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Lethal Fence Electrocution: A Major Threat to Asian Elephants in Assam, India

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Abstract

India has the largest population of Asian elephants (*Elephas maximus*) worldwide. Habitat fragmentation and loss of habitat have diminished food resources, and wild elephants have resorted to raiding crops grown within or adjacent to their home range. Elephants are often deliberately electrocuted for foraying into human-used areas, and this is a key reason for elephant mortalities in India. We collated data on elephant mortalities for a 13-year period (2003–2016) from the Forest Department records. We conducted surveys across Sonitpur District (East and West Forest Division), Assam, where electric fences are installed and documented their location, properties, and elephant presence. Overall, 138 elephants died between 2003 and 2016 due to retaliation, electrocution, accidental or natural death, and unknown reasons. We recorded 47 electric fences (27 lethal and 20 nonlethal) of which 49% were situated within notified forest boundaries. Most lethal fences (63%) protected agriculture fields and were seasonal installations, whereas nonlethal fences protected settlements and forest edges (25% each) and were permanent. Individuals controlled 52% of all lethal fences, while nonlethal fences were primarily controlled by the communities (50%). Most lethal fences (83%) were less than 1 km, whereas 80% of nonlethal fences were over 1 km. Elephant presence was seasonal in 56% of lethal fence locations and year-round in 85% of nonlethal fence locations. We postulate habitat loss and encroachment as two key drivers of fence installations. We recommend rehabilitation of encroachers, monitoring of areas where electricity is tapped illegally, sensitization of local communities, and involving multiple stakeholders to help reduce elephant mortalities because of electrocution.

Keywords

Asian elephant, electric fence, electrocution, Sonitpur district, Assam, India

Introduction

Humans and wildlife are increasingly interacting with each other due to rising human populations and declining wildlife habitats. A frequently used measure to deter human–wildlife interactions when traditional wildlife deterrents (watch towers, loud noise, and firecrackers) fail is fence installation. Fences (electrified or nonelectrified) are commonly used as barriers to restrict the movement of species, particularly mega-herbivores (Lindsey, Masterson, Beck, & Romañach, 2012) and safeguard resources (i.e., settlements, food, and goods) and livestock from foraging animals (Hayward & Kerley, 2009). Electrified fences are often installed to reduce negative interactions between humans and wildlife (Evans & Adams, 2016). However, in some cases, individuals modify them to kill problematic species (Menon, Sukumar, & Kumar, 1997). In India, electric fences are installed illegally to deter crop raiding, particularly by Asian elephants (*Elephas maximus*).

The Asian elephant is categorized as Endangered (International Union for Conservation of Nature, 2008) and is a Schedule I species as per the Indian Wildlife (Protection) Act, 1972. Currently, the elephant population in India is estimated to be around 27,000 (Ministry of Environment, Forest and Climate Change [MOEF], 2017). However, they are threatened by growing human populations, habitat fragmentation, and loss of habitat. The decrease in access to resources prompts

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the elephants to raid crops (Sukumar, 1990) and settlements, and their incursion into human-used landscapes is often met with lethal retaliation from local communities (Aziz et al., 2016).

Electrocution is a common cause of elephant mortalities in India and this occurs primarily in two ways: (a) by power wires that sag when electricity poles or pylons are positioned far apart and (b) when people illegally tap electricity from high and low tension wires (Rangarajan et al., 2010) or use inverters from a direct current (DC) source (battery) and to power fences installed to protect their homes and fields. Electric fences are often preferred as they keep elephants out of human habitations and discourage them from raiding crops. However, fences are lethal when powered by AC current at high voltages, such as 220 V (personal communication). Such practices exist in Assam, India, which is home to over 5,000 elephants (MOEF, 2017).

Assam accounts for 25% of all elephant mortalities by electrocution in the country (Talukdar & Barman, 2003). Between 2013 and 2016, 357 elephant mortalities were reported in the state, of which 37 were by electrocution. In addition, 71 were categorized as "unknown" when deaths by poisoning or electrocution were difficult to distinguish (unpublished data, Assam Forest Department). Previously, while elephant mortalities by electric fences were recorded, there was less clarity on who installed the fences, and where they were located. Our objective was to document the distribution of electric fences in and around elephant habitats across Sonitpur District, Assam. We tested the null hypothesis that (a) the fence installation pattern is not associated with elephant presence, (b) fence installation pattern is not associated with land use, and (c) lethal fences within notified forest boundaries are not lengthy.

Study Area and Methods

Sonitpur District (East and West Forest Divisions, henceforth Sonitpur) in the state of Assam has a human population of 1,924,110 (Census of India, 2011). It is spread across an area of 5,204 km^2 and land cover includes tropical semi-evergreen, moist deciduous and riverine forests, grasslands, agricultural land, and tea plantations. The district is situated on the Northern bank of the Brahmaputra River. Paddy, areca nut, tea, and pulses are the principal crops grown across the region. Forests cover an area of 1,055 km^2 (Forest Survey of India, 2017). Several notified forests such as Nameri National Park (200 km^2), Sonai Rupai Wildlife Sanctuary (220 km^2), Balipara Reserve Forest (RF; 190 km^2), Naduar RF (69 km^2), Charduar RF (260 km^2), Biswanath RF (110 km^2), and Behali RF (140 km^2) are situated in the district. These forests constitute the Sonitpur Elephant Reserve and are major elephant habitats. As many as 500 to 800 elephants are known to inhabit these forests (Choudhury, 2004).

We collated data on elephant mortalities in Sonitpur District for a 13-year period (2003–2016) from the Assam Forest Department records. We classified mortalities into five categories: (a) retaliation by humans (poisoning, shooting, and poaching), (b) electrocution (sagging powerlines and electric fences), (c) natural, (d) accidental (train hit and falling into trenches or river), and (e) unknown (reason for death being inconclusive). With the help of informants, we identified key areas across Sonitpur District where electric fences are frequently installed. We conducted field surveys between July and November 2016 and documented the distribution of electric fences. Fences powered using inverters, direct power supply from households, or by illegally tapping into electric poles were considered as lethal, and those powered by energizers were considered as nonlethal. Energizers do not pose lethal threats to elephants as they pass high voltage electricity between 5,000 and 8,000 DC V at low amperages and in short pulses.

We recorded details of fences such as their location (agriculture fields, human habitations, forests, tea plantations, or mixed—combination of all land uses) and the type of power supply (energizer and inverter or DC). In some cases, individual houses had fences; in others groups of houses, collectively installed fences. We recorded ownership of the fences and the length of the fences. We interviewed fence owners to assess elephant presence in the area where fences were installed and corroborated this information with that of the Forest Department. We used chi-square test to test our hypotheses.

Results

From the Forest Department records, 138 elephant deaths occurred between 2003 and 2016 in Sonitpur District (Figure 1). Of these, 28% were by retaliation, 23% by electrocution, 18% natural, 14% accidental, and 17% unknown. We located 47 electric fences of which 27 were lethal and 20 were nonlethal (Figure 2). Of the lethal fences, 63% were powered using inverters, 33% from direct supply, and 4% were a combination of inverter and direct supply.

Fence Location

Of the 47 fences, 49% were located inside notified forest areas. Of all lethal fences ($n = 27$), 63% were located in agricultural fields, 19% in and around settlements (19%), 11% in or along forest edges, and 7% in mixed land covers (Figure 3). Among all nonlethal fences ($n = 20$), 25% each were located in and around settlements and forest edges, 20% each within agricultural

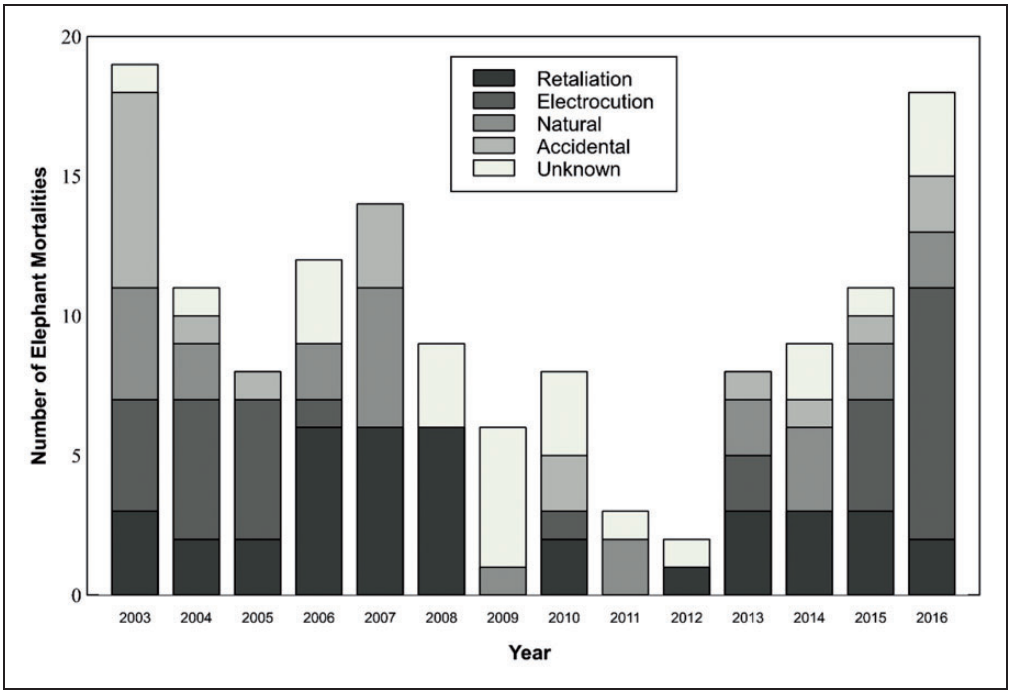

Figure 1. Elephant mortalities in Sonitpur District between 2006 and 2013.

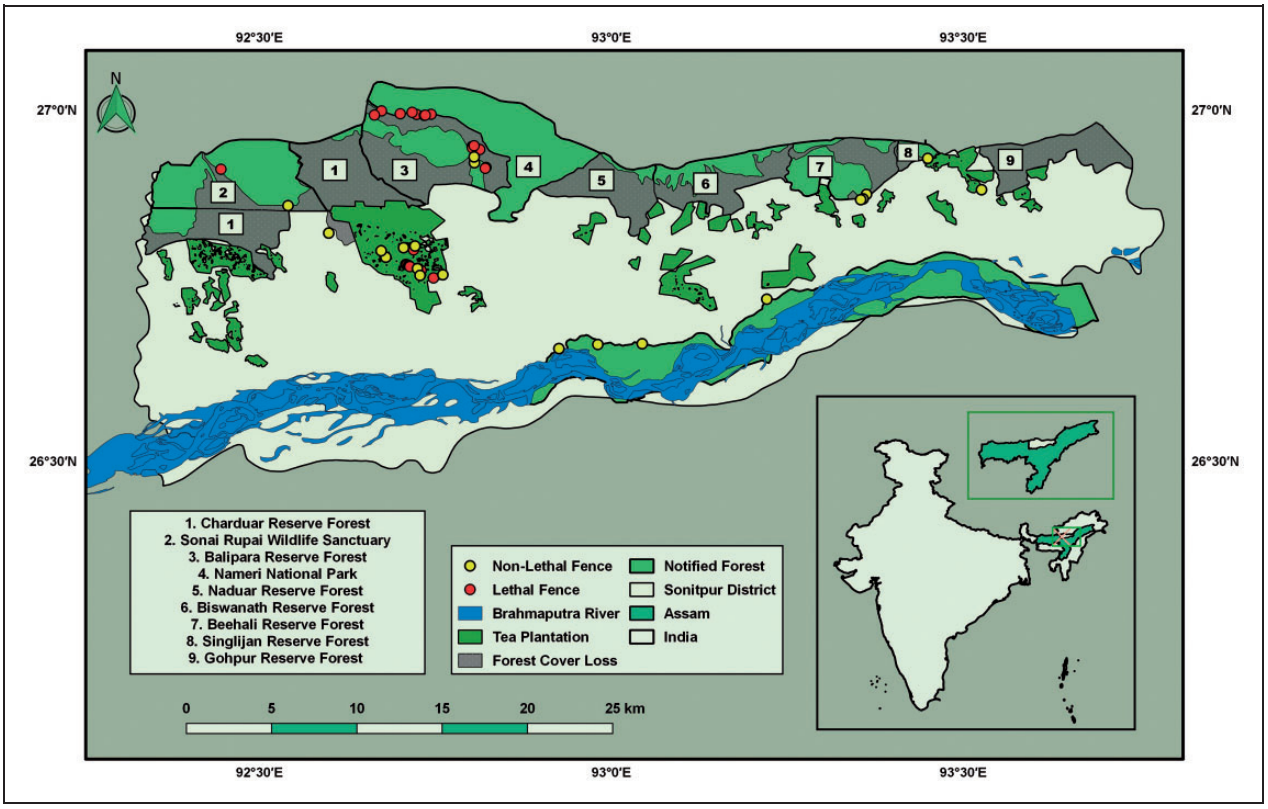

Figure 2. Map of the study region with the locations of all electric fences surveyed.

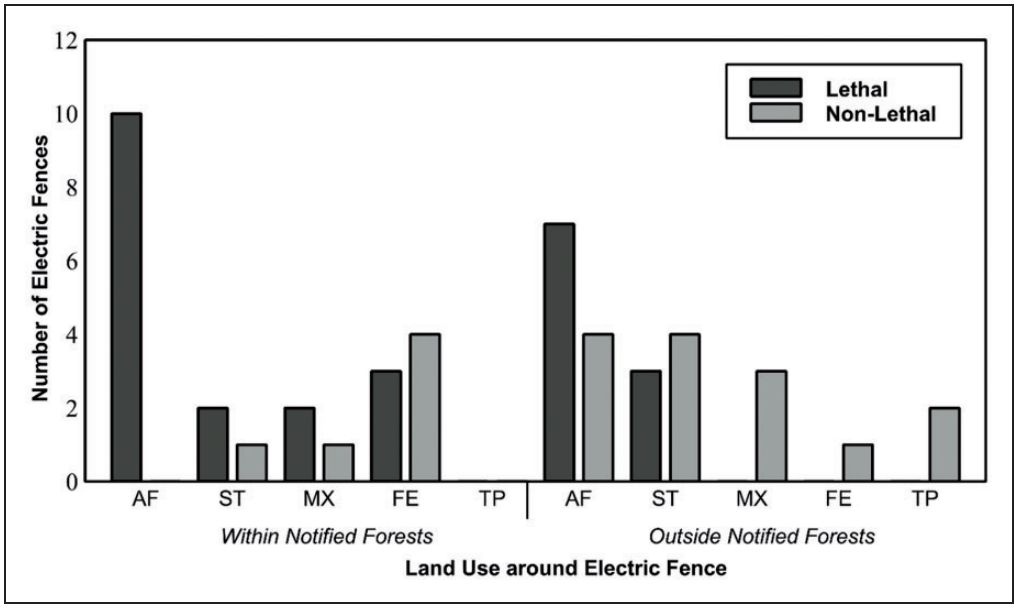

Figure 3. Land use in the area where electric fences were installed.
AF = Agricultural Field; ST = Settlements; MX = Mixed; FE = Forest Edge; TP = Tea Plantation.

fields and mixed land covers, and 10% inside tea plantations. Our hypothesis that the fence installation pattern is not associated with land use cannot be rejected ($\chi^2 = 8.506$, $df = 4$, $p = .07$; significance level 0.05).

Fence Control

Overall, communities installed and controlled 49% of all fences (lethal and nonlethal), while the Defense Establishment controlled 2% of these. Individuals controlled 52% of all lethal fences and 48% were by communities (Figure 4). On the other hand, 50% of all nonlethal fences were controlled by communities, 25% controlled by tea plantation managements, 20% by the Forest Department, and 5% by the Defense Establishment.

Fence Installation Pattern

Among lethal fences, 78% were installed seasonally, while 22% were permanent. Of the nonlethal fences, 85% were permanently installed and 15% were seasonal. Seasonal fences were installed between June and December each year.

Length of Fences

We excluded four fences in this analysis, as we could not obtain accurate lengths for three and one was an outlier (11 km long). Of the rest ($n = 43$, 23 = lethal and 20 = nonlethal), 53% were less than 1 km in length, 26% between 1 and 2 km, 7% between 2 and 3 km, and 14% over 3 km (Figure 5). Majority of the lethal fences (83%) were less than 1 km in length, whereas 20% of nonlethal fences were less than 1 km and 80% more than 1 km. Our hypothesis that lethal fences within notified boundaries are not lengthy is rejected ($\chi^2 = 16.217$, $df = 8$, $p = .03$).

Elephant Presence

In areas where lethal fences were installed, 56% experienced seasonal elephant presence (June–December), while 44% experienced elephant presence throughout the year (Figure 6). Where nonlethal fences have been installed, 85% experienced elephant presence throughout the year and 15% seasonal presence. Our hypothesis that the fence installation pattern is not associated with elephant presence cannot be rejected ($\chi^2 = 2.842$, $df = 1$, $p = .09$).

Discussion

Deliberate and accidental electrocution of elephants is a major threat to them. In Sonitpur, it was the second major reason behind elephant mortalities between 2003 and 2016. The deliberate electrocution of elephants is also rampant across many states in India. For instance, over a quarter of all elephants killed out of retaliation in India occurs in agricultural fields in Karnataka (Gubbi, Swaminath, Poornesha, Bhat, & Raghunath, 2014). Similarly in Odisha, between 2001 and 2012, 118 elephants were killed in 91 electrocution incidents, 34 of which were intentional (Palei, Palei, Rath, & Kar, 2014).

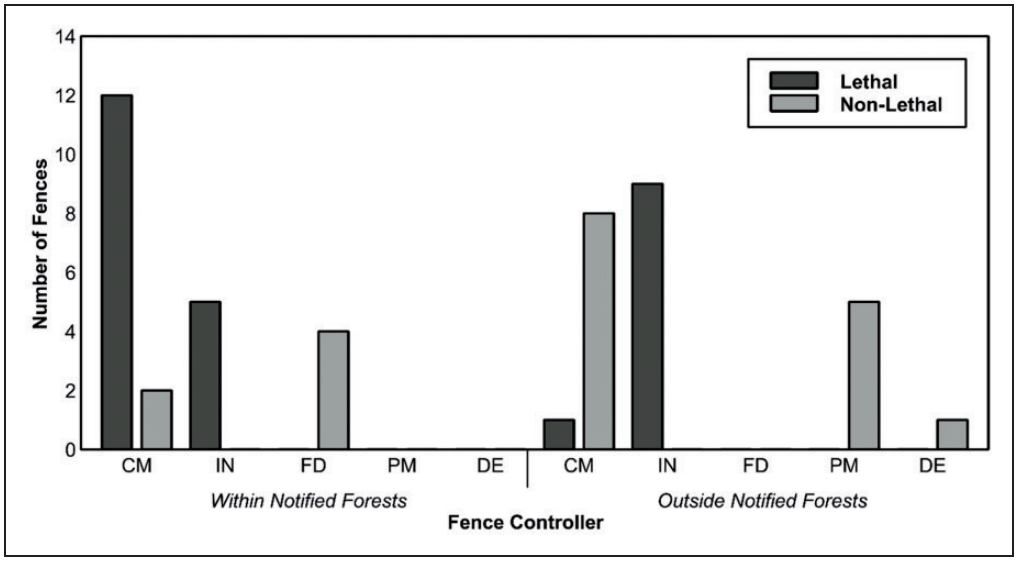

Figure 4. Electric fence controllers.
CM = Community; IN = Individual; FD = Forest Department; PM = Plantation Management (tea); DE = Defense Establishment.

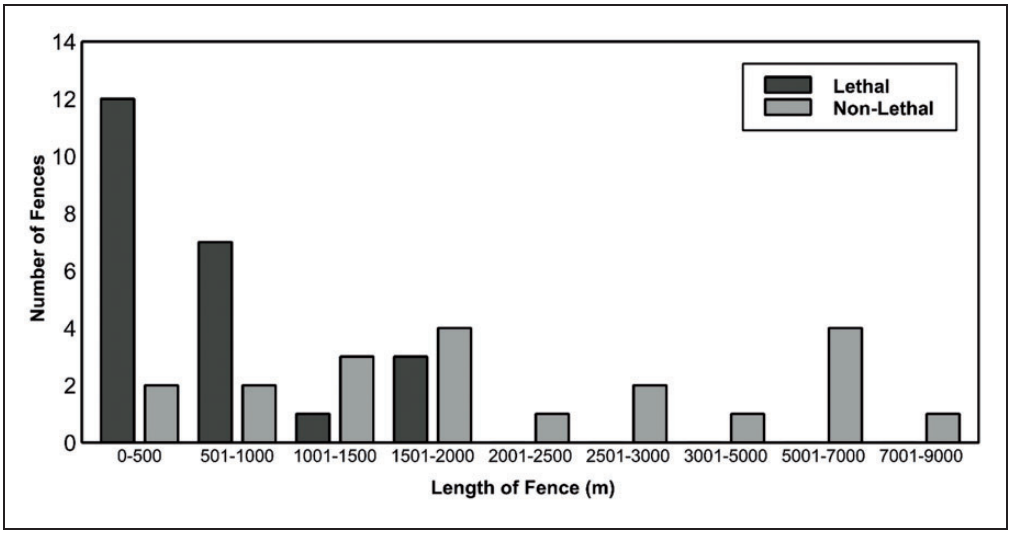

Figure 5. Length of electric fences.

We found a number of electric fences within notified forests. These belonged primarily to communities who have encroached into forested areas and illegally erected fences to protect their agricultural fields and settlements. Individuals who live with wildlife often incur economic losses resulting from crop damage (Nyirenda, Myburgh, Reilly, & Chabwela, 2013), livestock depredation (Holmern, Nyahongo, & Røskaft, 2007), and attacks on humans (Packer, Ikanda, Kissui, & Kushnir, 2005). This is a financial burden on those dependent on income generated entirely from a single source, such as agriculture or livestock rearing. Hence, lethal and illegal measures are adopted to protect assets. At times, individuals from low socioeconomic backgrounds cannot afford fencing. Under such circumstances, they collectively install fences by sharing the costs with others looking for protection. In line with the observation of Van Eden, Ellis, and Bruyere (2016), it is possible that these communities too collectively support the usage of fences and believe in their potential to deter elephant forays, negative interactions with elephants, and subsequent losses. However, this requires further study.

Our study found more lethal electric fences than non-lethal ones, with a greater number of the lethal fences erected illegally, inside notified forests. This is because lethal fences are cheap; usually built with easily available

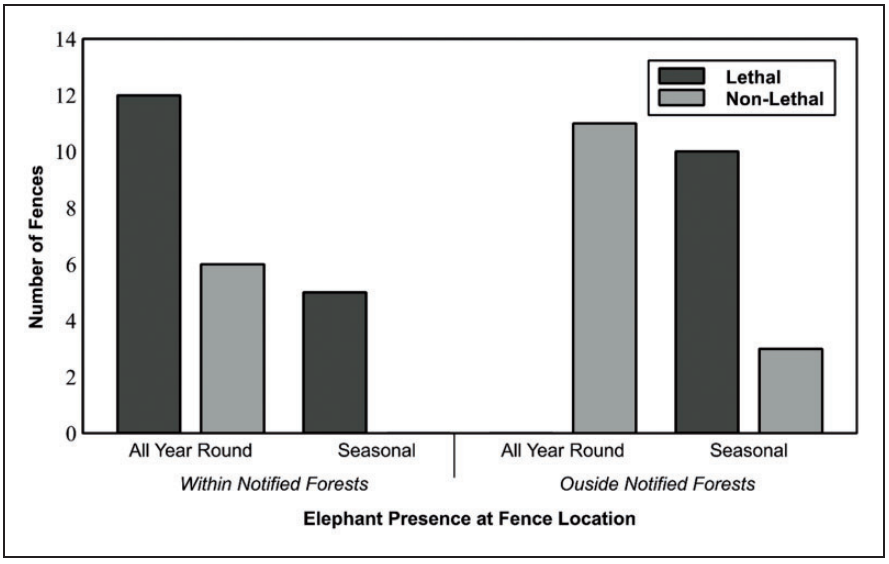

Figure 6. Elephant presence at electric fence sites.

materials such as bamboo poles, rubber or plastic bottles (insulators), and wires; and require low maintenance. The lack of awareness, popularity, and availability of energizers are also reasons why they are less utilized. Furthermore, energizers are more expensive (INR 7,000, USD 100), whereas locally made inverters cost approximately INR 2,000 (USD 20–30) and are easily available in local markets.

Most lethal fences in Sonitpur were installed seasonally (June–December), coinciding with the paddy sowing and harvesting season. Paddy is preferred by elephants because it is more nutritious, palatable, and has high sodium content (Sukumar, 1990). In Sri Lanka, elephants are known to promptly arrive at paddy fields with the onset of the harvesting season (Santiapillai & Read, 2010). Knowing their pattern allows farmers to preplan seasonal fence installations to limit crop loss. Contrary to our hypothesis, we found that most lethal fences (both within and outside forests) were of shorter lengths. This is because smaller length fences are easily dismantlable in the case of an elephant death or Forest Department inspection, and they also leave minimal evidence suggesting their presence. However, we located one illegally installed, lethal fence that was 11 km in length and located inside Sonai Rupai Wildlife Sanctuary. Nonlethal fences were largely found around forest edges and outside forests, were longer, and were installed permanently. Although people living outside notified forests witnessed elephant forays all year-round, they opted for nonlethal fences, suggesting that they are tolerant and hold favorable attitudes toward elephant forays. This is also attributed to the intensive awareness programs conducted by WWF-India toward adopting the use of nonlethal fences.

We postulate habitat loss and encroachment inside notified forests as two underlying drivers of electric fence installation in Sonitpur. Between 1960 and 2005, Sonai Rupai Wildlife Sanctuary lost 78.53 km^2 of forest cover from deforestation, degradation, and expanding settlements (Saherah, Sarbeswar, & Kumar, 2015). Similarly, most RFs have also undergone severe habitat loss. For instance, Naduar lost 90% of its forest cover, Charduar 60%, and Balipara 40% (Kushwaha & Hazarika, 2004). We found the largest concentration of electric fences erected inside Balipara RF, suggesting that fences are installed in areas that witness higher levels of habitat loss and encroachment. However, this too requires further study.

Human encroachments and habitat loss are therefore two key problems that require immediate interventions and remediation, particularly for ensuring the protection of elephants from future retaliation by communities. In Sonitpur, a number of elephant populations occur in RFs across the district. However, protection measures (regulations, monitoring, and forest staff) provided for RFs are inadequate when compared with wildlife sanctuaries and national parks. We recommend that encroachers be rehabilitated and that strict monitoring and law enforcement are imposed to curtail further habitat loss. The Forest Department, civil administration, and civil society organizations can work together to identify suitable areas or locations to rehabilitate forest encroachers. We recommend that these stakeholders also work together to sensitize local communities toward using nonlethal and nonconfrontational measures to protect their crops and settlements. This can be achieved by conducting outreach programs that promote coexistence with wild elephants. We also recommend engaging

these communities in ongoing conservation efforts in Sonitpur.

There is also an increasing need for collaboration between different stakeholders (nongovernmental organizations [NGOs], tea plantation managements, and other communities) with the Forest Department, as the latter lack resources and are understaffed. Combined efforts between the Assam State Power Distribution Company Limited and Forest Department while surveying areas where illegal tapping of electricity from transmission lines occur can help reduce elephant mortalities. Tea plantation managements adjacent to elephant habitats can play an active role by monitoring elephant movement on their premises and sensitizing plantation workers to adopt nonlethal practices. Electric fences are considered effective in mitigating negative interactions between humans and elephants (Gunaratne & Premarathne, 2006) when installed and managed appropriately. However, communities must also be sensitized toward understanding the difference between lethal and nonlethal fences and the need to use energizers rather than inverters.

Implications for Conservation

At times, elephant mortalities can go unaddressed, be mis-identified, or wrongly classified as an "unknown reason" or "natural death," particularly in cases of electrocution, as often there is no visible sign on the elephant's body nor is there any sign or presence of an electric fence at the site of the incident. Deliberate electrocution of elephants can have severe consequences on local elephant populations if left unchecked. Moreover, lethal electric fences are also fatal to humans. Hence, it is crucial to locate and regularly monitor areas where individuals and communities install electric fences. Through our preliminary study, we located numerous lethal electric fences, many of which were situated within notified forests. Monitoring of forest areas, strict law enforcement against lethal fences, rehabilitating encroachers, involving Assam State Power Distribution Company Limited and other stake holders (tea plantation managements, communities, and NGOs) can help conserve the species and landscape more efficiently.

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