

Land Sharing Patterns of Asian Elephants with Humans in the Hadgarh-Kuldiha Elephant Corridor, Odisha, India

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Introduction

Habitat loss, degradation, fragmentation, conversion, and resource exploitation due to human activities result in alterations of the extent and spatial configuration of habitats available for wild species (Gascon *et al.* 1999). As the largest terrestrial mammal, the Asian Elephant (*Elephas maximus*) requires large areas for its home range and is badly affected by habitat degradation and corridor loss as they migrate over long distances. Large-scale conversion of forests to monoculture plantations, croplands, and developed areas has drastically reduced and fragmented available habitats and confined them to isolated patches (Santiapillai & Jackson 1990; Nyhus *et al.* 2000; Sukumar 2003; Hedges *et al.* 2005).

Elephant distribution in India is limited to four widely separated geographical zones, viz. southern India, central India, northern India and north-eastern India with 28,000 individuals. Elephant reserves seldom contain the full range of natural resources necessary for the survival of a large elephant population and therefore migration across such reserves occurs. It is estimated that only 12% of the remaining 46,880 km² of wild lands is protected within the geographical range (151,309 km²) of Asian elephants in the country (Leimgruber *et al.* 2003). In this fragmented landscape, which typifies most elephant habitat in India, corridors play an important role for movement of elephants across different habitats.

Elephants use the same route over years for migration. But most parts of their traditional movement paths are under human encroachment in the form of settlements, agricultural land, roads,

railway lines etc.. As a result of fragmentation and the ensuing interspersed human habitation, cultivation, and natural habitats, elephants are compelled to share habitat with humans. Some elephant populations visit adjoining non-forest areas such as agriculture or human habitations, despite risk of life (Kushwaha & Hazarika 2004). Conflicts between humans and elephants are now widespread across Asia (Blair *et al.* 1979; Sukumar 1989; Madhusudan 2003). Close and frequent encounters between humans and elephants in landscapes with settlements and croplands have detrimental effects on the long-term conservation of elephants (Fernando *et al.* 2005).

During the last few decades, the forested areas and elephant habitat in Odisha has degraded remarkably due to illegal felling, encroachments, industrialization and mining (Singh & Chowdhury 1999). Out of the nine elephant corridors in Odisha, Hadgarh-Kuldiha corridor was identified as high ecological priority area (Tiwari 2005) as it maintains continuity between two largest populations of Asian elephants in Odisha i.e. Similipal and Kuldiha through Hadgarh Wildlife Sanctuary. Despite of high level of biotic pressure and obstructions in terms of human settlements, mining, livestock grazing, conversion of forest lands into agricultural fields and major road networks, it was found small herd of elephants regularly use the corridor and frequently come into different human occupied areas in the corridor. In this study we assessed the use of different types of human dominated habitat by elephants in the Hadgarh-Kuldiha Elephant Corridor of Mayurbhanj Elephant Reserve, Odisha, India.

Methods

The Hadgarh-Kuldiha corridor lies within 21°20'–21°23' N and 86°16'–86°25' E. The length of the corridor is about 19-20 km and width is about 2-2.5 km. It connects the Hadgarh Wildlife Sanctuary with the Kuldiha Wildlife Sanctuary through small hillocks (Fig. 1). The corridor is now confined only to these hills as villages have come up near the foothills as a result of settlements and agricultural practices (Tiwari 2005). About 14 villages occur in the corridor area. It is under the Forest Divisions of Keonjhar, Baripada and Balasore of Keonjhar, Mayurbhanj and Balasore districts of Odisha respectively. The vegetation type of the corridor is tropical deciduous Sal forest. Total area of the corridor consists of protected forest, reserve forest and revenue land. However, parts of the corridor are used for agricultural fields, settlements and mining activities.

A survey was carried out for 2 years from February 2011 to January 2013 of the presence of elephant sign and land use patterns in the corridor. The year was divided into winter (October-January), summer (February-May) and rainy (June-September) seasons. Elephant sign recorded consisted of dung, foot prints and feeding signs. Human occupied areas were clustered into 1 km² grids and two grids of each land use type were randomly selected for sampling. Each grid

was treated as one sampling unit. Signs or direct sightings recorded in a single day in each unit were treated as one. After recording, elephant signs were marked or wiped out. Additionally sightings of elephants by survey personal and local residents were recorded along with location, month and time period. A pre designed survey format was used for data collection. Based on the frequency of occurrence, preference of elephants towards different human occupied areas was ascertained. Victims of human-elephant conflict were interviewed to obtain information.

Results and discussion

Preference level of elephants towards different human occupied areas

During the entire study period 128 instances of elephant sign and 106 direct sightings were recorded. In the case of elephant signs, 65 (50.78%) were recorded within agricultural areas followed by 43 (33.59%) from residential areas, 19 near water bodies (14.84%) and only 1 (0.78%) near mining areas. In the case of direct sightings, 62 times (58.49%) elephants were observed within agricultural areas followed by residential areas with 34 times (32.07%), and near water bodies 10 times i.e. 9.43% (Fig. 2). Therefore, the most preferred human occupied area by elephants was agricultural land.

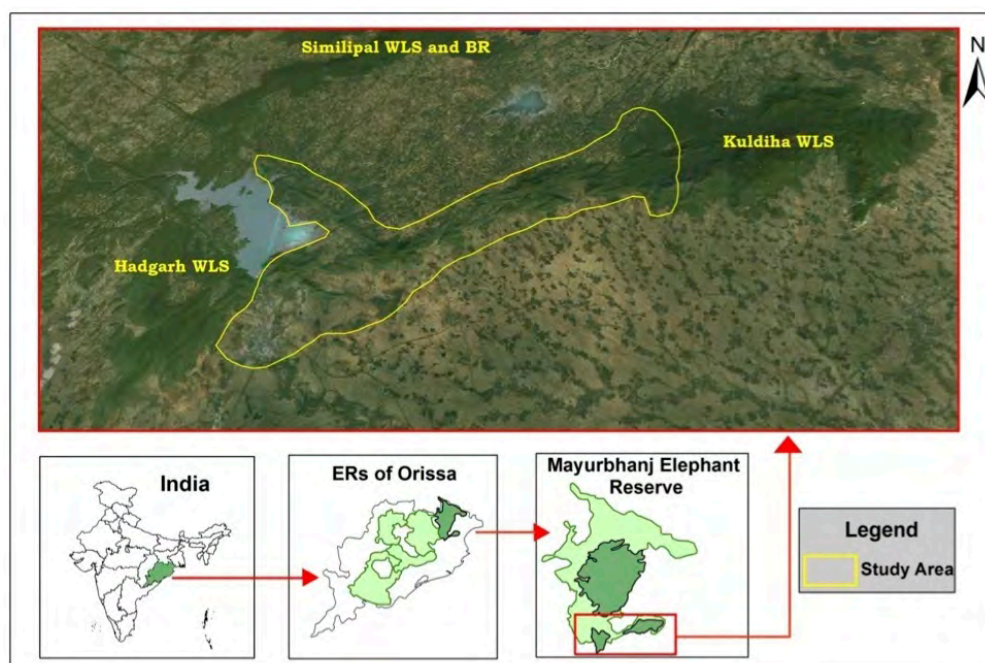


Figure 1. Map showing Hadgarh-Kuldiha Elephant Corridor.

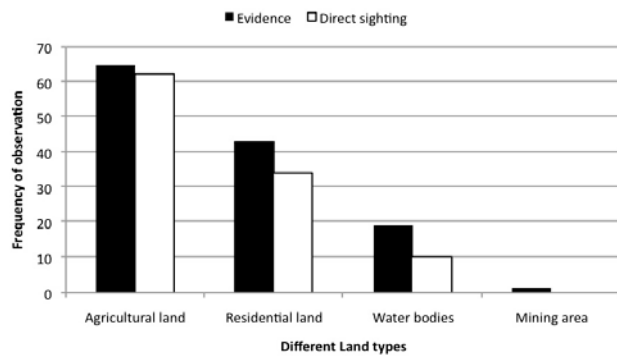


Figure 2. Preference level of elephants towards different human occupied areas.

Seasonality and time period of land use

In winter there were 57 (53.77%) sightings, followed by summer with 33 (31.13%), and 16 (15.09%) in the rainy season. Therefore elephant use of the area was greatest in winter followed by summer. Rainy season saw the lowest use of the area by elephants. From the 57 sightings in winter, 52 (91.22%) were recorded within agricultural areas, 4 (7.02%) within residential areas and 1 (1.75%) near a water body. No sign of elephants were found near mining areas, which were probably avoided due to loud noise and bright lighting. From all sightings in summer 21 (63.63%) were recorded within residential areas, 9 (27.27%) near water bodies and 3 (9.09%) within an agricultural area. In rainy season 9 (56.25%) sightings were recorded within residential areas, and 7 (43.75%) within agricultural areas (Fig. 3).

Therefore elephants used agricultural areas very intensively in the winter but residential areas more intensively during the summer. Both agriculture and residential areas were used to a similar extent in the rainy season. The greater use of the agricultural areas in winter coincides with harvesting, hence greater availability of crops for raiding. Summer is the fruiting and ripening period of some of the favourite food plants of elephants such as mango (*Mangifera indica*), jackfruit (*Artocarpus heterophyllus*), banana (*Musa paradisiaca*) and banyan (*Ficus bengalensis*) that are abundant in residential areas, which may explain the preference for residential areas in the summer.

Elephant use of human occupied areas may be due to range loss and obstruction of movement paths.

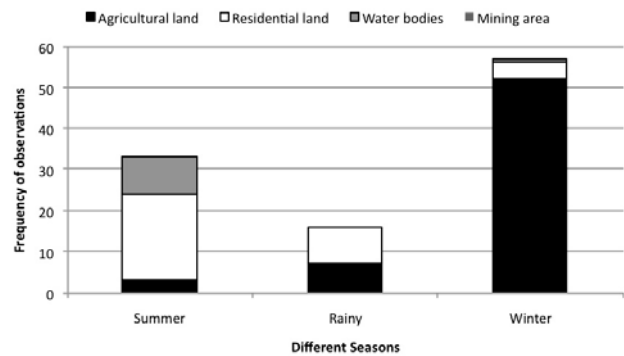


Figure 3. Seasonality of land use preference by elephants in different human occupied areas.

Such changes cause increased human elephant conflict as elephants are forced to move into new areas, or utilize richer sources represented by crops in order to compensate. Where they cannot compensate adequately it leads to increased elephant morbidity and mortality, especially in the case of herds (Fernando 2006; Fernando *et al.* 2008).

In relation to time, 21 (19.81%) sightings were between 5:01 pm to 7:00 pm, 74 (69.81%) between 7:01 pm to 5:00 am, 8 (7.54%) between 5:01 am to 7:00 am and 3 (2.83%) between 7:01 am to 5:00 pm. Therefore, elephants used human occupied areas mostly during the night.

Human-elephant interaction

In all 15 incidences of human casualty, 52 of crop raiding (agricultural area) and 46 instances of home garden raiding were reported during the study period. In the case of human casualty 64.28% of incidents occurred from 7 pm to 9 pm. Of the incidents 75.23% occurred in summer, with 64% of incidents occurring on roads and 36% in home gardens indicating that elephant use of residential areas led to the highest conflict. Most (82.21%) victims were from the age group between 35-45 years. Interaction on roads occurred due to meeting with elephants while returning from work places during late evening hours resulting in most of the victims being earning heads of families.

Increased human encroachment has negatively impacted the Hadgarh-Kuldiha Elephant Corridor and resulted in frequent interaction of humans and elephants leading to conflict. Kuldiha and

Similipal habitats being the home for the largest population of Asian elephants in Odisha, high importance should be given for the ecological restoration of the connecting corridor to maintain population viability and prevent inbreeding.

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