Using elephant pathways and dung to investigate human-wildlife conflict around Vwaza Marsh Wildlife Reserve

NVT Final Grant Report 2022

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Background

Human-elephant conflict is devastating to rural subsistence farming communities as it results in revenue and livelihood losses. This conflict, however, is also extremely hazardous for community members and often increases tension between humans and wildlife thereby instigating lethal retaliation (Naughton, Rose, & Treves, 1999). In Vwaza Marsh Wildlife Reserve (VMWR) the alignment of the southern boundary with the prime wildlife habitat of the South Rukuru River, coupled with the mass cultivation outside the reserve, creates high levels of human-elephant conflict (Anthony & Wasambo, 2009). Mitigation measures have been implemented in recent years - including the fencing of the southern boundary – but these are now deteriorating, and conflict remains high with devastating impacts on both people and wildlife. For example, in the first five months of 2020, three elephants were killed by communities in retaliation to conflict events (T. Mhango pers. comms). It is therefore critical that park management increases its ability to predict and mitigate human-elephant conflict.

In 2019 Lilongwe Wildlife Trust (LWT) collared two elephants to improve the understanding of movements in the area. Early analysis of collar data revealed high levels of movement into community land on the southern boundary of VMWR (Sievert *et al.,* 2022). Collar data showed that time spent by elephants on community land increased with decreasing rainfall and, in some months, elephants were found to spend upwards of 12% of their time outside the reserve. However, given the perennial water available from the South Rukuru River and Lake Kazuni, which border VMWR's southern boundary, it is anticipated that movements outside of the reserve are driven by anthropogenic food availability rather than water requirements. This is supported by conflict reports from communities (Anthony & Wasambo, 2009). However, these reports and collar data only allude to the drivers of elephant movements, which are multifaceted and dynamic. For example, conflict reports rarely distinguish between foraging or trampling and consequently do not consider resource selection. Additionally, areas often experience conflict at different times which is thought to relate to the elephants' perceived risks and/or resource availability both inside and outside the protected area.

This project aimed to better define the drivers influencing human-elephant conflict in VMWR by surveying elephant pathways and investigating forage selection. Pathways for elephants provide least-effort routes between resources, thereby increasing feeding efficiency by reducing travel times to clustered and stable food sources. The positions of pathways therefore reflect preferred routes to and from favoured resources (Shannon *et al.,* 2009). By mapping and surveying elephant pathways into community land during peak conflict times (May-Oct), we categorised hotspots of elephant activity and preferred anthropogenic resources, while also identifying the demographics and individuals partaking in crop-foraging behaviour. Additionally, by incorporating dung analysis we further developed our understanding of how forage choice influences conflict. This research complemented LWT elephant collar data and assisted in identifying system-specific drivers of human-elephant conflict in the region such as food availability and anthropogenic disturbances.

Objectives

The aim of this project was to contribute evidence-based knowledge to the emerging framework for reducing human-wildlife conflict in Malawi by examining the drivers of elephant crop-foraging behaviour in VMWR. Our objectives were as follows:

- Improve ability to predict hotspot areas of human-elephant conflict for targeted mitigation and community outreach work.
- Increase capacity to actively plan strategic fence patrols and protection measures for the upcoming fencing project in VMWR.
- Contribute to the increasing body of knowledge surrounding the effects of resource availability on elephant crop-raiding behaviour.
- Provide VMWR park management with an easily replicable baseline survey for investigating the effectiveness of human-elephant conflict deterrents.

Methods

Elephant Pathway Mapping


Benn Lilly recording data during pathway mapping

Elephant pathways are defined as permanent pathways with floors devoid of vegetation. Using data collected from two collared elephants, we chose to survey the south-eastern boundary of VMWR as this area appeared to have the highest occurrence of elephants leaving the reserve. Given time constraints, a subset of the southern boundary road was driven in search of pathway crossings between June and July 2021. All pathways into communities and the reserve were walked and mapped using the track function on a handheld GPS device. Any evidence of elephants or other species was recorded, as well as changes in land-use, what crop species is cultivated in the area, distance to human settlements, and any other pathways or road crossings. The width of the pathway is recorded every 100m as an indicator of how well the pathway is utilised.

Elephants Pathway Surveying


Pilirani Sankhani measuring the width of an elephant pathway dung

Once all pathways were mapped, ground surveys of the southern boundary of the reserve were conducted early mornings from July until November, before tracks were driven/walked over. Any observed elephant tracks were recorded, and the largest and smallest track of any spoor grouping measured to establish group composition and size (*i.e.,* male group, breeding herd, lone bull). A bearing for the general movement direction was recorded as an indicator if elephants used the respective travel route to leave or return to the reserve. Any crossings of other species were noted. All tracks along the southern boundary road were then cleared to avoid double counts. Pathways experiencing high levels of use were camera trapped to identify individual elephants traveling through.

Elephant Diet

Fresh elephant dung (<12 hours and with no signs of decomposition or insect activity) was collected opportunistically over the course of this project. Three boli from each pile were measured in order to determine the age of the elephant. Measurements were taken along the axes of the boli, and the average diameter recorded. Dung was then taken to camp where it was broken and sorted for seeds. Seeds were cleaned thoroughly, left to dry and subsequently photographed and identified.

Benni Hintz (left) and Pilirani Sankhani (right) measuring elephant dung boli

Findings

Elephant Pathway Mapping

In total, 180 pathways making up 45.53 km (average: 0.25km; range: 0.02-1.61 km) were mapped (Figure 1). Of the 180 pathways that were mapped, 132 had at least a portion that were outside the reserve and therefore in community land. These pathways traversed 484 crop fields, with the most common crops being maize (192 fields) tobacco (146 fields) ground nut (62 fields) and soybeans (36 fields). Interestingly, most pathways mapped were also used by humans with a large majority of them being secondary roads and bicycle paths. Additionally, pathways encountered infrastructure 207 times, 124 of these were dwellings. Dwellings were on average 0.044 km from the pathways that were being mapped (range: 0.00-0.348 km), which is concerning for human safety.

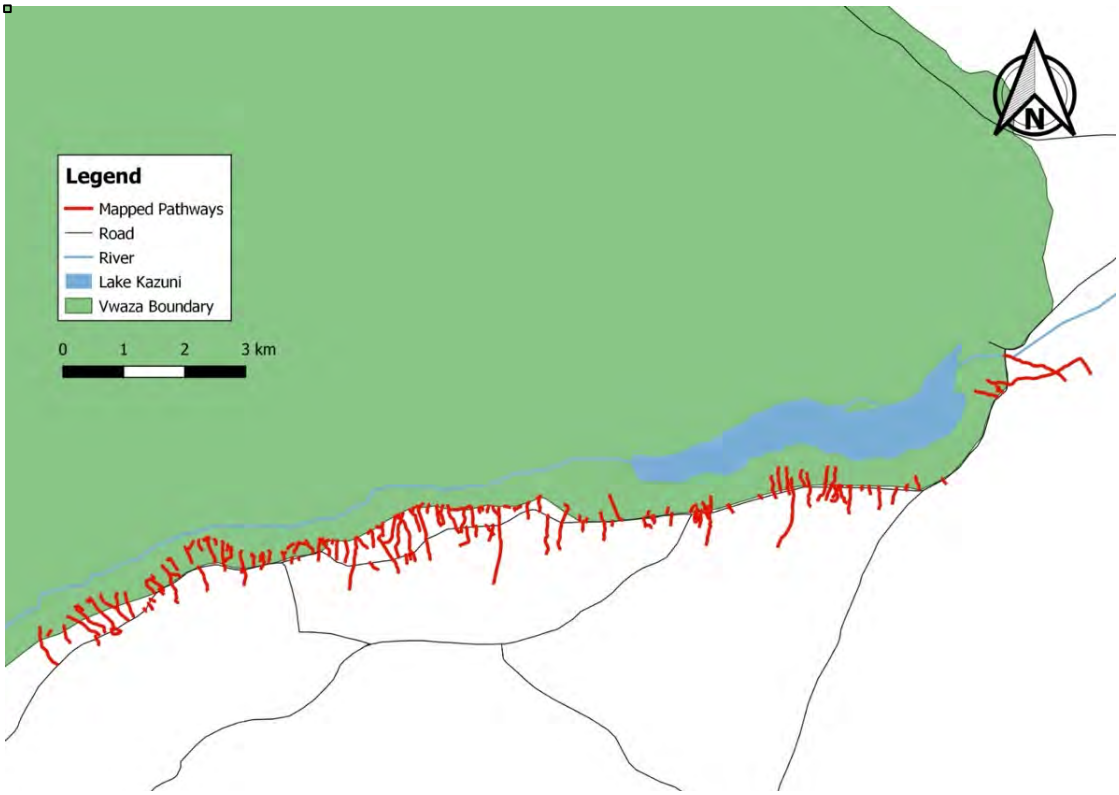

Figure 1 Pathways used by elephants along the southern boundary of VMWR (June-July 2021).

Elephant Pathway Surveying


Elephant damage to banana trees

A total of 367 records of elephant activity (dung, tracks, and conflict reports) were collected during the pathway surveys. Elephant activity appears to be centered around three hotspot zones (Figure 2). Of the tracks observed, 54.7% were confirmed to be from bull elephants. Pathways within these hotspot areas traversed a total of 158 crop fields, consisting of 9 different crop types. The predominant crop was maize (61 fields) followed by tobacco (39 fields) then ground nuts (28 fields). It is noted however, that the majority of maize was already harvested during these surveys. Over this period our team also recorded 61 cases of elephant related crop damage and reports from community members (Figure 3) interestingly community members reported damage to two crops which were not encountered on our pathway mapping; bamboo (2 reports) bananas (1 report).

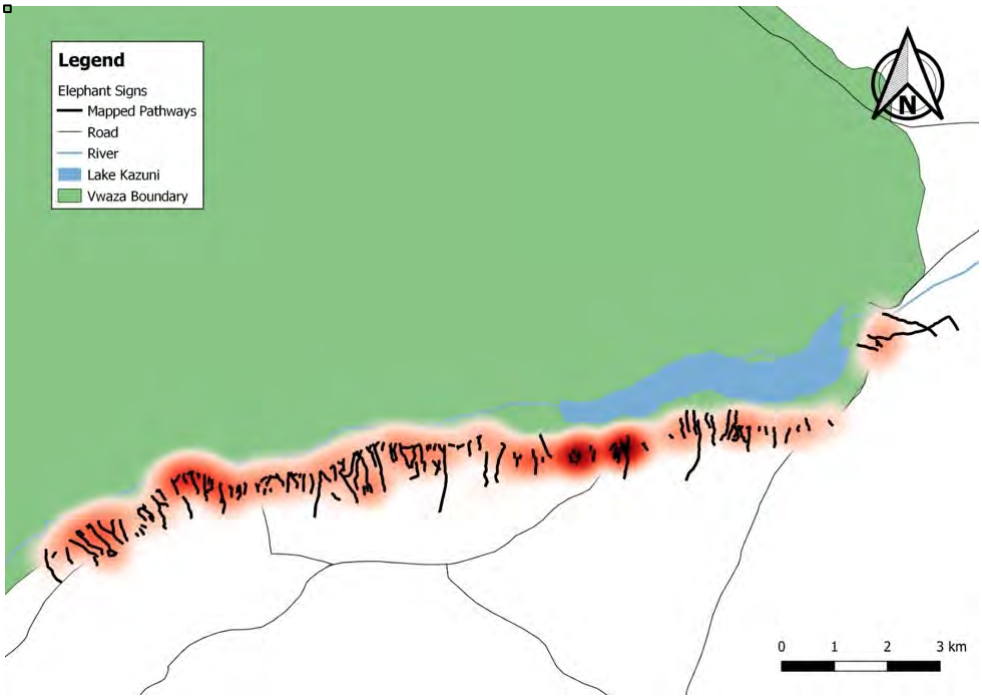

Figure 2 Pathways used by elephants along the southern boundary of VMWR and hotspots of elephant activity recorded from July 1st until October 31st, 2021.

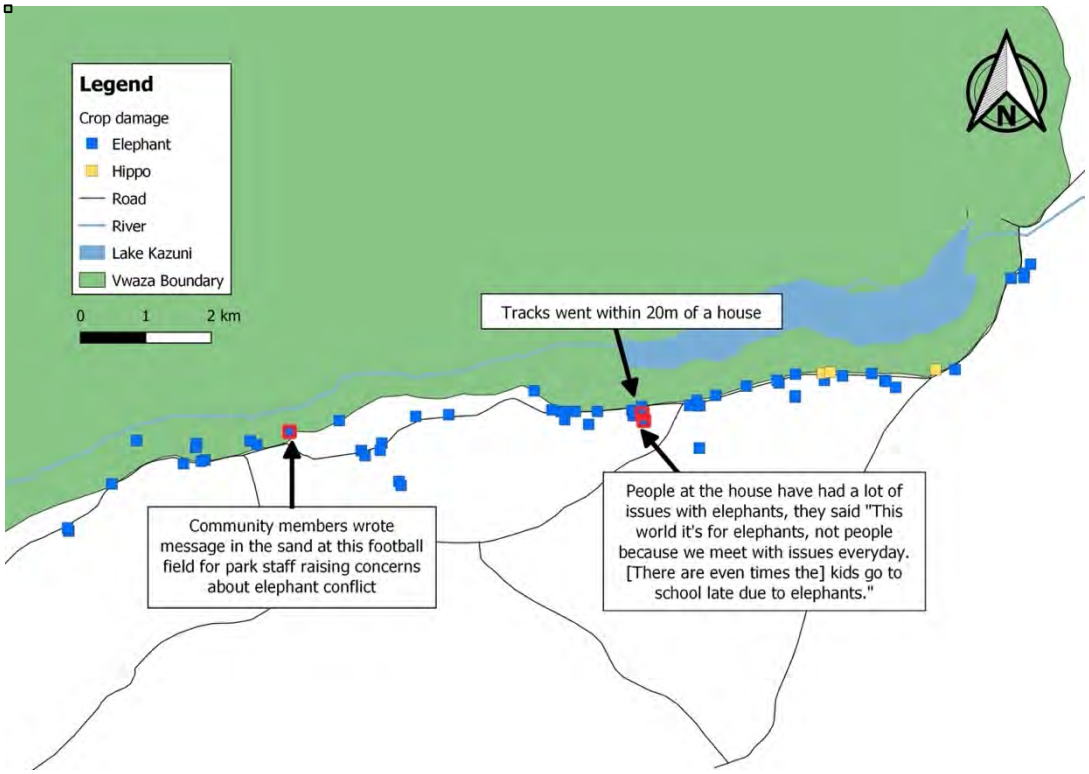

Figure 3 Records of crop damage and conflict reports along the southern boundary of VMWR recorded from July 1st until October 31st, 2021.

In addition to numerous signs of elephant activity on the pathways, our team also recorded signs of hippo (683 records), baboon (9 records), serval (8 records), buffalo (6 records), civet (5 records), genet (5 records), hyena (2 records), mongoose (2 records) vervet monkey (2 records) and bushpig (1 record). A heat map was generated of these records, it showed the activity of these species centered around Lake Kazuni, which is likely skewed due to the high number of hippo records. A total of 41 crop fields were recorded on pathways within this hotspot area. These fields consisted of 9 different crop types; the predominant crop was maize (19 fields) followed by soybeans (6 fields) then sweet potatoes (4 fields).

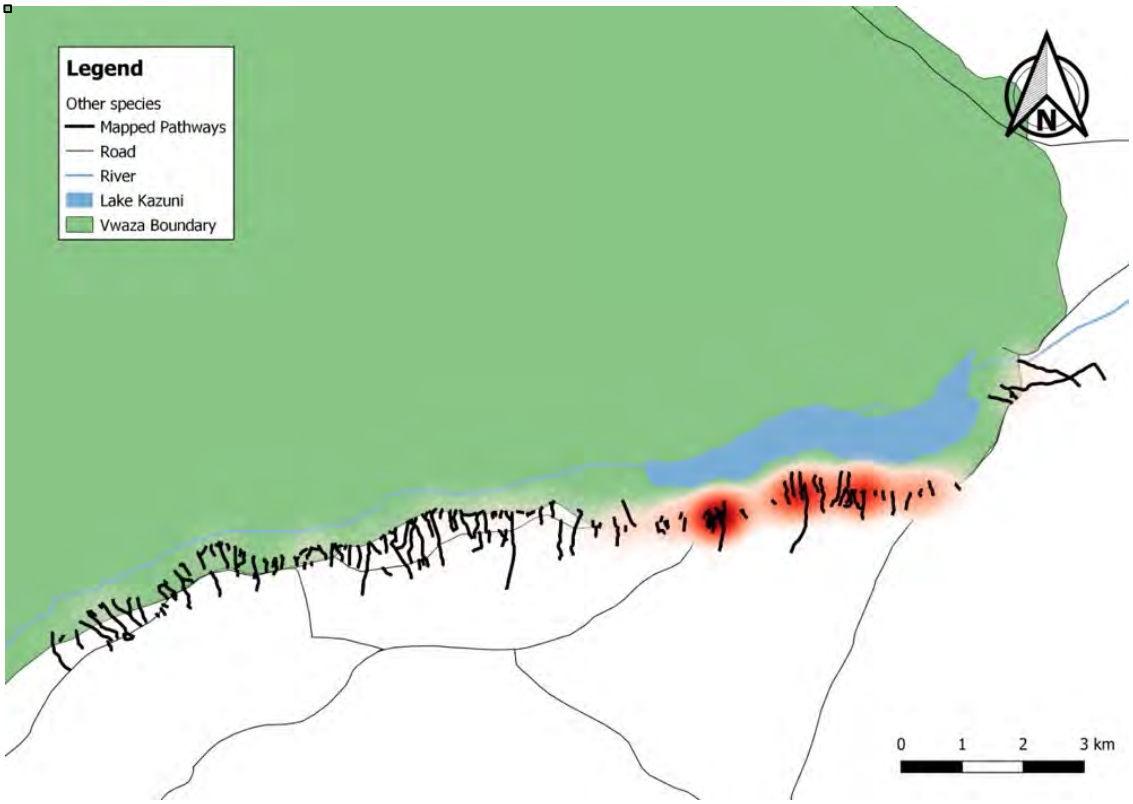

Figure 4 Pathways used by elephants along the southern boundary of VMWR and hotspots of non-elephant wildlife activity recorded from July 1st until October 31st, 2021.

Camera trapping

Camera traps were set along pathways on the southern boundary of VMWR (Figure 5). Unfortunately, of the eight camera traps purchased, three were subjected to vandalism; one camera had its flash damaged, two were stolen and on two occasions batteries and SD cards were stolen. Regardless, a total of 511 camera trap nights were completed across all deployments. Camera trapping along the southern boundary was not easy due to its open habitat, therefore it was difficult to identify individual elephants and herds. However, a total of 11 mammalian species were recorded along the southern boundary of the reserve.

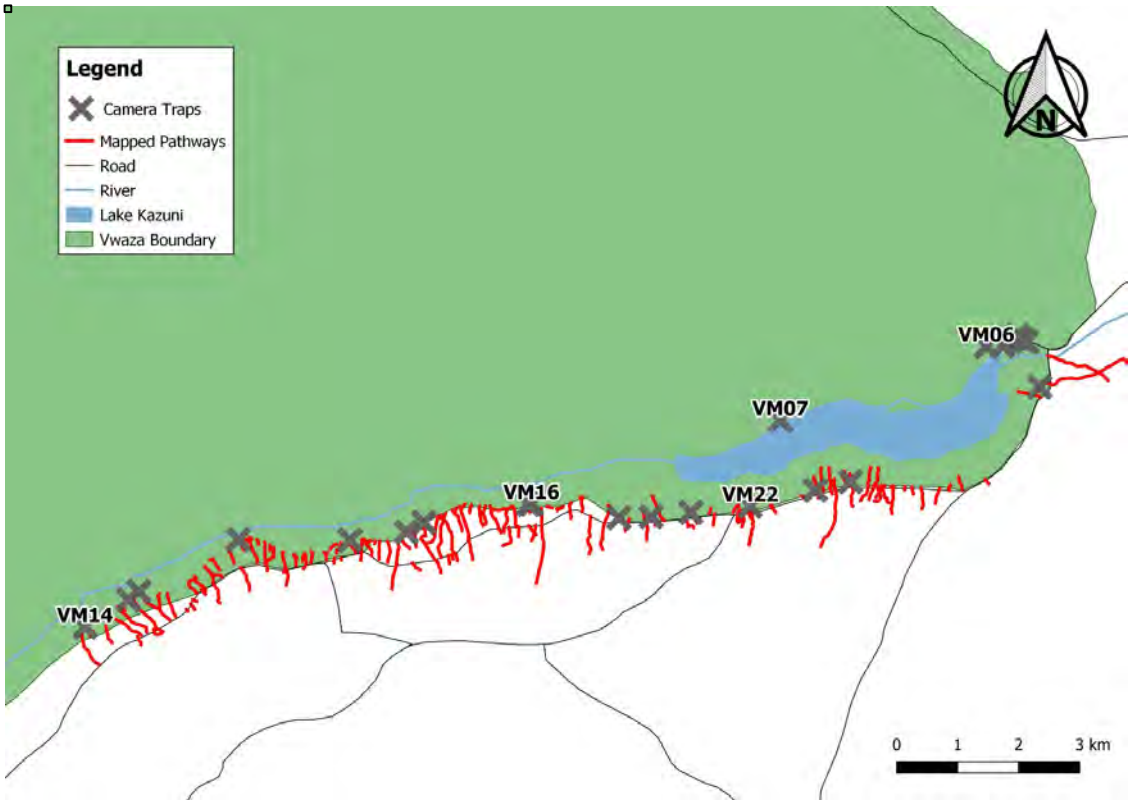

Figure 5 Location of camera trap stations around VMWR June 1st – October 31st, 2021

Figure 6 Camera trap photos from station VM06. Species in photos are (clockwise from top left) buffalo, hippo, spotted hyena, impala.

Figure 7 Camera trap photos from station VM07. Species in photos are (clockwise from top left) hippo, serval, leopard, elephant.

Figure 8 Camera trap photos from station VM14. Species in photos are (clockwise from top left) people, servals, civet, elephant.

Figure 9 Camera trap photos from station VM16. Species in photos are (clockwise from top left) elephant, elephant people, hippo.

Figure 10 Camera trap photos from station VM22. Species in photos are (clockwise from top left) mongoose, elephant, genet, hippo.

Elephant Diet

80 dung samples were collected from June to October 2021. This data was then supplemented for comparison with the 68 samples collected between June and October 2018. In both years most samples were collected along the southern boundary of the reserve with a few samples in 2018 collected further north in the reserve (Figure 11). However, a much larger proportion of dung samples contained crop seeds in 2021 compared to 2018 (2.9% of samples in 2018; 42.5% of samples in 2021) (Figure 12). In 2021 the two most common foraged crops were pumpkin (found in 20 dung samples) and maize (found in 17 dung samples) (Figure 13).

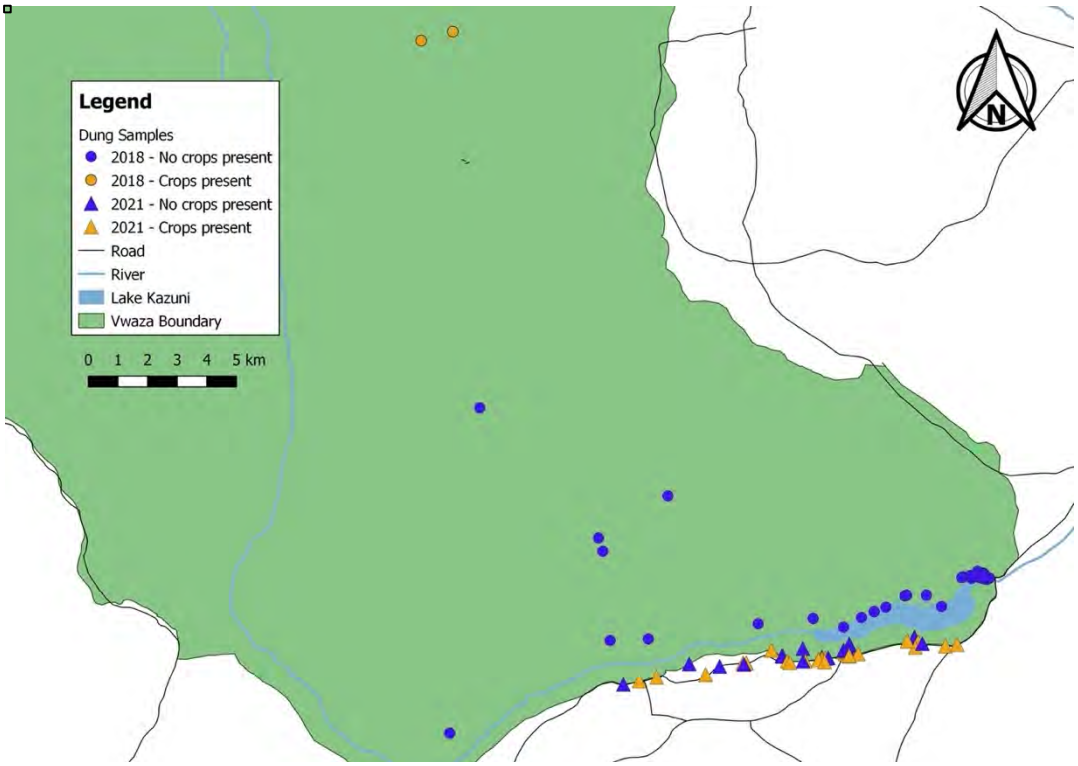

Figure 11 Location of elephant dung samples collected in VMWR from June 1st until October 31st, 2018, and 2021, indicating samples that contained evidence of crops and those with no crops present.

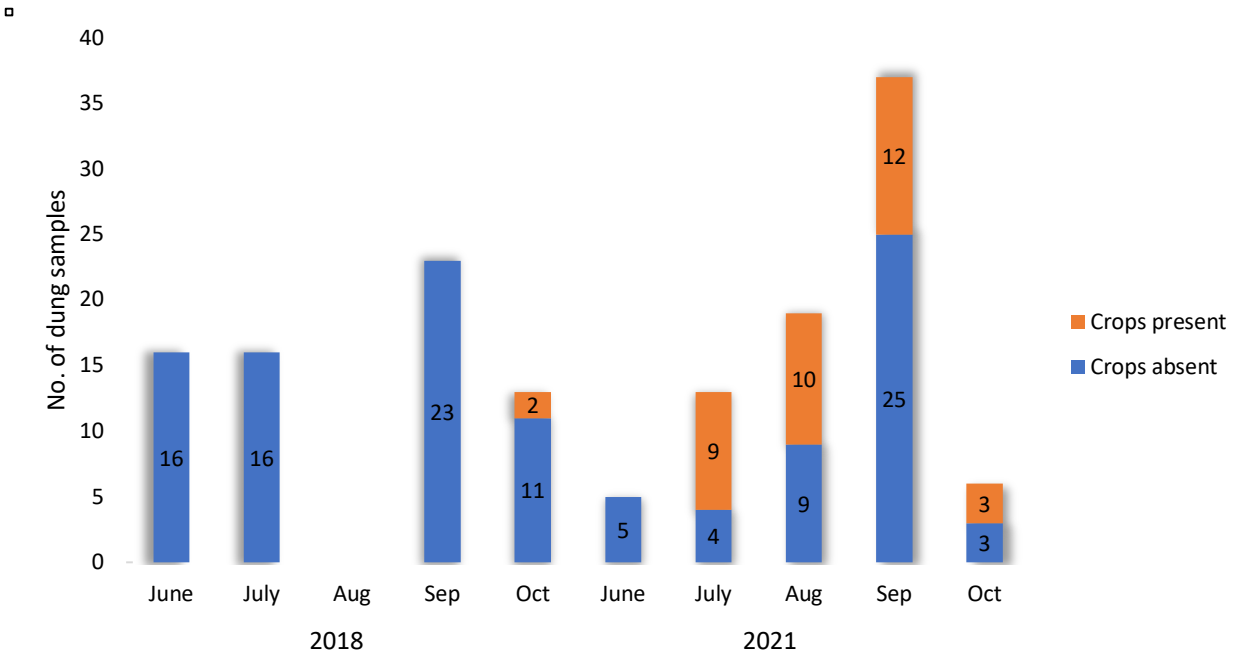

Figure 12 Number of dung samples collected in VMWR over 2018 and 2021 that were found to either have crops present or no crops present.

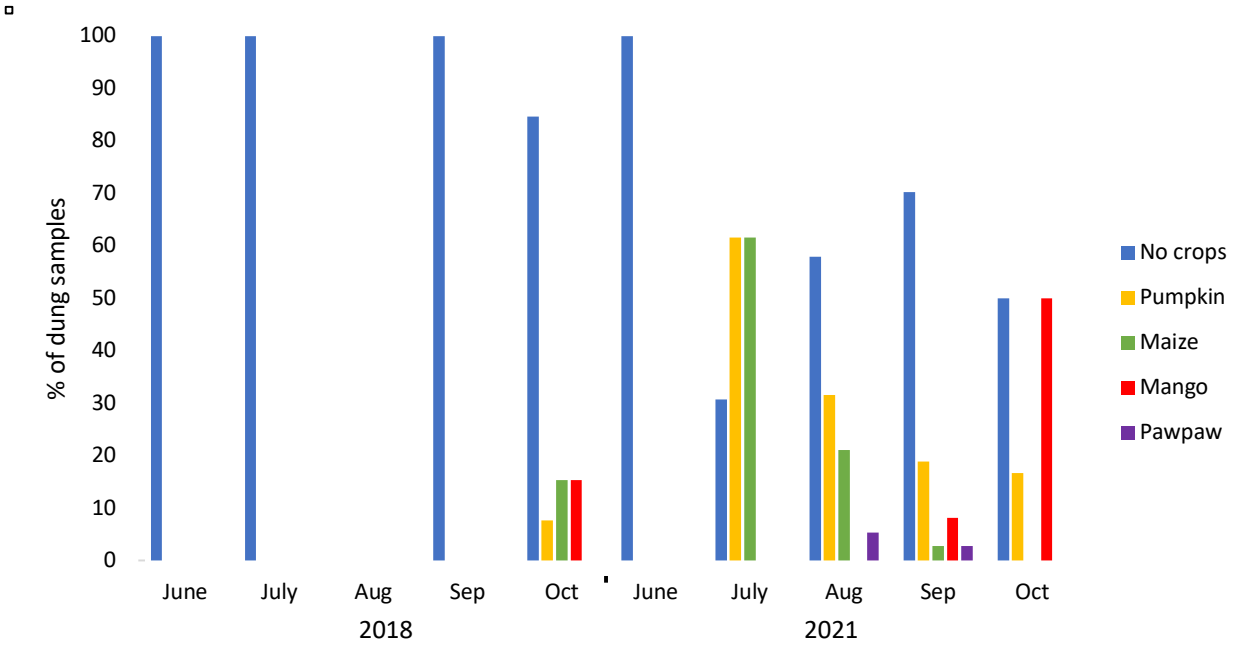

Figure 13 Percentage of dung samples collected in VMWR over 2018 and 2021 that were found to have various crop species present.

Discussion

During this project our team noted that the elephants in VMWR use all sorts of pathways once outside of the reserve, including, roads, human footpaths and bicycle paths. Given the directional movements of the tracks, it was noted that the elephants use secondary roads as a quick direct retreat to the park, which was confirmed by multiple community members. However, when moving into community land, elephants appear to use smaller footpaths or traveled spread out through uncultivated land, this made it difficult to follow their tracks as they move into preferred foraging areas. The difficulty of following this non-direct movement style could explain why our teams did not encounter many areas cultivated for pumpkins, the most common crops consumed by elephants around VMWR. It is therefore suggested that this method of moving through community land resulted in pathway surveys not being the most reliable method of categorizing preferred anthropogenic resources for elephants in VMWR. However, surveys for elephant activity within community land was successful in identifying hotspot areas of elephant activity along the southern boundary.

Furthermore, while the diet analysis was successful in detecting an increase in crop foraging from 2018 to 2021 and was able to pinpoint monthly changes in crop foraging, diet analysis contains inherit bias. For example, we received reports of recently raided sweet potato, banana, and groundnut fields, but none of these crops would easily show in the dung sampling methods we undertook. We therefore recommend a multi-facetted approach to identifying hotspots of elephant activity and preferred anthropogenic resources including gathering conflict reports, diet analysis, and boundary surveys.

Support to DNPW

Going forward we are continuing to support DNPW with the management of their elephant population in Vwaza Marsh Wildlife Reserve. We've recently collared an additional two bulls (bringing the number of collared elephants in VMWR to three) within the reserve, which will increase our understanding of elephant movements across the larger Malawi-Zambia Transfrontier Conservation Area landscape and allow management to monitor potential conflict around the reserve. We have also treated three elephants for human-conflict related injuries since the start of this project.

Acknowledgements

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