

Human-Elephant Conflict in Joypur Forest Influence Areas, West Bengal, India

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Introduction

Human-elephant conflict (HEC) has multidimensional causes in different spatial domains with increasing anthropogenic pressure on ecosystems being one of the most crucial factors. Movement of elephants is connected with contact between elephants and people, therefore with HEC. Species such as elephants have large home ranges and use different habitats to fulfil their biological requirements (Meyer *et al.* 2019). Elephants consume 10% of their body weight and drink 250 l of water per day (Sukumar 2003). Asian elephants (*Elephas maximus*) may move to human dominated areas to meet their basic needs. Such movement may occur due to unavailability of resources in their natural habitat (Sitompul *et al.* 2013; Guha 2017) or their greater availability and accessibility in human areas (Chatterjee 2016).

The Joypur forest is a protected area in Bankura District, West Bengal. It and surrounding area is part of the extended range of elephant herds from Dalma (Mandal & Chatterjee in press). Elephants frequent this area throughout the year. From about two decades ago some bulls have been resident in the area (Kulandaivel 2010). HEC has increased in recent years in the area around Joypur forest.

We collected information on patterns of HEC in the area around Joypur forest and analysed geo-spatial attributes to identify possible reasons.

Methodology

The study area

The Joypur forest is situated between 87°18'54.46" E to 87°29'46.94" E and 22°55'49.12" N to 23°24'7.10" N. It covers three

forest ranges; Joypur, Bishnupur and Bankadaha under the Panchet Forest Division. The vegetation is mostly dry deciduous, dominated by Sal (*Shorea robusta*). We defined the Joypur forest influence area as the area outside the forest boundary within a circle of 11 km radius, centred on the Joypur forest (Fig. 1). Paddy is cultivated in the Joypur forest influence area from July to August with rainwater and in the dry season (pre winter to post summer) vegetables are cultivated with irrigation water. Most villages are located at the forest fringe.

Information collection

Information on HEC incidents was obtained from the Forest Department and from victims' family members and neighbours. A total of 93 households were chosen for gathering information related to HEC. The oldest person or a person who experienced HEC was chosen for interview from each household.

Geo-spatial analysis

Moderate and large sized water bodies were identified and demarcated from Google images. The distance from the centre of the forest to each water source was measured. Agricultural encroachment into the forest was assessed using LISS-III, P6 satellite images of 1980 and Landsat 8 (OLI/TIRS) images of 2018. Measurements were done using ArcGIS 10.3v software.

Results and discussion

HEC in study area

According to the Bankura Forest Division report, 17 people were killed by elephants from 2010 to 2018 in the Panchet Forest Division. Of these, 14 were in the Joypur, Bankadaha, and

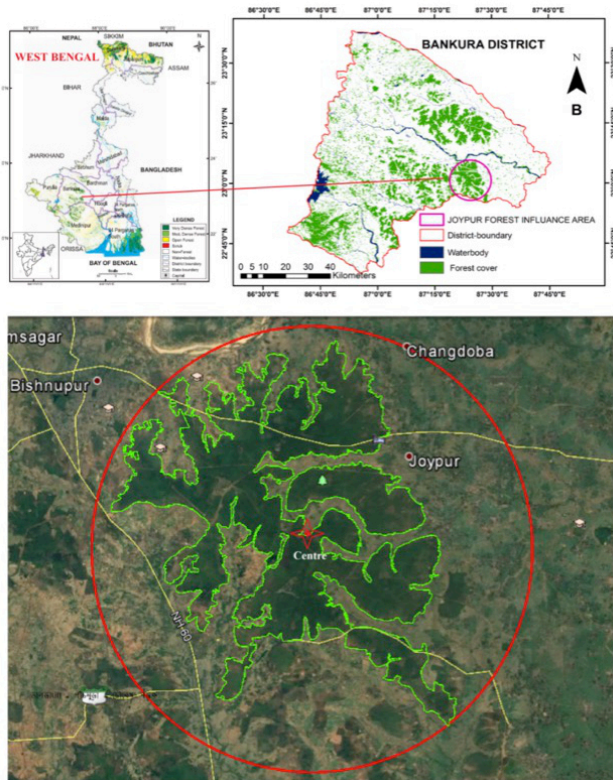


Figure 1. Location map of the study area.

Bishnupur forest ranges. All human deaths were allegedly due to resident bull elephants and not by herds, as reported by District Forest Officer Panchet Forest Division. Most human deaths happened during the early morning or afternoon

with 10 deaths occurring outside the forest and 7 inside.

Some residents said that deaths occurred in the early morning and afternoon, as resident elephants regularly come from inside the forest to fringe areas for drinking water and consuming agricultural crops at those times. According to the District Forest Officer, conflict probability was high in the morning and afternoon because villagers go to the forest for toilet and collecting forest produce in the morning, and in the afternoon they are working in paddy fields adjacent to the forest when elephants come to these areas for drinking and raiding crops.

Water availability

The number of water sources increased with distance from the forest centre (Fig. 2B). Most perennial water sources were outside the forest and 6 were within 1–2 km from the centre and 42 between 7–8 km. There were 12 water sources inside the forest, which dried up during the dry season from January to May.

Of the 17 human deaths recorded, 15 occurred between December and April. In this period the weather becomes very dry and only some of the

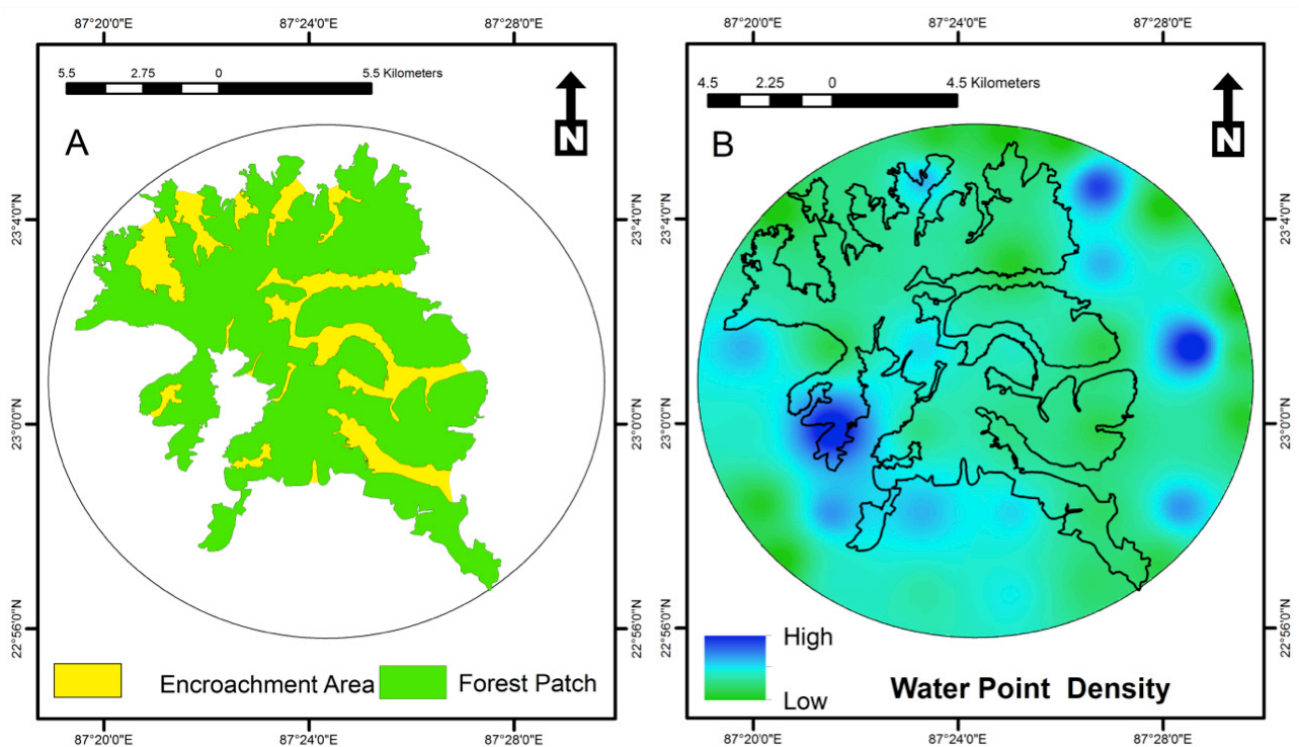


Figure 2. Forest encroachment (A) and water point density (B) maps of the Joypur forest and influence area.

water sources outside the forest and near the forest fringe villages held water. Therefore, it is possible that during the dry season elephants did not have access to water inside the forest and were compelled to venture out, leading to HEC incidents.

Forest encroachment due to agricultural expansion is another common factor that creates HEC. We found that there was extensive encroachment into the forest in the study area (Fig. 2A). As vegetables are cultivated in the encroached lands after the monsoon, the presence of villagers in the forest was high at that time.

Food availability

Food sources near the forest fringe may be another cause of HEC incidents. During the wet season elephant movement towards the fringe area was infrequent as the forest was productive and food was plentiful. In the dry season, food availability in the forest was less and elephants move to the fringe area for food (Mandal & Chatterjee 2019). Especially as vegetable and paddy were cultivated during the dry season, HEC incidents may be more frequent.

We conclude that lack of perennial water sources inside the forest and their presence in the forest fringe areas, and encroachment maybe the main contributory factors for HEC in the study area. Landuse management, preventing encroachment, allowing forest regeneration in encroached areas and perennial water source development inside the forest may limit elephant movement towards forest fringe areas, therefore help in mitigating HEC in the study area.

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