

Interim report to Bangalore Sustainability Forum

Project title:

Elephant on the zebra crossing: Predicting human-elephant conflict to inform urban development in and around Bengaluru city

Anisha Jayadevan^{1,2}, Nishant Srinivasaiah¹ and Srinivas Vaidyanathan²

1. Frontier Elephant Programme
2. Foundation for Ecological Research, Advocacy and Learning

Elephant on the zebra crossing: Predicting human-elephant conflict to inform urban development in and around Bengaluru city

The broad aim of our project is to highlight potential impacts of land-use change on Asian elephants in peri-urban areas around Bengaluru city. Our specific objectives are:

- a) To assess environmental and biological factors influencing the current foraging and ranging decisions by elephants in the peri-urban areas of Bengaluru city.
- b) To assess current trends in elephant distribution and human-elephant conflict in the districts of Bengaluru, Ramanagara, Tumakuru and Krishnagiri and to identify human-elephant conflict hotspots.
- c) To develop predictive models of human-elephant conflict, given future trends in landuse change in Bengaluru city, including Tumakuru, Ramanagara and Kanakapura towns based on the Master Plan 2031 of Government of Karnataka and the identification of Hosur as a special investment region by the Government of Tamilnadu.
- d) To generate guidelines that can act as a policy document to help urban development in regions co-habited by elephants.

For Objective 'a', we used data collected since 2009, on nearly 200 elephants ranging in and around the Bengaluru district. We analysed contiguity in the study area for 7 different land-use and land-cover (LULC) categories: built-up, agriculture, plantations, forest, scrubland, barren areas and waterbodies. We then associated individual elephant locations in the study area with the corresponding contiguity values. Using recursive partitioning classification trees, we used this combined data of elephant locations and contiguity, to assess environmental and biological factors influencing foraging and ranging patterns of Asian elephants, especially males, in peri-urban areas of Bengaluru (Figure 1). The results from this exercise have provided us with the baseline values that reflect decision-making in the individual elephants.

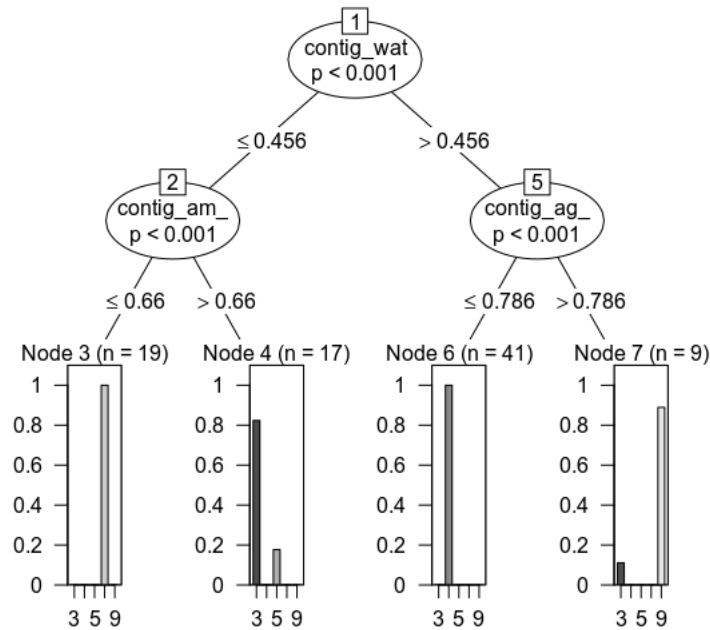


Figure 1: Classification tree of the probability of an elephant occurring in different land-use categories, based on contiguity values of waterbodies (contig_wat), forests (contig_am_) and agriculture (contig_ag). On the x-axis, numbers indicate LULC categories; 3: plantations, 5: scrubland, 9: waterbodies

These baseline values are used as parameters in an agent-based model to simulate elephant movement in current and future land-use scenarios (Objective 'c'). We have extracted baseline values of 50 individuals of two different age classes, representing the typical structure of the population. We are currently finalising on LULC and infrastructure layers that will be used in the model. We have modified the future land-use change scenarios that we will consider in the model, to three different scenarios: 1) modeled: future land-use change is modeled based on past land-use change; 2) planned: future land-use change is modeled based on past land-use change, and incorporates planned changes to infrastructure as detailed in the Master Plan 2031 of Government of Karnataka, and 3) hopeful: future land-use change based on 1) and 2), which incorporates mitigation structures to enable increased permeability to elephant movement. We are in the process of finalising layers to begin the analysis of generating future land-use layers.

Under Objective 'b', we are in the process of finalising the visualisation of the changing movement patterns and distribution of elephants, collected through questionnaire surveys by interviewing field-level Forest Department staff, covering an area of nearly 10,000 sqkm. Preliminary heat maps indicating elephant distributions are shown below (Figure 2).

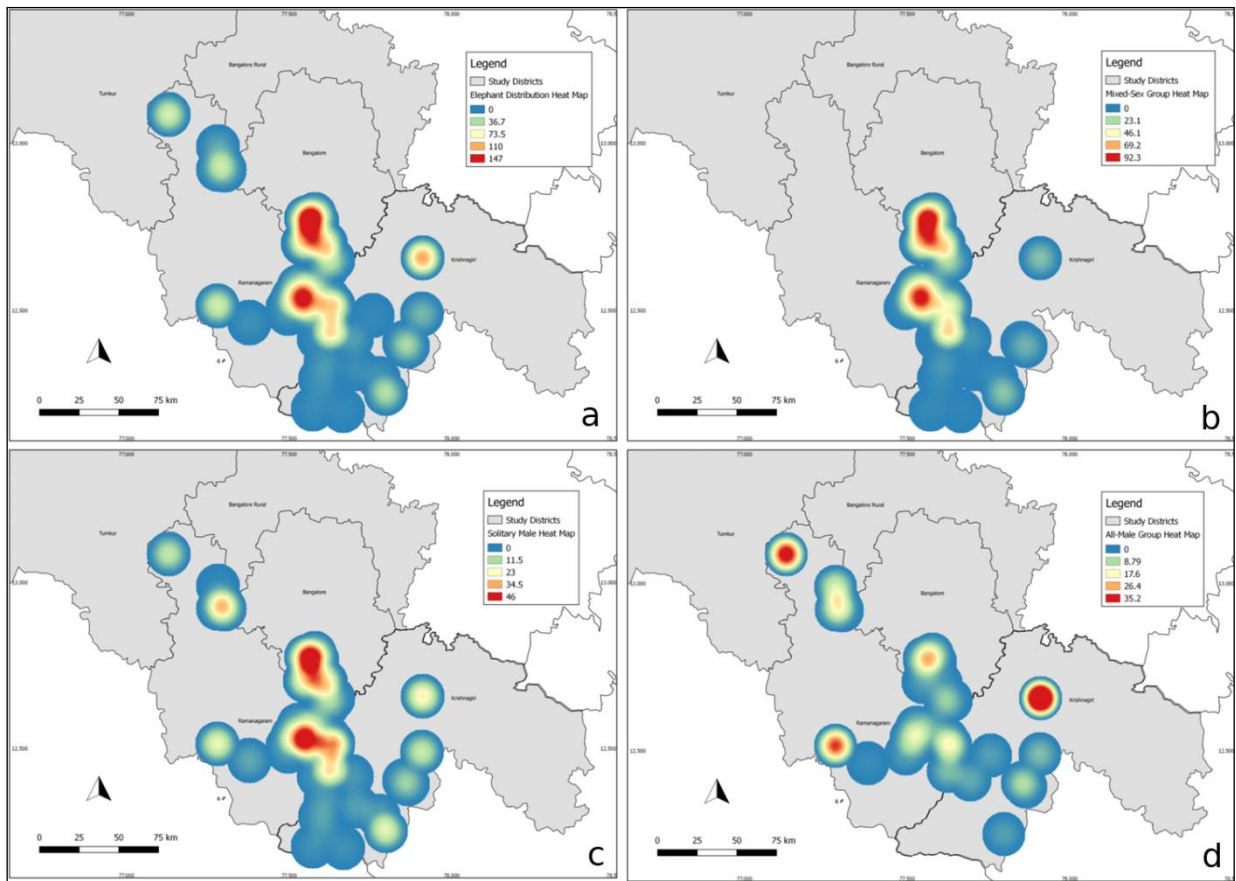
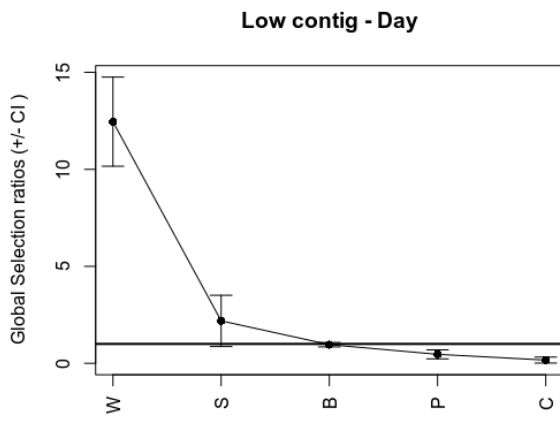


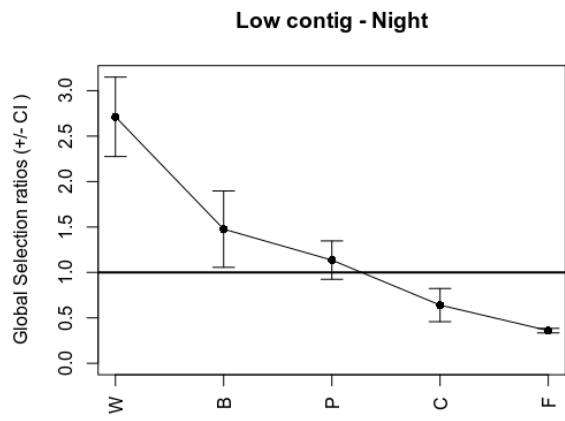
Figure 2: Heat maps showing the distribution of elephants across three different social groups, solitary, herds and all-male groups in the study site

Finally, we are finalising a draft of a manuscript that assesses the change in habitat selection and daily activity patterns in elephants as they transition across a gradient of forest contiguity in peri-urban areas around Bengaluru. One of the main results from our paper (Figure 3), suggests that when male elephants are in low contiguity areas with little available natural forest, they have modified their behaviour to select waterbodies as refuge sites, more than expected based on its availability. In contrast, when they are in high contiguity areas, elephants use forests more than expected based on availability, and adjoining crop fields and scrublands as per availability.

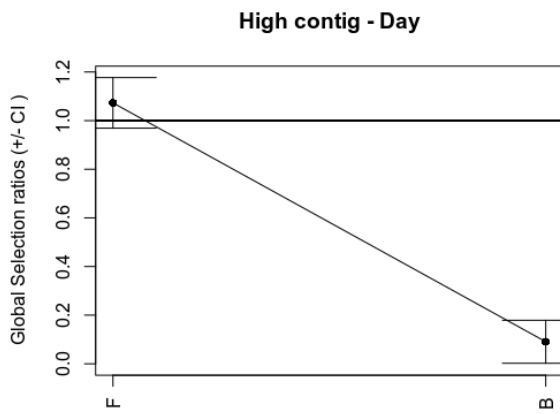
Our paper will provide an understanding of unique behavioural adaptations of elephants to navigate human-dominated, low forest contiguity landscapes, and will help meet both Objectives 'a' and 'd'.



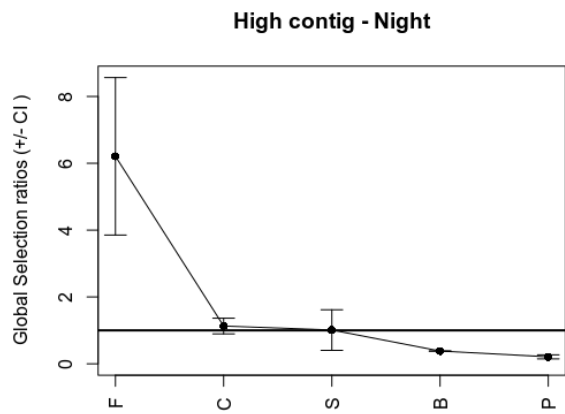
a.



b.



c.



d.

Figure 2: Habitat selection in a) low contiguity areas during the day; b) low contiguity areas during the night; c) high contiguity areas during the day and d) high contiguity areas during the night