

# Variation in Behavioral Responses to Visual Light Stimuli in Asian Elephants

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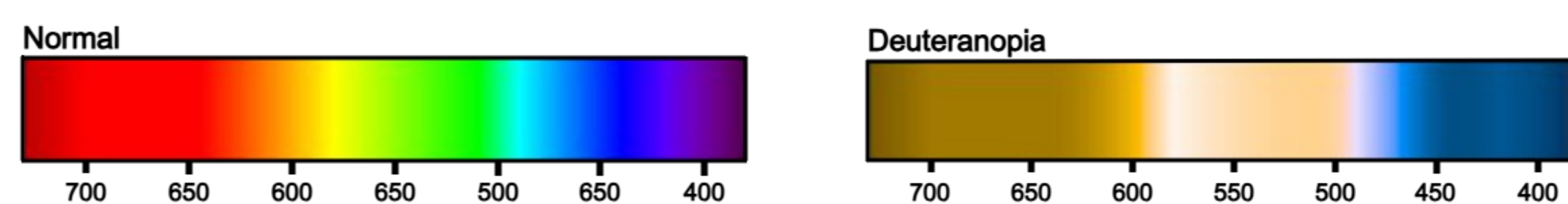


## Introduction

- Habitat fragmentation and agricultural expansion are increasing contact between humans and Asian elephants (*Elephas maximus*).<sup>1</sup>
- Effective, non-invasive strategies are needed to reduce human-elephant conflict (HEC).
- Many existing deterrents lose effectiveness over time as elephants habituate to them.<sup>1</sup>
- Considering individual variation in elephant behavior and cognition may be key to improving HEC mitigation strategies.**<sup>2,3</sup>

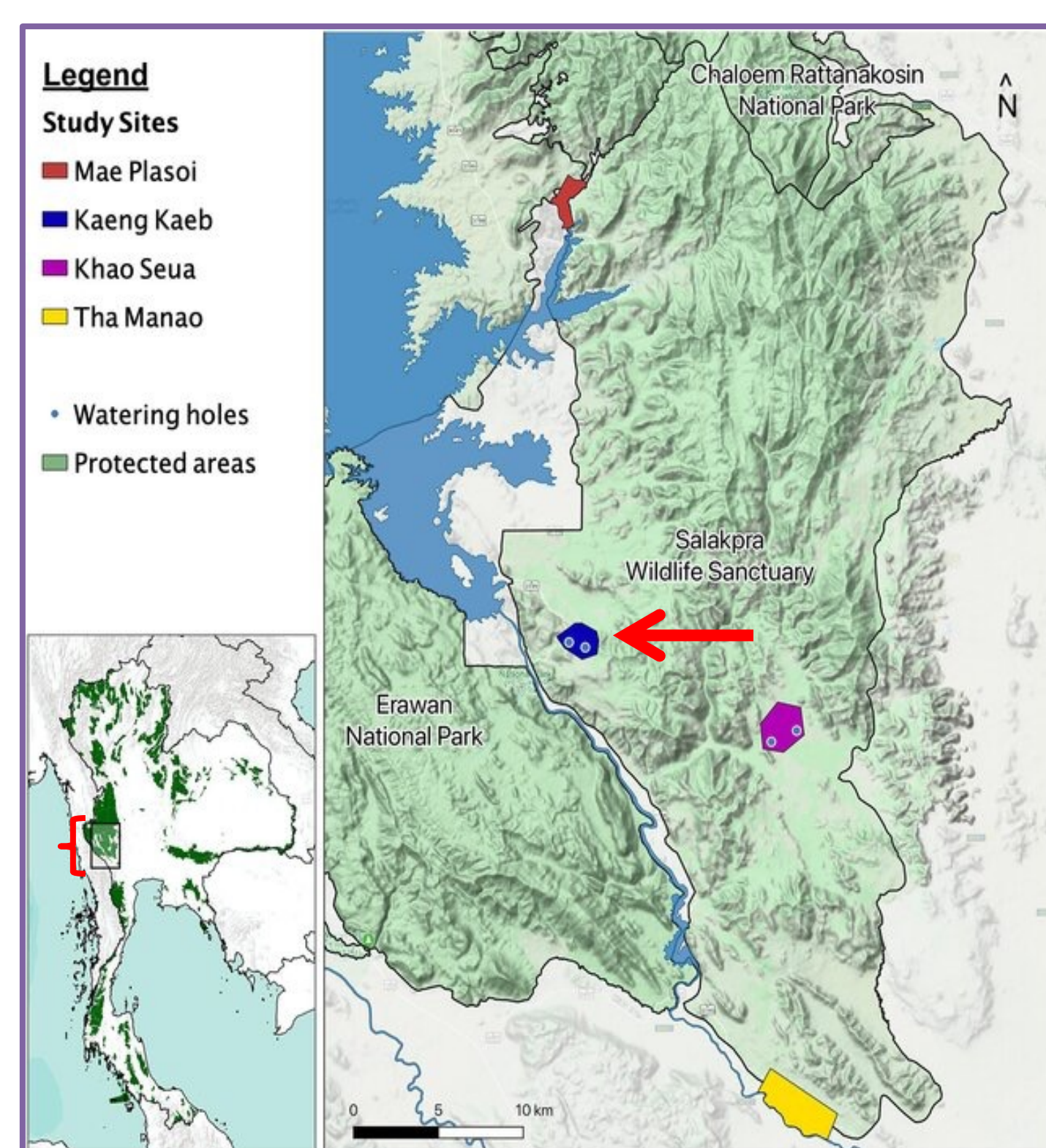
**Objective:** To experimentally examine whether different types of visual light stimuli affect behavioral responses in wild Asian elephants.

- In Botswana, solar-powered strobe light barriers reduced elephant entry into crop fields, highlighting the promise of light-based deterrents for conflict mitigation.<sup>4</sup>
- However, whether specific features of visual light stimuli shape elephant behavioral responses has never been experimentally tested in the context of HEC mitigation.
- Neophobia—or the fear of novelty—may be one aspect of behavior that contributes to avoidance of unfamiliar visual stimuli.<sup>5,6</sup>



Comparison of the visual light spectrum (700 – 400nm) under normal human vision (left) and deuteranopia (right), illustrating reduced sensitivity to green wavelengths and diminished red-green color discrimination. Elephants show peak visual sensitivity to wavelengths between 420–552 nm.<sup>7</sup>

## Field Site: Salakpra Wildlife Sanctuary



- Protected area (858.55 km<sup>2</sup>) located in Kanchanaburi Province, Thailand
- Our lab has individually identified over 300 unique individuals<sup>3,8</sup>
- Surrounded by agricultural fields (e.g., cassava, sugarcane, corn, pumpkin, etc.)<sup>9,10</sup>
- 96% of farmers report crop raiding at least once a month, and 54% report daily raiding.<sup>10</sup>

Note: The red bracket in the left panel indicates Salakpra Wildlife Sanctuary, a protected area in Kanchanaburi, Thailand, and the arrow in the right panel indicates the ranger station where this study was conducted.

## Predictions

- Elephants will show stronger aversive responses to a strobe light than to a solid light.<sup>4</sup>
- Elephants' responses will vary between daytime and nighttime exposures, with stronger responses expected at night due to elephants' increased vigilance at night.

## Light-Emitting Device

- Motion-activated, light emitting device, positioned so that it triggers when an elephant crosses into a 5 m perimeter.
- Elephant behavior recorded using three additional camera traps, set to record 20 s videos with a <1 s recovery time.



Light-emitting device and front facing camera, placed inside a brown metal mounting box.



Light-emitting device installed on tree. Photo is of baseline condition, with no light.



Camera trap installed above light-emitting device.

## Light Conditions

- Baseline:** Dome with no light
- Condition 1:** Dome with solid light
- Condition 2:** Dome with strobe light



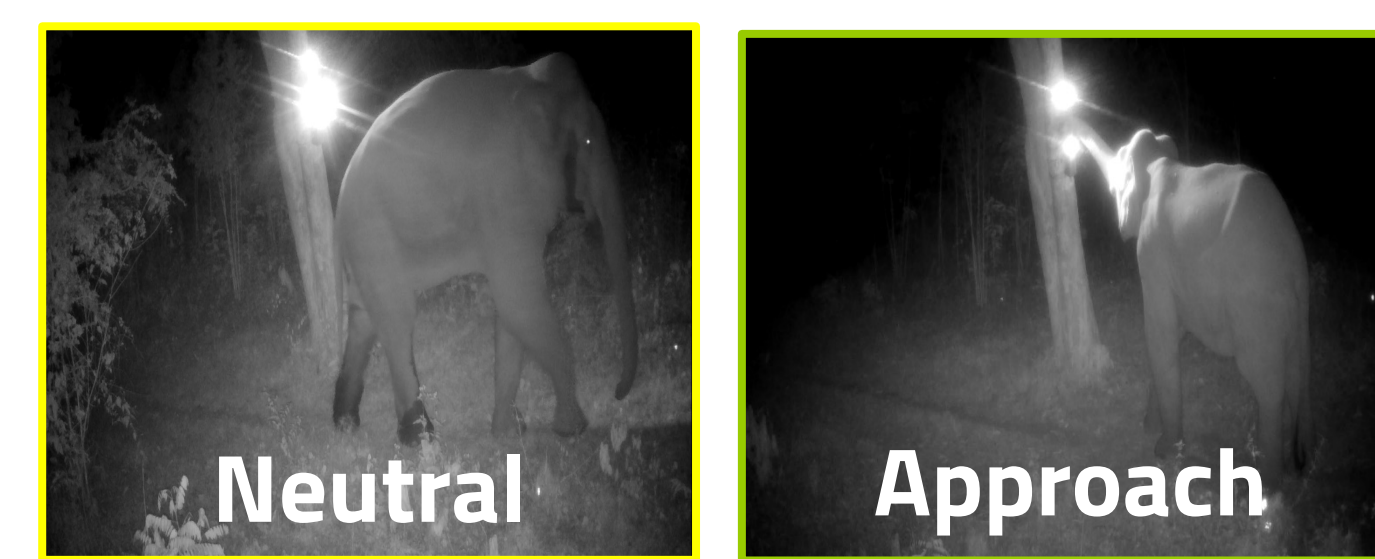
The elephant can see the **white light** illuminating from the device, but cannot see the camera's **infrared light**.



## Measures of Behavior

Data collection for condition 2 is currently in progress. We plan to code for the following behaviors in the final dataset:

- Freeze response:** scored as whether the elephant froze after the light triggered (yes/no).
- Latency to freeze:** time from light trigger onset to when the elephant stopped moving.
- Freeze duration:** how long the elephant remained still before taking another step.
- Retreat/approach latency:** time between light trigger onset and when elephant began moving away from or toward the device.
- Tolerance of the area:** time the elephant remained in the area after the flash.



## Preliminary Results – Initial Responses

- We recorded the first response of each elephant when they passed the mark where baseline camera or light was triggered.
  - **Retreat or Froze** = **Negative response**
  - **Approach** = **Positive response**
  - **No Response** = **Neutral response**
- In other species, a freezing response is a behavioral response to a threat, marked by attentive immobility that may reduce detection risk and enhance perception.<sup>11</sup>
- In a preliminary analysis, we recorded whether eight elephants, who were observed in both the baseline and condition 1, differed in their response to first time exposure of the device.
- We predicted that elephants would respond negatively more often in response to condition 1 than during baseline.**

Elephant ID	Baseline	Condition 1	Trend
KKLD101	No Response	Froze	Neutral -> Negative
KKLD103	Froze	Retreat	Negative
KKLD104	No Response	No Response	Neutral
KKLD106	Approach	Retreat	Positive -> Negative
KKLD109	No Response	No Response	Neutral
KKLD118	Froze	Retreat	Negative
KKLD120	Froze	No Response	Negative -> Neutral
M007	No Response	Retreat	Neutral -> Negative

## Discussion

- In Baseline, elephants showed a mix of neutral, negative, and one positive response. In Condition 1, responses shifted toward freeze or retreat, with no positive responses.
- Mixed responses indicate the deterrent may not be equally effective across individuals.
- These preliminary results suggest that the light was salient for some elephants, but not all.
- Additional data will help determine whether these early patterns remain consistent across repeated exposures and more individuals.
- Elephants' negative responses in baseline (e.g., freezing) could indicate a typical behavioral response to a novel object (the dome and mounting box).<sup>12</sup>
- The next condition will compare responses between solid and strobe lights to see if the strobe could be more effective as a potential crop-foraging deterrent.

## Acknowledgments

We thank the Thai Department of National Parks, the staff, rangers, and elephants of the Salakpra Wildlife Sanctuary, and local community members in Kanchanaburi, Thailand. We thank the National Research Council of Thailand for permission to conduct research in Thailand. This work was approved by Hunter College and Walailak University IACUCs. This work was funded in part by the Hunter College Foundation, the Templeton World Charity Foundation, and the Animal Behavior and Conservation Program at Hunter College. We also thank members of the Comparative Cognition for Conservation Lab at Hunter College for their support and collaboration on this project for my Master's thesis.

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## Proposed Analysis

- ✓ Baseline vs. light conditions will be compared across all behavioral measures.
- ✓ Time-to-event analyses will be used for latency variables when a behavior did not occur during the observation period.
- ✓ Time of day may be included as a covariate to account for natural light differences.