

A god becomes a pest? Human-rhesus macaque interactions in Himachal Pradesh, northern India

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Abstract Human-rhesus macaque conflict due to crop raiding is a major problem affecting northern India, particularly the states of Himachal Pradesh and Uttarakhand. Management techniques are challenging both due to the commensal nature of the macaque as well as the culturally significant status of the species in India. Studies on wildlife crop raiding indicate that people's reactions to crop raiding are strongly influenced by their attitudes towards the species involved and that insights into these perceptions are critical to work towards conflict-resolution measures. Hence, we investigated the attitudes and perceptions of farmers in Bilaspur district, Himachal Pradesh, towards the rhesus macaque (*Macaca mulatta*) and the impact of macaque crop raiding on their lives. We interviewed 54 farmer-families from five villages in Bilaspur and collected data on the extent of crop damage caused by wildlife species, farmers' attitudes towards the rhesus macaque and conflict-mitigation strategies as suggested by the farmers. The results of our study indicate that farmers hold ambivalent attitudes towards the rhesus macaque and mixed opinions regarding its management.

Keywords Human-wildlife conflict · Northern India · Human perception · Rhesus macaque · Crop damage · Wildlife management

Introduction

Human-wildlife conflict (HWC), a phenomenon probably as old as humankind itself, arises when the needs of a wildlife species overlap with those of humans or when a particular species is perceived as a threat to livestock, crops or the wellbeing of humans (Madden 2004). As a form of interface between humans and wildlife species, HWCs throw enormous light on the complex relations that we share with other animal species, as human reactions to different conflict species are rarely the same. Whereas some wildlife species are demonized and seen as requiring punishment for their unacceptable behaviour, others may be viewed with more tolerance. Cultural and societal values deeply colour perceptions of conflict, and this, in turn, dictates the efficacy of mitigation measures (Knight 2000).

Crop depredation by wildlife species is one of the major causes of human-wildlife conflict, and this is true in northern India too, with several wildlife species such as the rhesus macaque (*Macaca mulatta*), wild pig (*Sus scrofa*), porcupine (*Hystrix indica*), barking deer (*Muntiacus muntjak*) and the nilgai (*Boselaphus tragocamelus*) becoming agricultural pests in recent years due to their crop-raiding activities (Rao et al. 2002). While the wild pig and the rhesus macaque are fairly abundant across the region, the other species are relatively more restricted in their distribution. Because of its ability to occupy forests as well as human habitats in large numbers (Roonwal and Mohnot 1977), conflicts due to rhesus macaques are problematic in urban as well as in agricultural areas in northern India, particularly in the twin hill-states of

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Uttarakhand and Himachal Pradesh (Radhakrishna and Sinha 2011). In urban areas, rhesus macaques damage property and injure people when they raid houses in order to gain access to food and provisions while in agricultural areas, they cause financial losses to farmers due to crop depredation (Singh 2000; Malik 2001; Southwick and Siddiqui 2001; Chauhan and Pirta 2010; Singh and Thakur 2012). Estimates of crop damage in Himachal Pradesh range from 10–100 % to 40–80 % of all crop losses and financial losses to be around USD 200,000 in agriculture and USD 150,000 in horticulture (Jardhari et al. 2008; Singh and Thakur 2012). Demographic studies on rhesus macaques in some parts of northern India indicate that their numbers have been steadily increasing from 1978 when a governmental ban was imposed on their export (Southwick and Siddiqui 2001; Imam and Ahmad 2013). It was estimated that rhesus macaque populations in India numbered more than 3 million in 1994, a several-fold increase from their estimation of 410,000–460,000 in 1988 (Southwick and Siddiqui 1994, 1988). Censuses conducted by the forest department of Himachal Pradesh (reported in Singh and Thakur 2012) record large increases in rhesus populations in the state over the last few decades; from 155,000 in 1988–1989 to 223,014 in 1995 to 317,112 in 2004. It has been suggested that the increase in macaque numbers is largely responsible for heightened levels of human-macaque conflict in urban and rural areas (Southwick and Siddiqui 1988; Imam et al. 2002; Rao 2003).

Despite the universality of the problem, HWCs related to crop raiding are rarely straightforward issues that may be resolved by a single approach (Conover 2002; Madden 2004; Woodroffe et al. 2005). A farmer's perception of crop losses may be influenced by the emotional privations undergone by her/him while growing the crops and, hence, may not be a true measure of the actual financial damage that was caused by the wildlife species. Studies have shown that perceived losses, rather than actual losses, shape retaliation against the offending wildlife species (Gillingham and Lee 2003; Naughton-Treves and Treves 2005). Also, tolerance for damages sustained due to wildlife species varies among farmers and depends on a number of factors such as the economic status and stability of the farmer in question, cultural attitudes towards the given species and the frequency and intensity of wildlife conflicts (Mishra 1997; Nath and Sukumar 1998; Naughton et al. 1999; Knight 2000). Resolution or mitigation of human-wildlife conflict issues, therefore, depends crucially upon a clear understanding of people's perceptions or attitudes vis-à-vis crop-raiding wildlife species (Hill 2004; Dickman 2010).

HWC involving the rhesus macaque presents a remarkable case of human-wildlife interface. Since the rhesus is considered a common and commensal species and therefore not an object of conservation concern, it is more vulnerable to survival threats as a consequence of its crop-raiding activities.

(Interestingly, although the rhesus macaque is categorized as Least Concern by the 2013 IUCN Redlist, in acknowledgment of its widespread distribution, population trends are unknown for the species in many parts of its range). However, it is also culturally revered as a living representative of the Hindu deity Hanuman in India, and hence, cultural beliefs regarding the sanctity of the species are likely to influence people's tolerance for its crop depredations. As people's attitudes towards the species are of significant importance for its future survival, we proposed to investigate this aspect in a human-rhesus macaque conflict area in Bilaspur district of Himachal Pradesh in northern India. The primary aim of our study was to understand farmers' perceptions of crop-depredating species and their attitudes towards the rhesus macaques in this context, particularly with respect to conflict management strategies aimed at the species.

Methods

Study area

Bilaspur district is situated in the Satluj valley in the outer hills of the Himalayas (Shivaliks) in the state of Himachal Pradesh in northern India. We conducted our study in five villages in the district: Kathalag (31.45° N, 76.68° E), Kasaru (31.47° N, 76.67° E), Deoli (31.37° N, 76.81° E), Mangrot (31.35° N, 76.81° E) and Samoh (31.39° N, 76.69° E).

Methods

The study was conducted from January to June 2010, and we used an interview-survey method to collect data. As the villages comprised different social castes,¹ a stratified sampling technique was employed to ensure representative samples of all major groups in the villages. In some of the study villages, different caste groups lived in hamlets in different parts of the village. Hence, we initially used random sampling to select samples from different parts of the village and, thereafter, used snowball sampling to choose the remaining few samples for the different communities. The interview schedule, comprising of three questionnaires, was administered to each family/household in the local languages (Hindi/Pahari/Punjabi) with the average time taken per family being approximately 45 min. The questionnaires included open-ended and fixed-response questions.

The first questionnaire collected information on the extent of crop damage experienced by the farmers and the wildlife

¹ Following Ogra (2009), we did not include caste identities in our analysis, as we do not believe that the study justified intrusion of participants' privacy regarding this matter.

species responsible for this damage. Respondents were asked to rank the importance of the problems they faced in agriculture, such as drought, wildlife depredation, weeds, stray animals and pests from a scale of 1 to 5, with 1 representing the most serious threat. They were also asked to rank the animal/wildlife species in order of the threat they represented. Farmers were asked to estimate the fraction of produce that was destroyed by the prominent crop-depredator species.

The second questionnaire collected information on people's attitudes towards rhesus macaques, their perceptions regarding the reasons for rise in macaque numbers, if any, and ways to mitigate macaque conflict. We permitted multiple responses to queries in this questionnaire as we aimed at obtaining an accurate representation of people's opinions vis-à-vis the rhesus macaque. The third questionnaire focused on the socioeconomic background of study households and gathered data such as sources of income, size of land holdings, farming practices and productivity of the two main crops, maize and wheat.

Data analysis

We analysed the interview data to investigate three main aspects: (i) respondents' perceptions of the extent of crop damage caused by rhesus macaque and other wildlife species, (ii) respondents' attitudes towards the rhesus macaque and (iii) conflict mitigation solutions offered by the respondents. Data relating to the multiple-response questions were depicted as percentage of respondents for each response and, in many cases, summed to over 100 %. In order to obtain a comparative perspective of crop-depredating species, we weighted each species by the proportion of respondents who ranked it most serious, second most serious, third most serious and so on and then rank-ordered the proportions to determine the most serious crop depredator. These measures were calculated for the crops taken together and not separately for wheat or maize.

We estimated perceptions of crop losses due to the main crop-depredator species for wheat and maize using the following formula:

Crop-loss due to a depredator (kg crop in one season)

= Average crop produced per family in the given village (for that season)

× Average crop damage (in percentage, %) inflicted by that particular depredator species in the given village.

Based on crop productivity (maize and wheat) estimates given by the farmers and crop losses due to depredator species, we calculated potential productivity that may have occurred if farmers did not accrue losses due to wild pigs and macaques. In order to estimate the monetary value of crop produce and crop losses, we multiplied crop quantity (productivity as well as estimated losses) with the local cost for maize and wheat, i.e., INR 7.5/kg and INR 8/kg, respectively. Although the retail prices for maize and wheat were higher, we chose to use the government-subsidized food rates, as maize and wheat are typically grown for subsistence in this region.

Respondents suggested several methods to resolve or mitigate macaque conflict. Based on the nature of the recommended approach, we classified them (as exemplified) thus

- (1) Evasive: "What can we do? It is the government's responsibility; the macaques should be moved to a zoo or a park or translocated elsewhere",
- (2) Manipulative: "The macaques should be killed or sterilized or trapped in cages and starved to death",
- (3) Constructive: "We should plant more fruiting trees and dig water-holes in the forests for the macaques", and

- (4) Preventive: "The macaques must not be provisioned; we should employ guards or trained langurs² to protect our crops".

Results

We surveyed a total of 54 households, with the age of the respondents ranging from 26 to 85 years. A large percentage of the study households had members who were government employees (59 %) or were working in privately owned enterprises (35 %). Most of the families in the study villages practised subsistence farming, and farmers mainly grew two kinds of crops in a year, wheat in winter (*rabi* crop) and maize in summer (*kharif* crop). Along with these two crops, they also grew a number of other crops like pearl millet (*Pennisetum typhoides*) for fodder, *khair* (*Acacia catechu*) for commercial purposes, vegetables and fruits.

² In some regions of northern India, people resort to the practice of using trained common langur (*Semnopithecus entellus*) individuals to chase away rhesus macaques.

Crop depredation and wildlife pests

The majority of the farmers (98 %) stated that the biggest problem that worried them was the drought that had been prevailing over the last 4 to 5 years. A considerably large percentage (77 %) also reported that the wild pig was a serious menace, while 73 % of the respondents termed the rhesus macaque as a nuisance. Seventy-four percent of the people found weeds like *Anagallis arvensis* and *Lantana camara* to be problematic, and 57 % thought stray cattle was a serious depredator. Among animals, particularly wildlife species, farmers ranked the rhesus macaque as the most serious crop-depredator species, the wild pig as the second most serious depredator, stray cattle as the third most serious depredator, rodents as the fourth and birds as the fifth most serious crop depredator.

Fifty-eight percent of the respondents found macaques to be the most serious wildlife threat to crops whereas only 27 % of the respondents found wild pig as the most serious wildlife threat to crops. However, according to the crop damage estimates (expressed as percentages) given by study respondents, wild pigs appeared to have caused greater damage than rhesus macaques. The extent of crop loss due to the two species varied between the different villages. Crop depredation due to wild pigs was highest in Kathalag and lowest in Samoh, and crop depredation due to macaques was highest in Kathalag

and lowest in Kasaru. Overall, Kathalag appeared to be the worst hit village, with more than 60 % of the village produce being estimated as depredated by monkeys and pigs (Fig. 1).

Maize crop losses due to macaques and wild pigs were highest in Kathalag and Mangrot, and wheat crop losses were highest in Deoli and Mangrot. In monetary terms, potential crop produce was estimated to be around INR 4566 per family for maize and INR 3005 per family for wheat. The estimated crop losses due to rhesus macaques and wild pigs combined were more than half these amounts—INR 2501 per family for maize and INR 1646 per family for wheat (Table 1). Overall, crop losses (based on estimates given by respondents) showed that damage due to wild pigs were higher than those caused by macaques.

People's attitudes and perceptions towards rhesus macaques

The majority of the respondents (80 %) in Bilaspur considered macaques to be a part of the army of the monkey god Hanuman, and only a smaller percentage (29 %) stated that they were agricultural pests. About 11 % of the respondents saw rhesus macaques as 'a part of nature, just as I am'. None of the respondents agreed to the notion that the macaque was 'an animal that humans should take care of', and only one individual opinioned that it is a 'wild animal'. Interestingly,

Fig. 1 Crop depredation by rhesus macaques and wild pigs in the study villages of Himachal Pradesh state, northern India

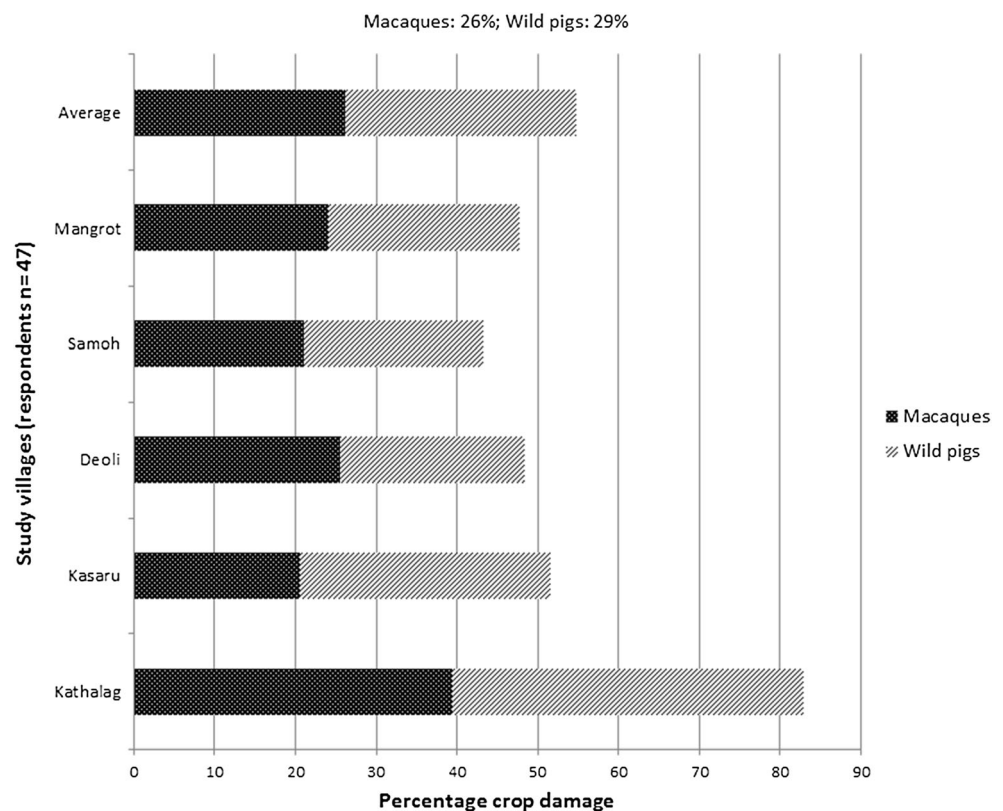


Table 1 Average crop produce and estimated crop loss due to wild pigs and rhesus macaques in the study villages of Himachal Pradesh state, northern India ($N=42^a$)

Wheat/maize quantity (kg)	Kathalag ($n=4$)	Kasaru ($n=8$)	Deoli ($n=10$)	Samoh ($n=15$)	Mangrot ($n=5$)	Average	Monetary value (INR)
Potential average maize produce per family in 2009 ^b	869	368	656	289	862	608.7	4566
Maize crop loss due to macaques in 2009	342.2	75.9	167.7	60.7	206.9	159.0	1192
Maize crop loss due to wild pigs in 2009	378.0	114.1	149.6	64.2	205.2	174.5	1309
Potential average wheat produce per family in 2010 ^b	276	39	901	140	522	375.6	3005
Wheat crop loss due to macaques in 2010	108.7	8.0	230.5	29.4	125.3	98.1	785
Wheat crop loss due to wild pigs in 2010	120.1	12.0	205.7	31.1	124.2	107.7	861

^a Some respondents did not wish to share information regarding their wheat/maize production

^b If losses due to wild pigs and macaques did not occur

18 % of the respondents had mixed feelings regarding rhesus macaques and replied that they were agricultural pests as well as a representation of a god.

About 32 % of respondents believed that the rhesus macaque had always been an agricultural pest. The remaining (68 %) asserted that it had become a menace only in the last 8 years. Almost all the respondents (90 %) agreed that the macaque population had increased in their locality; the most common response was that there had been a tenfold increase in the last few years. Village-wise, respondents in Kathalag (100 %) and Deoli (93 %) felt that the monkey problem was a recent phenomenon, whereas the opinion was somewhat divided in Kasaru (60 %), Mangrot (40 %) and Samoh (46 %).

Respondents cited various reasons for the rise in macaque population, and there were differences in the opinions expressed by people in the five villages (Table 2). Talking about the decrease in forest cover, some people expressed the opinion that the main cause for this was growth in human population leading to greater urbanization, whereas others blamed the practice of indiscriminate logging for timber or to gain grazing land.

Conflict mitigation solutions

People in the five study villages practised several strategies to scare away macaques. Apart from throwing stones at the macaques (78 %), they used firecrackers or beat upon drums and tin cans (14 %) and used dogs to guard against the monkeys (14 %). Many people (14 %) complained that these methods were ineffective in chasing away the macaques.

Most of the respondents were aware of the sterilization campaign conducted by the state forest department (84 %), but a large percentage (71 %) were sceptical about its effectiveness. Some of the respondents (11 %) expressed the view that the Forest Department did not help them in any significant way to resolve the macaque-conflict problem. A common feeling was that the sterilization exercise was a mere formality, as less than 2 % of the monkey population was sterilized 2 or 3 years earlier. Respondents argued that sterilizing such a small number was of no use, as the population returned to original levels in about 3 months' time.

When questioned on methods that may be used to tackle the macaque conflict, respondent farmers suggested many techniques ranging from translocation and sterilization to crop guarding and prevention of monkey provisioning. While most

Table 2 Perceived causes for rise in macaque populations in the study villages of Himachal Pradesh state, northern India ($N=31^a$)

Reasons cited for rise in macaque population	Kathalag ($n=4$)	Kasaru ($n=4$)	Deoli ($n=9$)	Samoh ($n=10$)	Mangrot ($n=4$)	Overall percentage
Increase in forest cover	7	3				10
Decrease in forest cover				13	3	16
Protection by the Forest Department				3	7	10
Macaque fecundity	3		13	7	3	26
Macaque ingress due to translocation		10	7	13	3	32
Drought/fire		3	19	7		29
Tourist provisioning	7		7	3		16

^a Many of the survey respondents did not wish to answer the question regarding causes for rise in macaque population. The numbers in the table are the percentage of respondents in each village who answered the question

of the farmers responded with evasive (49 %) and manipulative (39 %) suggestions, a smaller percentage proposed preventive measures (15 %). Only a very small number of respondents recommended constructive (9 %) methods. Interestingly, respondents in the different villages differed in their opinions on the best way to deal with the macaque problem (Fig. 2).

Discussion

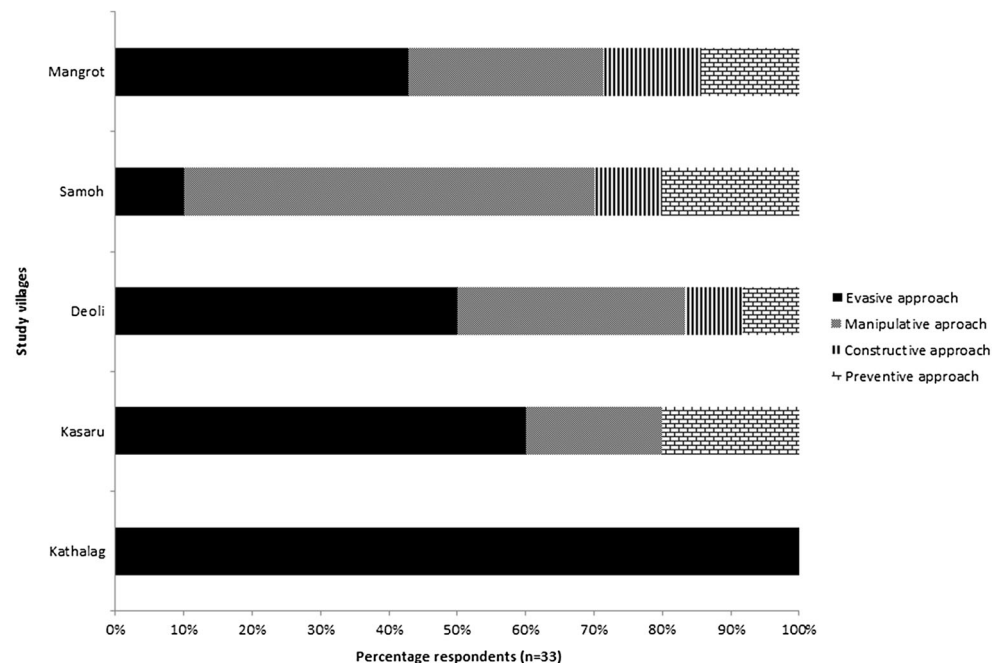
Humans share complex relations with many wildlife species that are often an amalgam of fear, tolerance, compassion and dominance, and nowhere is this more clearly evident than in their interactions with problem wildlife species that are also culturally significant icons. Many primate species are apposite examples of this—species that have become crop raiders in parts of Asia and Africa, such as baboons (*Papio anubis*, *Papio cynocephalus*), vervet monkeys (*Cercopithecus aethiops*), chimpanzees (*Pan troglodytes*), macaques (*Macaca brunnescens*, *Macaca tonkena*, *Macaca fuscata*) and the common langur (*Semnopithecus entellus*) are problem wildlife species not only because of their crop depredations but also because their ‘protected’ status (either due to cultural imperatives or because of conservation policies) complicates retaliation measures against them (Hill 2000, 2004; Sprague 2002; Priston 2005; Khatun et al. 2013). Their wide dietary range and occasionally aggressive behaviour make primates formidable crop raiders; the problem is exacerbated when the species involved are commensal and well adapted to living within and in association with human settlements (Sillero-

Zubiri and Switzer 2001). In India, a measure of the extent of social wrath caused by the crop depredations of the rhesus macaque was the decision of the Himachal Pradesh state government in 2010 to permit the culling of rhesus macaques by afflicted farmers (Chauhan 2011). An interesting corollary is that owing to public pressure, this decision was revoked by the state high court a couple of months later, and the state forest department stopped issuing shooting permits to farmers.

Results from our study highlight two significant aspects of the human-rhesus interface in Himachal Pradesh; one, farmers’ perceptions that crop-raiding problems caused by the rhesus had become intolerable only in the last decade and two, the ambivalent attitude of people towards the species. That the rhesus has become an agricultural pest only in more recent years has been noted by another study on rhesus crop raiding in the state of Uttarakhand. Farmers in the village of Jardhagaon in Uttarakhand reported that they had always been subjected to rhesus crop raiding. However in earlier times, their crop losses due to the rhesus were about 10 % whereas over the last 5 to 10 years, it had become about 50–90 % (Jardhari et al. 2008). Rhesus macaque numbers have increased in Himachal Pradesh and in many parts of northern India over the last couple of decades (Southwick and Siddiqi 2001; Singh and Thakur 2012; Imam and Ahmad 2013); however, it is still not clear if the increase in crop depredations are due to the increase in rhesus numbers.

Farmers in Bilaspur perceived the rhesus macaque as a serious agricultural threat; however, they also saw it as an important religious icon, and this inhibited them from practising or advocating strong retaliatory measures against the species such as physical harm or killing. Interestingly, farmers

Fig. 2 Conflict mitigation measures suggested by respondents in the study villages of Himachal Pradesh state, northern India



also exhibited reluctance to harm stray cattle (cows are typically venerated by those following the Hindu faith in India) whereas they admitted that they kill and consume wild pigs. Apart from religious concerns, farmers also expressed sympathy for the macaque; they felt that the species was forced to crop raid as drought, fire and loss of forest cover had left the monkeys with little natural forage. Earlier studies have noted this cultural reverence for the rhesus macaque (Richard et al. 1989); however, retaliation against another culturally significant crop-raiding primate species, the bonnet macaque, in some parts of India (Kumara et al. 2010) caution that tolerance for the rhesus macaque may not last forever.

Debates surrounding human-wildlife conflict issues point out the necessity of addressing two important aspects of conflict to ensure successful mitigation interventions: (a) sources of conflict between human groups involved in HWC and (b) quantification of actual damage caused by the conflict animal species (Siex and Struhsaker 1999; Madden 2004; Riley 2007; Dickman 2010; Peterson et al. 2010). The findings from our study support these conclusions; respondent farmers in Bilaspur appeared to have little faith in the ability of the state forest department to resolve their conflict problems, and a large part of their discontentment with the conflict situation was directed at the Forest Department for making, what they described as, token gestures towards macaque management. A study on the human-rhesus macaque conflict situation in Jhardhargaon in the state of Uttarakhand documents a similar sense of resentment on the part of the farmers towards the Forest Department (Jardhari et al. 2008). Farmers in Jhardhargaon felt that the rhesus macaque population had increased because the Forest Department had reforested the areas around their village and because they protected the macaque from retaliatory measures by the farmers. Hence, the responsibility of controlling or resolving the crop-raiding activities of the macaques was also the onus of the Forest Department (Jardhari et al. 2008).

Perceptions of crop losses strongly impact attitudes towards conflict animal species and, by extension, their conservation. For this reason, quantification of actual crop damage is an important component of understanding conflict situations and working towards their resolution (Naughton-Treves 1996; Riley 2007). Although we did not directly measure crop losses in our study, we quantified farmers' perceptions of crop depredation in order to compare between the crop-raiding species. Interestingly, although farmers named the rhesus macaque as the most serious threat to crops, the estimates they provided indicate that the wild pig causes greater crop damage in their villages. The mismatch between farmers' perceptions and actual crop damage has been reported by many studies, and it has been argued that diurnal, larger-bodied species whose raiding activities are more visible tend to bear a disproportionate proportion of farmers' ire (Naughton-Treves 1996; Siex and Struhsaker 1999; Hill 2000; Riley 2007). Indeed the

results of our study argue for the need for more studies that quantify crop losses and thereby validate (or invalidate) perceptions regarding wildlife-caused crop damage.

Mitigation measures proposed by the study respondents reinforce the point of macaque ownership raised earlier by Jardhari et al. (2008). Although farmers acknowledged that reasons like loss of forest cover, macaque provisioning by tourists and macaque ingress due to translocation were responsible for escalation in macaque numbers and increased crop raiding by the species, only a small minority expressed the view that addressing these problems would help resolve crop raiding. Instead, most of the farmers declared that handling the macaque conflict was the concern of the Forest Department and that there was little they could do about it. Adherence to wildlife laws may be a reason why farmers were reluctant to react against the rhesus macaque or deter its crop raiding behaviour; however, it is more likely that the culturally revered status of the species was a far more compelling cause for their compunction. For, in contrast to the macaque, the other agricultural pest, the wild pig, was neither considered protected nor the responsibility of the Forest Department, and farmers did not appear to experience any constraint retaliating against this species.

Management practices for crop-raiding primates range from translocation, culling, sterilization, chasing away of the problem species to guarding crops and using fences or fire to prevent the entry of animals (Sprague 2002; Priston 2005; Beck et al. 2007; Hockings and Humle 2009; Malaivijitnond et al. 2011). Other proposed techniques include creating buffer zones of preferred foods or physical barriers, planting primate-aversive crops, the use of acoustic or chemical repellents and modifying cropping regime to reduce crop losses (Chalise 2001; Forthman et al. 2005; Hockings and Humle 2009; Priston and Underdown 2009). In India, methods that are typically used include guarding crops, chasing away crop-raiding individuals, translocation and sterilization, although none of these have been completely effective (Radhakrishna and Sinha 2011; Rattan 2011; Singh et al. 2007). Mitigation measures regarding problematic wildlife species work successfully in the long term, only when afflicted communities are convinced about its efficacy and invest in its outcomes. In Bilaspur, farmers appeared to divorce themselves from macaque mitigation schemes, possibly because they feared the repercussions of harming a culturally revered species. The increasing numbers of rhesus macaques in rural and urban areas in northern India and the very real damage to farmers' livelihoods in the region argue for the need for some form of population management mechanism to control rhesus macaque population levels. However, as highlighted by the findings of our study, it would be equally important, if not more, to take into consideration the views of farmers from conflict areas before management decisions are thrust on them.

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