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Human-Elephant Conflict around North and South Forest Divisions of Nilambur, Kerala, India

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Abstract. We studied attitudes towards elephant conservation and human-elephant conflict through a questionnaire survey of 239 forest fringe residents of Nilambur North and South Forest Divisions, Kerala. Respondents perceived restriction of free movement and crop damage as the most important problem. Conflict increased in some areas during the rainy season due to failure of protection methods, and in others in the summer due to availability of water and fruiting trees in the forest fringes. In some areas conflict occurred throughout the year because of perennial crops. Co-operative management of conflict was supported by only 27.4% and most considered conflict management as the exclusive responsibility of the Forest Department. Two thirds of the respondents expressed positive attitudes towards elephant conservation.

Introduction

Conservation of the Asian elephant (*Elephas maximus*) ensures maintenance of large tracts of natural habitats that facilitate ecological functions and improve the quality of life of millions of people across India (Baskaran 2013). Expanding human populations and developmental activities have isolated elephant habitats of Western Ghats (Sukumar 1989), where the largest Asian elephant population in the world occurs. Asian elephants require larger areas of natural habitat than any other mammalian species in tropical Asia for survival, therefore are severely affected by development activities (Sukumar 1989). Human-elephant conflict (HEC) has been an important issue for conservationists across the world (Lee *et al*. 1986). Being a conservation hotspot within a thickly populated region, HEC is very pronounced in the Western Ghats region.

Elephants are among the most conflict-prone wildlife species in India, causing large-scale damage to crops and human lives. Each year, nearly 400 people and 100 elephants are killed in conflict related instances in India, and nearly 500,000 families are affected by crop damage (MoEF 2010). HEC negatively affects people's tolerance and thereby poses a challenge to the survival of elephants (Sarker & Roskaft 2010). Due to regular conflict incidents people oppose ventures promoting conservation of elephants in the wild. It has been recognized that people residing in proximity to conservation areas make significant contributions towards the survival of elephants (Naughton-Treves 1998). Therefore it is necessary to understand the people's opinion about the elephant conflict and their attitudes towards conservation. Evaluation of people's attitude towards wild elephants is also essential in formulating appropriate policies for conservation of the species (Hill 1998).

The present study was carried out in the forest fringe regions of Nilambur North and South Forest Divisions, part of Southern Western Ghats. The objectives of this study was to understand (i) the impact of HEC on forest fringe residents (ii) seasonal patterns of conflict (iii) temporal pattern of occurrence of conflict and associated

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factors (iv) people's willingness for co-operative mitigation of conflict (vi) views about 'who is responsible to solve the conflict' (v) attitudes towards elephant conservation.

Methods

The Nilambur forests, which cover an area of 760.29 km^2 is administratively divided into Nilambur South and North Forest Divisions (Fig. 1). These forests are part of the Nilambur Elephant Reserve (Range No: 8) where the elephant population is in danger of splitting into isolated sub-populations due to habitat fragmentation (Sukumar & Easa 2006). Forest areas under Nilambur North and South Division support an elephant population of about 525 individuals (Anon 2012). The Vazhikadavu corridor across the Nilambur-Gudallur Ghat Road (Nilambur North Division) is the only link between the North and South Forest Divisions. The New Amarambalam Reserve Forest (NARF), which is part of the Nilambur South Forest Division, forms a core area of the Nilgiri Biosphere. There are about 38 forest fringe villages within ~1 km distance from the forest boundary, with rapid population expansion. Retaliatory killing of elephants, agitations and farmer protests following conflict, are very common in these areas (Rohini *et al*. 2015). Many people residing in the fringe areas depend on the forest for their livelihood, and are involved in livestock grazing, fodder and fuel wood collection.

There are three seasons in the year in the study area. Summer begins from February and lasts up to the end of May. This is followed by the southwest monsoon, which is the main rainy season in Kerala. It begins in early June and continues till the end of September. Winter season is from October to January.

A questionnaire survey was conducted with 239 residents in 17 forest fringe villages. Respondents were selected from households less than 500 m from the forest boundary. The survey was performed through interviews lasting 30–45 minutes. The questionnaire sought information on elephant conflict, seasonality of conflict, trend in conflict, factors behind the increased incidences of conflict, attitude towards elephant conservation and willingness for cooperative management of conflict.

Results

Problems experienced due to conflict

Of the respondents, 73.6% (n = 176) mentioned that the presence of elephants on roads in the

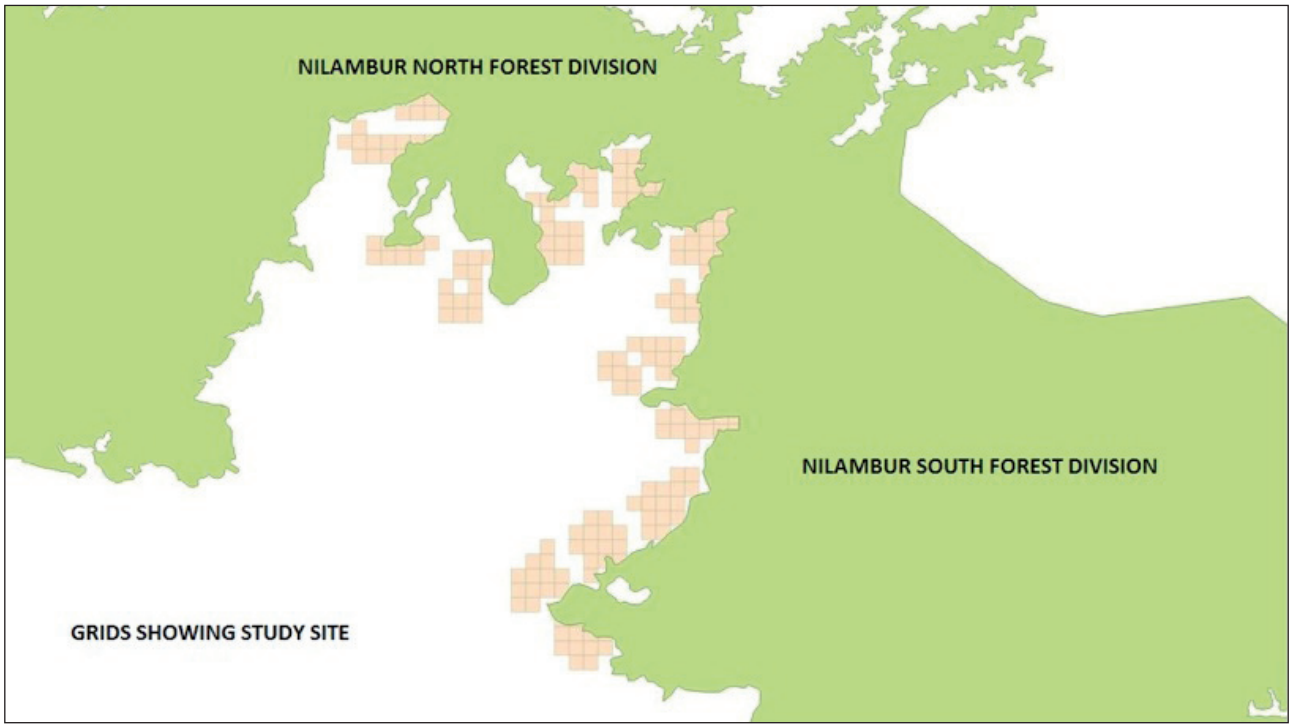

Figure 1. Map of the study area. Grids indicate the villages sampled.

evening restricted their movements and 39.3% (n = 94) experienced crop damage. Several villagers cut down jack trees due to fear of elephants coming near their houses and consequent crop damage during the jack fruit season. Property damage by elephants was experienced by 27.6% (n = 66). Among them, 84% mentioned damage to water pipelines within the forest as the most important difficulty experienced. Other damaged property included barbed wire fences, water tanks, vehicles and compound walls. Incidents of direct attacks or injuries caused by elephants were experienced by 3.3% (n = 8) of respondents.

Trend in HEC and associated factors

Of the respondents, 79.9% (n = 191) perceived that conflict with elephants was much less during the past, but has intensified significantly in recent times, while 15.1% (n = 36) found a decline in intensity of conflict compared to the past. According to 5.0% (n = 12) of respondents, elephant intrusions into forest fringe villages occurred in the past and continue at present. They also observed that the level of conflict was stable.

According to the respondents, increased incidence of conflict could be due to several factors. Food scarcity in the forest and poor quality of existing forest habitat were suggested by 65% of respondents, population expansion of elephants and migration from adjacent forests by 19.4%, human activities such as destroying bamboo and setting forest fires by 9%, reduced retaliation due to strict laws by 4.6% and attraction to palatable crops by 2.0%. The respondents who found a decline in conflict stated that the mitigation methods are very effective in preventing elephant entry into the villages.

Seasonality of conflict

When asked about seasonality of conflict, 38% (n = 91) perceived that it was highest during the rainy season. According to their opinion, HEC intensified during the rainy season due to higher failure of protection methods, power failures, and poor guarding and vigilance. According to 30% of respondents (n = 72) conflict occurred mainly in the summer due to water availability in fringes and fruiting season of jack and mango trees. According to 20.5% (n = 49) of the villagers there was no seasonality for crop raiding and it occurred throughout the year. As plantation crops such as coconut *(Cocos nucifera)* and arecanut *(Areca catechu)* formed a high percentage of the total area under cultivation, crop raiding occurred throughout the year. According to 11.5% (n = 27) of people crop raiding occurred more in winter, associated with the maturity of crops and seasonal movement of elephants.

Attitudes towards cooperative management of conflict

Of the respondents, 77.2% (n = 185) considered the Forest Department to have the sole responsibility for HEC mitigation, 19.1% (n = 45) suggested that the Forest Department and people should share the responsibility and 3.7% (n = 8) considered it as the sole responsibility of villagers.

Of the respondents 88.6% (n = 212) expressed willingness to participate in co-operative management of HEC with the Forest Department while 11.4% (n = 27) were unwilling. Though majority of the respondents expressed their willingness, most believed that co-operative management would be in name only and would not be effective in practice. Of the respondents 79.9% (n = 191) were willing to pay for the maintenance of mitigation activities and 20.1% were not.

Elephant conservation

Considering respondents' attitudes towards elephant conservation in the wild, positive responses were expressed by 62.4% (n = 143). Of those, 79% (n = 113) expressed compassion towards elephants as they had a right to live in the wild and 16% (n = 23) considered elephants a property of the forest. A few respondents (5%, n = 7) regarded elephants as Gods and appreciated their presence in the forest. According to the religious views of few respoondents, it was a sin to mention anything bad against elephants. The interference of humans into the elephants' life was questioned by some respondents who mentioned

positive attitudes towards conservation. About 36.2% (n = 83) of respondents expressed a negative attitude towards elephant conservation due to fear of crop damage, restriction of free movement, and damage caused to economically important trees and teak plantations.

Discussion

It was observed that the majority of residents experienced difficulties associated with elephants. Fear associated with the presence of elephants near their residences and restriction of free movement were the most important problems due to elephants mentioned by respondents. In some villages, people depended on forest roads, which were the only connection between the village and town areas. In such instances they experienced difficulty to return home after work, go to relatives' places or to church, due to fear of the presence of elephants. Restriction of movement is a less documented form of HEC. It was mentioned as the most serious problem after crop raiding in North Shimba Hills, Kenya, with disruption of social activities in the evening and children reporting to school late (Kamula 2003). The presence of elephants interfering with children's schooling was also reported in the Transmara District, adjacent to Masai Mara National Reserve in Kenya (Sitati *et al*. 2012).

Crop depredation by elephants has been identified as the most critical HEC issue in India (Sukumar & Gadgil 1988; Ramakumar *et al*. 2014) and Africa (Sitati *et al*. 2003; Stephenson 2004). In regions with large-scale seasonal crops in forest fringes, patterns of wildlife conflict are strongly influenced by the agricultural calendar (Wilson *et al*. 2013). In our study, crop damage was mentioned by only about half the respondents, possibly because few were doing large-scale cultivation, extensive crop damages were less in the study area.

Previous studies in Kerala have observed a higher incidence of crop raiding by elephants in the rainy season (Easa & Sankar 2001). In our study area, one third of the residents experienced crop damage during the rainy season and another third during the summer. One of the main reasons for damage during the rainy season could be the greater failure of protection methods during rains. For example, insufficient charging of batteries powering electric fences by decreased exposure of solar panels makes electric fences ineffective. Damage to elephant proof trenches by water logging and soil erosion due to heavy rain results in failure of ditches. Additionally, greater difficulty in crop guarding because of heavy rains could contribute to higher conflict in the rainy season.

A third of our respondents stated that crop raiding was higher in the summer. Presence of perennial water sources in some villages abutting the forest boundary, attract elephants in the summer and subsequently they raid crops. In other villages, the presence of crops such as jack and mango the fruiting of which occurred in summer led to higher conflict.

A few respondents observed occurrence of conflict throughout the year associated with the presence of perennial crops. This finding is comparable to results observed in North West Maharashtra where crop raiding occurs all year as plantation crops are abundant (Mehta & Kulkarni 2013).

Damage to property by elephants was reported by close to one third of respondents, the majority of whom mentioned recurrent damage to water pipe lines as the most serious issue. In the study area, to provide water to residents lacking wells, water holes were made in forest 50–500m away from villages and pipes laid from there to households. Elephants mostly damage the pipes by accident, when moving through the area. But during summer, damages to pipelines were very frequent as the elephants used the water holes for drinking. People set up barbed wire fences around the waterholes to prevent elephants from destroying their water source and contaminating the drinking water during summer. Though it was not expensive to repair damage to pipelines, villagers found difficulty in going into the forest several times a day for repairs. In most instances, as the men went out to work in the morning, females feared to go and repair the pipes. Property damage is a common

manifestation of HEC. It was the commonest type of damage around Chitwan National Park and Parsa Wildlife Reserve in Nepal, were crop damages were found to be much less (Pant *et al*. 2015).

Very few respondents had experienced attacks by elephants, but several reported accidental meetings and narrow escapes while collecting fuel wood or water, grazing cattle or in driving away crop raiding elephants. As injury or death due to elephants is publicized rapidly (Ngure 1995), it causes fear among people and local support for elephant conservation is lost (Wilson *et al*. 2013). During the survey, it was observed that fear persisted in a whole village after the death of a tribeswoman by an elephant. It was also noted that, following this incident, people did not cooperate with the Forest Department to extinguish a forest fire near their village.

The majority of respondents observed recent intensification in conflict. This is particularly important because increasing conflict creates negative attitudes towards elephants (Sarkar *et al*. 2013). Habitat destruction and food scarcity within the forest habitat were suggested as the major reasons for increase in conflict. Similar findings were observed in Kameng Elephant Reserve, Northeast India (Sarkar *et al*. 2013). This is probably an important factor in our study area as large areas of natural forests have been cleared for monoculture teak and rubber plantations in the Nilambur region (Kakkoth 2001). One fifth of respondents suggested population expansion and migration of elephants from nearby forests through established forested corridors that are adjacent to human settlements as the reason for increase in conflict. Overpopulation of elephants has been suggested as a main reason for conflict in India (Karanth & Nepal 2012). Occurrence of conflict by elephants migrating from a protected area through a corridor adjacent to human settlements was reported within fringe villages of Kaziranga National Park, Assam (Di Fonzo 2007). Similarly, migration of elephants from Karnataka state to Kolhapur and Sindhudurg district of Maharashtra and subsequent conflict has been reported (Mehta & Kulkarni 2013).

A few respondents observed a decline in conflict incidents associated with the presence of effective barriers, which are maintained regularly in a few villages. The creation of barriers and other deterrents must be explored to mitigate elephant conflict. Unresolved wildlife conflicts create negative attitudes towards both the government and wildlife related developments (Anderson & Pariela 2005).

People regarded the Forest Department as the sole stakeholder in resolving conflict, as they were powerless and distressed by their unsuccessful attempts using traditional practices to reduce losses. People believed that expenses associated with addressing the problem could only be borne by the government, as they were very high. However those respondents who preferred village-led approaches, expressed suspicion of the Forest Department due to perceptions of officials' corruption and lack of sincerity. People also demanded that the government should take the initiative for planning cooperative management of conflict. These results regarding co-operative management were similar to findings by Ogra (2009) in Rajaji National Park, Uttarakhand, India.

As the majority of respondents were willing to support co-operative management of conflict despite the mistrust, there is still hope for a cooperative approach to conflict resolution in our study area. Proper communication and appropriate implementation of strategies by a cooperatively operated institution involving forest authorities, ground level staff and people could ensure trust on both sides (Ogra 2009). Such an approach would be relevant to our study area also.

When farmers feel powerless to manage conflict, they hold wildlife managers responsible for crop losses and expect action from them (AfESG 2000). Osborn and Parker (2003) observed that shifting crop protection responsibility to farmers and providing the tools they need, is the best approach for preventing conflict with wildlife and the more responsibility given to farmers for crop protection, more effective the deterrent. Therefore, people's participation is

essential for conflict management. By combining villagers' experience in living with elephants and abilities of forest staff, the conflict could be alleviated significantly. Moreover in practice it is almost impossible to depend on forest staff during a conflict incident. Therefore, collective action by villagers alone will enable successful management of conflict.

Community-based conservation has been suggested as the most practical approach to conflict management in developing countries (Mehta & Kellert 1998). Community based HEC mitigation was successfully practiced in fringe villages of Nameri National Park and Sonai Rupai Wildlife Sanctuary, Assam (Zimmerman *et al*. 2009) and Simao region of Yunnan province, China (Zhang & Wang 2012). Although community-based HEC mitigation does not address the root cause of conflict, it helps to stabilize tolerance and thereby facilitate long-term survival of elephants (Zimmerman *et al*. 2009).

A study in Laikipia, Kenya by Ellis *et al*. (2014) has shown that communities were willing to pay for constructing or maintaining electric fences to mitigate crop damage by elephants. The majority of respondents in our study as well expressed their willingness to pay for the maintenance of barriers. Only a few respondents expressed unwillingness due to financial problems.

Approximately one third of respondents expressed negative attitudes towards elephants due to impacts of HEC. Elephant conservation is difficult if people consider elephants as their enemy. In some high conflict areas such as Nyatana Game Park, Zimbabwe, elephants are seen as pests, which must be eradicated to reduce conflict (Taruvinga & Mushunje 2014).

Despite losses due to conflict in their daily life, about two third of respondents expressed positive attitudes towards elephant conservation. Similar results were observed in Manas National Park, India (Nath *et al*. 2015) and in Shew-U-Daung Wildlife Sanctuary, Myanmar (Allendorf *et al*. 2015) where people appreciated conservation despite losses. In our study area, positive attitudes towards elephant conservation were mostly due to sympathy for their right to exist in forests. A few respondents had positive attitudes due to the belief that elephants were the manifestation of God. Such beliefs can have a major impact on elephant conservation (Sarkar *et al*. 2013).

The ecological value of elephant conservation was totally unknown to the respondents irrespective of whether they appreciated elephant conservation or not. This was evident as several respondents were concerned that elephants caused damage to forests by destroying trees and losses to government as teak trees planted for commercial purposes by the Forest Department were also damaged. Environmental education programs have been successful in encouraging better implementation of forest management schemes (Gillingham & Lee 1999). Therefore, it is necessary to improve conservation attitudes of people by making them aware of the ecological importance of elephants in forest ecosystems.

We conclude that ecological awareness, interaction among stakeholders and participatory maintenance of mitigation methods could reduce conflict and contribute towards coexistence of people and elephants in this human-dominated landscape.

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