discrete settings: one where forest is in the village's vicinity and one where all forest has gone and the primates live largely on the village grounds, and explore differences and similarities in attitudes and perceptions in two groups of human residents based on age.

2. Methods

2.1. Study area and its inhabitants

We selected six villages and hamlets for our assessment, Talangama [06°54′N, 079°57′E], Bandoragama [06°42′N, 080°00′E], Piliyandala [06°50′N, 080°10′E], Labugama-Kalatuwawa [06°51′N, 080°11′E], Nissarana [07°00′N, 080°10′E], and Ingiriya [06°44′N 080°11′E]. Close to Sri Lanka's capital Colombo, the villages are either situated in the capital's district or in adjacent districts (Gampaha and Kalutara) but close to the capital district. The first three villages and their near surroundings, being nearest to Colombo, are largely devoid of forest, whereas the other three villages have forest adjacent to them, with some communities living inside the forest.

Based on the 2001 government census (http://www.statistics.gov.lk/) some 5.3 million people live in the three districts at an average human population density of approximately 2000 individuals km^{-2} with an annual growth rate of around 1.5%. The majority of people are Sinhalese (85%) and Sri Lanka Tamil (6%), with Buddhism (73%), Islam (8%) and Hinduism (5%) being the main religions. Of those employed (37% of the population) about 40% are listed as craftsmen or as working in an elementary occupation.

Three out of the five Sri Lankan primate species occur in the study area, i.e. the dusky toque macaque *Macaca sinica aurifrons* Pocock, 1931, the western purple-faced langur *Trachypithecus (Semnopithecus) vetulus nestor* (Bennett, 1833) (Figure 1), and the red slender loris *Loris tardigradus tardigradus* (L. 1758). The first taxon is considered Endangered, largely based on habitat loss (Dittus et al. 2008b), whereas the second is considered Critically Endangered, with Dittus et al. (2008a) predicting a decline of more than 80% in the next three generations. The western purple-faced langur, for three consecutive periods, has been selected as one of the World's Top 25 Most Endangered Primates (Nekaris and Nijman 2008). While the langurs are largely arboreal and naturally confined to forest, the macaques are more terrestrial and in other parts of Sri Lanka occupy less forested areas as well as forest (Dittus 1988; Nekaris and de

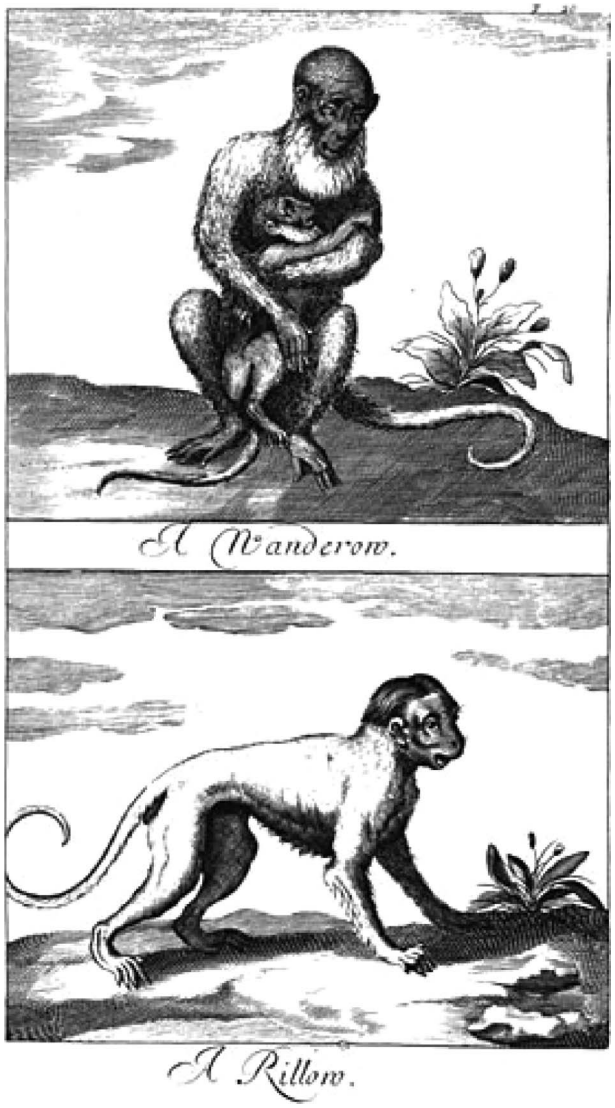

Figure 1. A wanderow (purple-faced langur *Trachypithecus vetulus*) and a rillowe (toque macaque *Macaca sinica*) as depicted in Knox's '*An Historical Relation of the Island of Ceylon* . . .' published in 1681. In parts of Western Sri Lanka these primates now are largely dependent on crops leading increasingly to conflict.

Silva Wijeyeratne 2008). The red slender loris, being nocturnal and confined to forest (Nekaris and Jayewardene 2004), living apparently without coming into conflict with villagers, is not considered here.

2.2. Data collection and analysis

In May–July 2006 we assessed the attitudes of humans towards primates in the aforementioned villages. Our analysis focused on those people that encountered primates on a regular basis and that showed a good knowledge of primates (by correctly identifying photographs of primates) as we expect them to be most informative in terms of human–primate attitudes. Interviews, conducted in a semi-structured way by L. Parker aided by a local interpreter, were carried out at the respondents' home, farm or monastery. To ensure independence of data, each interview was conducted separately (Lammertink et al. 2003). Questions focussed on the locations where the primates were observed (garden, forest, etc.), frequency of observation (daily, weekly), numbers (individuals, groups), attitudes (positive, neutral, negative), and perceived needs for protection (forest, monkeys).

We created four categories of respondents based on age (with 40 years as a cut-off line between young and old) and on whether or not forest was in the vicinity of the village. Each category contained 12 respondents for a total of 48 respondents. Using eleven questions and answers, we used Fisher's Exact Probability Tests to test for differences in the proportion of responses (Siegel 1956) using the Vassar on-line calculator (http://faculty.vassar.edu/lowry/fisher.html). We explored both the effect of age and the effect of deforestation separately, testing affirmative versus negative responses, and, taking advantage of having the exact same amount of respondents in every category, the interaction between the two by testing either affirmative or negative responses. With 22 female and 26 male interviewees we explored the effect of sex on perceptions as well. Significance is accepted when $P \leq 0.05$ in a two-tailed test (Zar 1999).

3. Results

3.1. Species contribution and conflict

Contrary to Knox's time it was not the toque macaque that was most familiar, and most infamous, to the villagers, but the Western purple-faced langur. In all villages, apart from Ingiriya, people rarely, if ever, indicated familiarity with toque macaques. In Ingiriya toque macaques are not present in or near the village, but are confined to the forest reserve, where a small hamlet has sprung up in the forest grounds. In the three villages without forest one to seven groups of langurs lived in the village grounds, and in the other villages interview results suggested langurs frequented the few houses within or at the border of the forest area, but only at certain times of the year. The total population of monkeys in the villages without forest was estimated at some 130 langurs, whereas it was some 80 langurs and at least 15 macaques in the villages with forest. Since primates in the forested areas spent less time in the villages, these are likely to be underestimates, but give a good impression of the ratio of the two species. Given the rarity of macaques, most of the respondents referred to langurs only when discussing their perceptions and attitudes towards primates.

Interview results, and subsequent studies (Dela 2007; Moore et al. 2008), reveal the main conflict with the langurs was crop-raiding on fruit trees in home gardens. Commonly eaten fruit were jackfruit *Artocarpus heterophyllus* Lam. 1789 and breadfruit *A. incisus* Thunb 1782 [Moraceae], rambutan *Nephelium lappaceum* L. 1767 [Sapindaceae], banana *Musa* spec. L. 1753 [Musaceae] and mango *Mangifera indica* L. 1753 [Anacardiaceae]. In the villages without forest nearby, crop-raiding was a significant problem. In addition, villagers reported that arboreal langurs caused damage to roof tiles, as they use the roofs for resting and to disperse from one part of their home range to another.

3.2. Perceptions in relation to age and sex

The average age of the interviewees was 40.6 $\pm$ 13.7 years, with 22 female and 26 male respondents (Table 1). Answers to all of the eleven questions were similar for young and older respondents, and there were no significant differences in answers between males and females.

3.3. Perceptions in villages with and without forest

There were clear differences between the number of interviewees that observed langurs daily between forested and non-forested villages. In villages near forest a third of the respondents observed the langurs daily, whereas in the non-forested villages it was

Table 1. Origin, sample sizes and ages of the 48 interviewees included in this study.

	Villages (number of interviewees)	Age young interviewees	Age elder interviewees
Forest in vicinity	Labugama-Kalatuwawa (7), Nissarana (5), Ingiriya (12)	29.2 $\pm$ 5.1	51.7 $\pm$ 8.9
No forest in vicinity	Talangama (13), Bandoragama (6), Piliyandala (5)	29.2 $\pm$ 5.1	52.5 $\pm$ 9.7

two-thirds (Table 2). Most of these were observed in gardens as 18 respondents in non-forested villages indicated observing the langurs there most frequently, but in the villages near forest only seven respondents observed them frequently in gardens, the difference being significant (Fisher's Exact Test, $P = 0.008$). In villages near forest and villages without forest, an equal number, about half of the interviewees, reported seeing the langurs most frequently in forest. The frequent observing of langurs, especially in gardens, in villages without forest resulted in a clear difference of perception within the villages where forest still occurs on whether or not langurs are preferred in an area. In the non-forest villages 18/24 interviewees prefer not to have langurs in their area, whereas in forested areas it is only 8/24, the difference again being significant (Fisher's Exact Test $P = 0.008$). When probing for a reason, the same proportion of people indicated considering langurs a nuisance. In total eight people from three villages (Ingiriya, Piliyandala, Talangama) indicated that they were aware of people killing monkeys, while the distribution of these interviewees (seven from villages without forest and one from a village with forest) suggests a systematic association between village type and knowledge of hunting (Fisher's Exact Test $P = 0.048$), we could not ascertain to how many instances of hunting these answers referred. Also people reported langurs being killed by electrocution in the three villages without forest, whilst this was not reported as occurring in forested areas.

3.4. *Interaction between forest presence and age*

In villages where there is still forest, 2/12 of the older interviewees but 11/12 of the younger interviewees indicated that the langurs are most observed in forest. In villages without forest, these numbers are 8/12 and 6/12, respectively; the difference being significant (Fisher's Exact Test $P = 0.046$). None of the other interactions proved to be significant.

Table 2. Perceptions of villages ($n = 48$) to western purple-faced langurs in six villages in Sri Lanka, expressed in percentages.

	Villages with forest in vicinity	Villages without forest in vicinity	*P*-value
Observed frequently in gardens	29	75	0.003
Forest indicated as main habitat	58	54	1.0
Observed daily	33	71	0.020
Negative attitudes prevail	33	75	0.008
Show empathy towards langurs	25	29	1.0

Note: *P*-values are based on Fisher's Exact Tests.

4. Discussion

4.1. *The nature of conflict perceptions*

Prior to British colonial rule in the eighteenth century, when large tracts of forest were cleared for rubber, coffee, and tea plantations, all of Sri Lanka's Wet Zone was blanketed in lowland rainforest (Weerakoon 2001). With an increasing human population, deforestation has left a mere 4.6% of rainforest standing (Gunawardene et al. 2007). The two species of monkey living in this part of Sri Lanka appeared to have responded differently. The toque macaque, although naturally more inclined to live commensally with humans (Bishop et al. 1981; Nekaris and de Silva Wijeyeratne 2008), has largely disappeared, with the remaining populations inhabiting the forest remnants or residing near monasteries, where they take advantage of the Buddhist devotion to primates. Although difficult to quantify, if Knox's (1681) accounts are anything to go by, this massive loss of numbers with small populations living mainly in forested areas led to a decrease of conflict between humans and macaques. In contrast to the macaques, it is somewhat surprising to see an arboreal folivorous langur persisting, living in home gardens in village grounds, where the more ubiquitous macaque no longer is present.

Although we did not quantify actual levels of conflict, in line with earlier studies in Asia and Africa we found a clear relationship between the presence of forest and the perceived levels of tolerance towards primates (cf. Hill 2000; Linkie et al. 2007, Warren et al. 2007). It appears that, certainly in the villages where forest is still nearby, residents use few active methods to protect their crops from primates, with the most frequent response to the primates' presence on people's land being throwing stones, shouting or setting dogs on them, and, less frequently, using firecrackers. In accordance with other studies on human–primate conflict in Asia (Southwick and Siddiqi 1994; Wang et al. 2006; Riley 2007) overall there was a high degree of tolerance towards the primates, even when they shared some of the resources. In Sri Lanka all primates are protected by law and, in a society where hunters are ostracized because of Buddhist philosophy (Rudran 2007), lethal wildlife control has a slim chance of success. Nevertheless, we received more frequent reports of killing langurs from interviewees in villages without forest nearby compared to those villages with forest. Previously, we compiled data on reports of killing or accidental deaths in Western purple faced langurs (Parker et al. 2008), most of them originating from villages without forest in the vicinity.

We found significant differences in perception and levels of tolerance towards commensal primates between villages with and villages without forest nearby. Interestingly, this was not related to age. Similar to studies in Africa (e.g. Hill 1997; Kaltenborn et al. 2006; Kideghesho et al. 2007) but contra to others

(e.g. de Anthony 2007), we found that age was not a good predictor of positive or negative attitudes towards wildlife. Perceptions towards primates were similar for villagers in their late 20s and those in their 50s.

4.2. *Management implications*

In conservation management it has become apparent that, in order to be successful, the local perceptions, including differences in perceptions by different stakeholders, have to be taken into account (e.g. Nepal and Weber 1995; Hill 1997, 2000; Madhusudan 2003; Bhatnagar et al. 2006). This is especially true for species living commensally with humans. In our study area, some populations of langurs seem to persist in villages, but as Dela (2004, 2007) pointed out, the heavy dependence on fruits in people's gardens makes the primates vulnerable to changes that are bound to occur in these unstable human-modified environments. This is possibly when natural food abundance is low and raiding home gardens becomes more of a viable option (perhaps suggesting forest does not have carrying capacity to support populations). In this respect, the situation in this part of Sri Lanka mirrors that of what happened in parts of India with rhesus macaques *M. mulatta* (Zimmermann, 1780) and hanuman langurs *Semnopithecus* spp. Desmarest, 1822 (Pirta et al. 1997; Chhangani and Mohnot 2004). As noted by Parker et al. (2008) for the western purple-faced langur, but clearly also needed for the toque macaque, more proactive management of these primates and their habitat is imperative for their survival. Improved management of protected forest areas as well as locating and protecting key forest patches and corridors is overdue (Rudran 2007). In areas where primates and humans do live in close proximity, and where human–primate conflict has been identified (e.g. Bandaragama, Talangama), ways to mitigate these conflicts peacefully need to be explored. Mitigation may include translocation of primates from some of the areas most devoid of forest to more forested areas without resident primates (although, admittedly, finding these forests will be somewhat of a challenge), compensation schemes (paying villagers for allowing the primates to eat parts of their crops), reforestation (initially with fast growing species), and creating arboreal pathways (ropes, bridges) for especially the langurs to cross parts of their home range without coming into contact with man-made structures.

We have noted elsewhere (Nekaris and Nijman 2008) that since being selected as one of the Top 25 Most Endangered Primates, several research teams and local NGOs have stepped up their efforts in presenting their data on the western purple-faced langurs and are undertaking positive actions towards their conservation (e.g. Eschmann et al. 2008). We here would make a plea that it is imperative to collect and publish data on the dusky toque macaques as well, especially when it pertains to data on conflict and conservation.

Without any action taken we fear that more and more villagers in an increasing number of villages in western Sri Lanka will change their levels of tolerance towards commensal primates. We hope that one or more of the many local conservation NGOs that have emerged in Sri Lanka in recent years will take up the daunting task of instigating such an initiative. After all, as quoted by Rudran (1979: 19), on the teachings of Buddha to the people of Sri Lanka to reflect on his words, '*The forest is a peculiar organism of unlimited kindness and benevolence that makes no demands for its sustenance and extends generously the products of its activity; it affords protection to all beings, offering shade even to the axe-man who destroys it*'.

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