# LINKAGES BETWEEN MUTUALISM BREAKDOWN, LANDSCAPE CHANGE, AND PREDATOR-PREY DYNAMICS IN A HUMAN-OCCUPIED SAVANNA


## Progress Report

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## INTRODUCTION

By concealing predators and providing cover for ambushes, trees shape the outcome of predator-prey dynamics in African savannas: large carnivores like lions *(Panthera leo),* leopards *(Panthera pardus),* and African wild dogs *(Lycaon pictus)* are more successful at killing prey where tree cover is high (Hopcraft et al. 2005, Ford et al. 2014, Ng'weno et al 2019A). Consequently, ungulates like antelopes and zebra *(Equus burchelli)* congregate more in areas that are relatively open, because such areas are perceived to be safer (Ford et al. 2014, Riginos 2015).

Over the past decade on the Laikipia Plateau of central Kenya, invasion of the big-headed ant (*Pheidole megacephala*) has disrupted a foundational mutualism between the whistling-thorn tree (*Acacia drepanolobium*) and their symbiotic bodyguards, native ants in the genus *Crematogaster* (Riginos et al 2015). *Crematogaster* ants protect trees from catastrophic (fatal) herbivory by elephants (*Loxodonta africana*) in exchange for food and shelter (Goheen and Palmer 2010). However, big-headed ants kill and displace these native bodyguards, thereby rendering trees defenseless against browsing, breaking, and uprooting by elephants. Because whistling-thorn occurs in monodominant stands, big-headed ant invasion has transformed vast swathes (1000s of kilometers) of savanna bushland into open (treeless) grassland**.** Consequently, I hypothesize that mutualism breakdown influences predator-prey interactions by altering the spatial distribution of ungulates, and thus where lions hunt.

### ***Hypotheses***

**Hypothesis #1:** Mutualism breakdown alters the spatial distribution of ungulates.

*I expect zebra and other wild ungulates will select areas recently invaded by big-headed ants, given such areas exhibit significantly lower tree cover relative to un-invaded areas.*

**Hypothesis #2:** Mutualism breakdown influences the success of hunting forays by lions.

*Despite the increased abundance of lion prey in invaded areas (Hypothesis #1), I expect reduced success (i.e.,* per capita *predation risk—the number of kills for a given prey density) of hunting forays by lions in invaded areas.*

## ACTIVITIES

### 1. Mapping big-headed ants invaded areas and assessing Acacia tree damages

We randomly sampled points across the Ol Pejeta conservancy, to map the areas invaded by the big-headed ants (Fig 1). We also assessed the level of *Acacia drepanolobium* tree damages by the mega herbivores within invaded and uninvaded areas. The preliminary results showed a higher acacia tree damages by elephants *(Loxodonta African)* and giraffes *(Giraffa camelopardalis)* within BHA invaded compared to uninvaded areas (Fig 2).

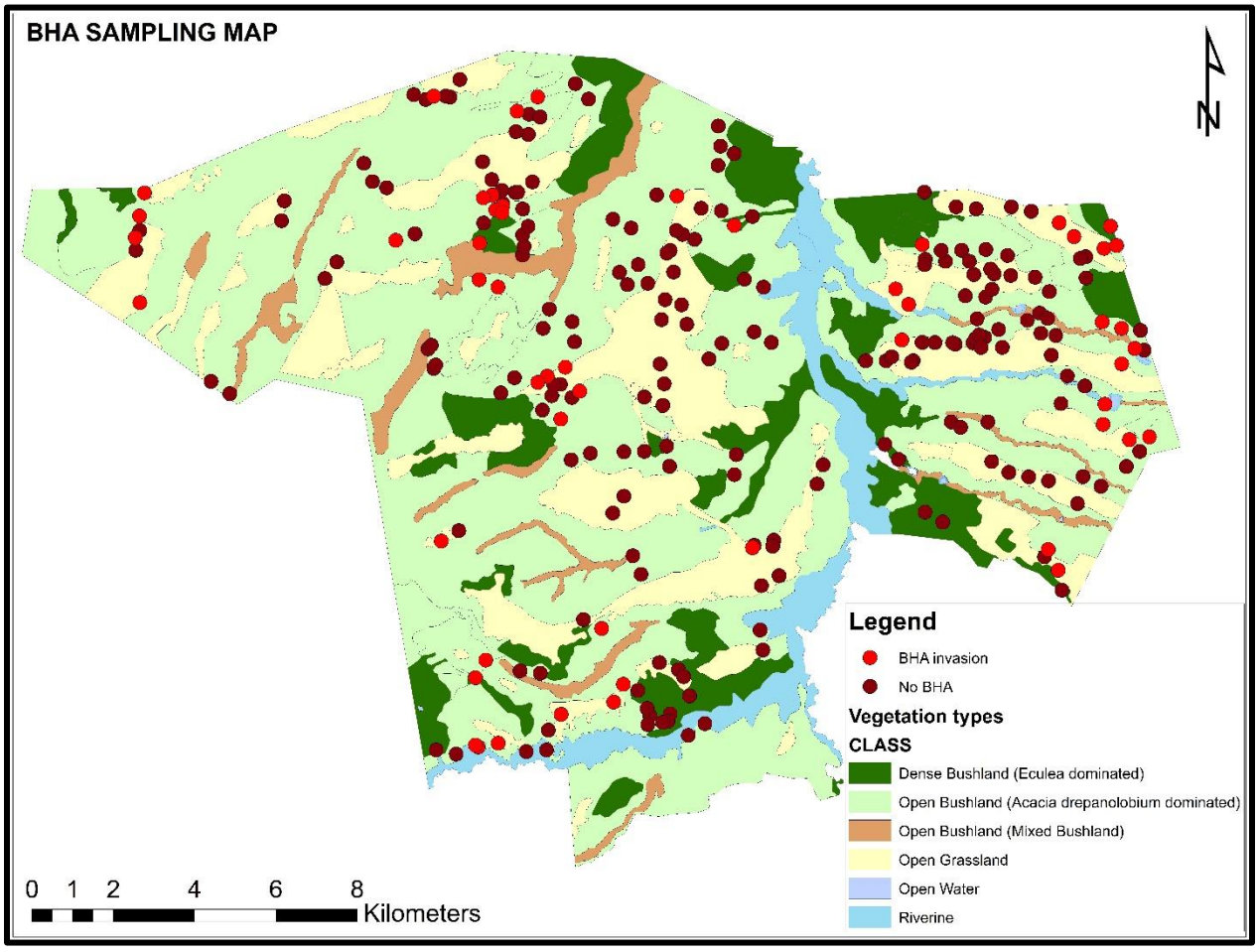



**Figure 1:** Big-headed ants random sampling points in Ol Pejeta Conservancy (red dots=invaded) and (purple dots=uninvaded) areas.

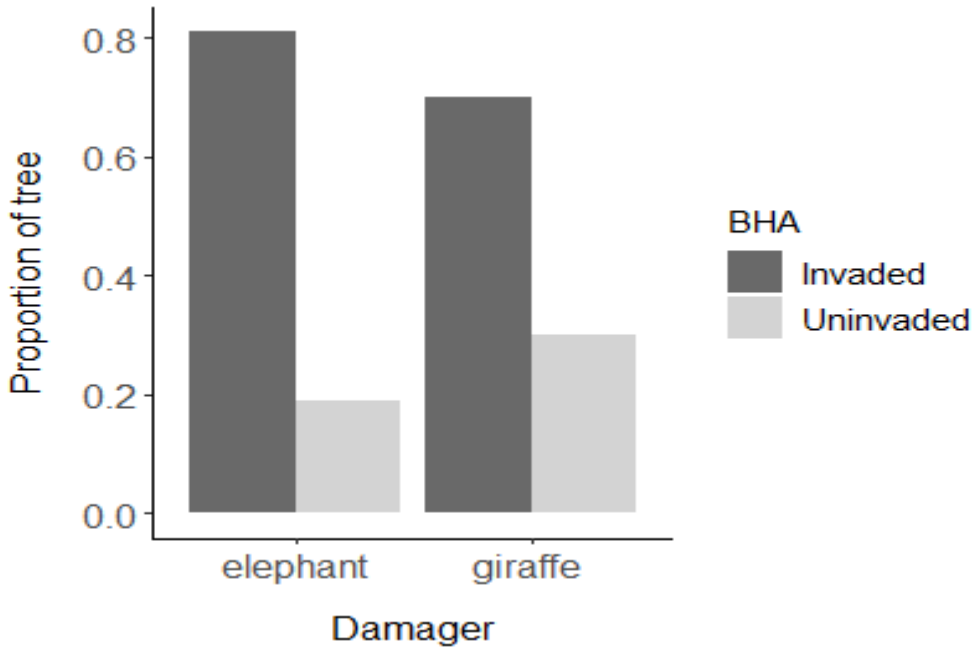


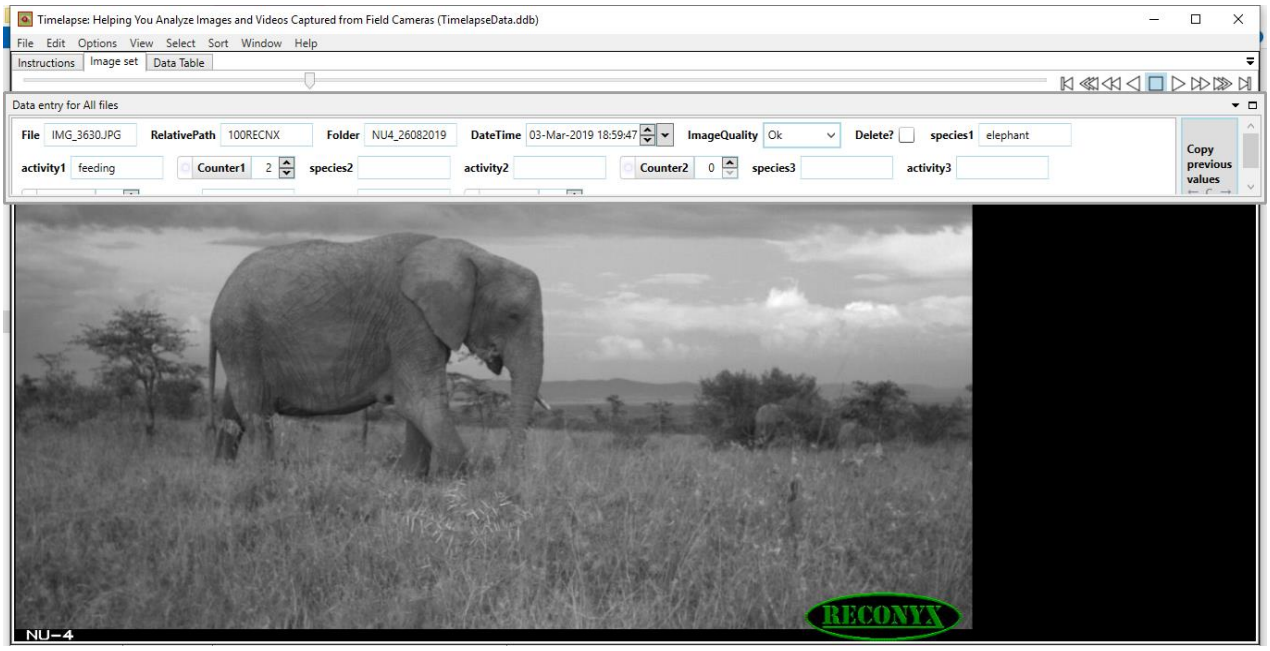

**Figure 2:** Proportion of *A. drepanolobium* tree damages by elephants and giraffe in big-headed ant invaded and un-invaded plots.

## 2. Camera trapping

We deployed 54 camera traps in January 2020, on a 3 x 3 km grids with 500 m spacing between the traps and set at 60 cm from the ground inside a metallic cage, hammered in the ground to prevent damage by animals e.g., hyena. The traps were also set within 3 m from an active animal trail to increase chances of detections. Half of the camera traps were deployed within BHA invaded and half within uninvaded areas. We check and download images from the traps on a weekly basis. Images are then stored in an external hand drive and classified using the "Timelapse2" software adapted from Greenberg and Godin (2015). Data on species, count, day and time, and activity are recorded from each image. So far, we have downloaded 2561197 images from the 54 functional camera trap. This data will be used to estimate ungulate abundance by calculating capture rates (the ratio of independent photographs to the number of trap-days, multiplied by 100) of ungulates (lion prey) for each camera trap location within the BHA invaded and uninvaded areas.


Plain zebra *(Equus quagga)*


Black rhino *(Diceros bicornis)*




*A screen shot of timelapse2 image classification database (Greenberg and Godin. 2015).*

## 3. Kill sites

To identify kill sites, we are using GPS locations from the six collared lionesses using an algorithm to identify "clusters", defined as ≥2 successive GPS relocations occurring within 100m of each. To find the kill and identify the predator responsible, we look for signs of lion claws and bite marks on the carcass, scats, hair and foot-prints. So far, a total of 129 lion kill sites were positively identified from GPS cluster sampling, comprising 10 different species of prey. Comparatively, the

highest proportion of lion kills occurred in BHA uninvaded areas (81%, *n* =104), compared to invaded areas (19%, *n* = 25). Zebras recorded the highest kills attributed to lions (50%, *n* = 65), followed by buffalo (24%, *n* =31) (table 1).

***Table 1:*** Proportions of kill site occurrences per individual prey species in big-headed ants invaded and un- invaded areas

| **Species** | **Invaded** | **Un-invaded** | **Total proportions** | **n** |
|---|---|---|---|---|
| Buffalo | 0.01 | 0.23 | 0.24 | 31 |
| Eland | 0.02 | 0.05 | 0.06 | 8 |
| Giraffe | 0.01 | 0.05 | 0.06 | 8 |
| Hartebeest | 0.00 | 0.01 | 0.01 | 1 |
| Oryx | 0.00 | 0.01 | 0.01 | 1 |
| Rhino calf | 0.00 | 0.01 | 0.01 | 1 |
| Unknown | 0.01 | 0.02 | 0.02 | 3 |
| Warthog | 0.00 | 0.07 | 0.07 | 9 |
| Waterbuck | 0.00 | 0.01 | 0.01 | 1 |
| Wild pig | 0.00 | 0.01 | 0.01 | 1 |
| Zebra | 0.16 | 0.35 | 0.50 | 65 |
| **Total** | **0.19** | **0.81** | **1** | **129** |

*A female lioness with her cubs feeding on a hartebeest kill*

*One of the prides feeding on a buffalo kill*

## 4. Outreach and capacity building

Throughout my project, I am advising students at local universities through internship placements and attachments to enhance their knowledge and skills in scientific research. Here, I engage them in deployment and servicing of camera traps, image classification, lion tracking and kill search, thus providing them opportunity to interact directly with wildlife and wildlife conservationists. Since January 2020, I have engaged more than 10 students from different colleges and universities Including the Kenya Wildlife Service Training Institute, Karatina University, University of Nairobi, Chuka University and University of Eldoret.

Student from the Kenya Wildlife Service Training Institute collecting lion scat sample from the field.

Students from Kenya Wildlife Service Training Institute and University of Nairobi assessing *Acacia drepanolobium* tree for ants and damages