

Using camera traps to study elephant use of waterholes on village land in Ruaha-Rungwa, Tanzania



**Interim Progress Report to Jana Robeyst Trust Fund
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1. Executive summary

This study focuses on elephant use of water sources located on village land bordering the Ruaha-Rungwa ecosystem in southern Tanzania. This ecosystem is home to one of East Africa's largest elephant populations, and human-elephant conflict (HEC) is a growing threat to both elephants and local livelihoods in this area. One pressing conservation issue is the shared use of water sources by elephants, people, and livestock. Developing strategies for water access for both people and elephants is key to long-term community welfare and elephant conservation goals in the region.

This project is helping develop to such strategies by using camera traps to acquire detailed information on spatial and temporal patterns in elephant use of village water sources. Camera traps were deployed at water sources in three villages in September 2018. Data collection is ongoing and will continue through December 2019. Results from the first ten months of data (September 2018 through June 2019) are presented in this report.

Key findings include:

- Elephant use of water sources on village land is seasonal: 80% of events occurred during the dry season (September-December 2018 and June 2019), while 20% of events occurred during the wet season (January to May 2019).
- The frequency of elephant use of water sources varied by village. The daily probability of elephant use of focal water sources was 0.07 for Malinzanga, 0.09 for Kitisi, 0.17 for Tungamalenga.
- Camera captures reveal a distinct pattern of elephant movements toward and away from water sources on village land. Movements toward water sources are concentrated between 19:00 and 23:00, with a peak between 20:00 – 20:59. Movements away from water sources and back towards adjacent protected areas are concentrated between 00:00 and 04:59, with a peak between 3:00 and 3:59.
- Most elephant activity occurs before sunrise and after sunset. However, there is risk of overlap with human activity between the early hours of the morning (05:00 – 08:59) and early evening (18:00 to 21:59), when movement of people and livestock occur.
- The majority of events (88%) captured by the camera traps involved elephant bulls. Cow-calf groups comprised 9% of events, and mixed groups only 3%. These results are suggestive of greater risk aversion by female-led cow-calf groups.
- In 79% of cases, there was a period of 0 – 3 days between subsequent events, indicative of regular use of village water sources. Furthermore, repeat use of water sources has been observed for several individuals.
- One water source stands out as being of particular importance to bulls, with a median of 10 and average of 13 bulls using the water source per night. In one night, it was visited by 36 unique bulls, and, on 16 occasions, 20 or more bulls visited the water source in one night.

The results of this study will help to recommend safer hours for human use of village water sources based on the knowledge of elephant visitation patterns. This study will also help to recommend cases where separate water sources for people and elephants should be invested in, for example, for those water sources where elephant use is very regular.

2. Conservation background

The Ruaha-Rungwa ecosystem in south-central Tanzania is home to one of East Africa's largest elephant populations (approximately 15,000 individuals). Human-elephant conflict (HEC) in this area is a growing concern to rural communities, Government, and conservationists. HEC threatens people's livelihoods and welfare, and threatens elephant populations by creating negative perceptions of elephants that undermine conservation goals and through the retaliatory and legal

killing of elephants under Tanzania's Problem Animal Control laws. HEC also threatens the recovery of Ruaha-Rungwa's elephant population from the poaching crisis which reduced this population by more than 50% in ten years.

Surveys conducted by Southern Tanzania Elephant Program (STEP) show that, alongside crop losses to elephants, the shared use of water sources by elephants, people, and livestock is of concern to local communities, especially as the region's largest water source, the Great Ruaha River, is drying up. In areas where water is already scarce, people are afraid of using village wells because the risk of encountering elephants poses a potential danger to their lives. Elephants have fallen into and damaged village wells and have been injured and killed for damaging village farms. Developing strategies for water access for both people and elephants is therefore key to long-term community welfare and elephant conservation goals in the region. This project aims to address this issue by collecting detailed scientific data on elephant use of village water sources to inform approaches for managing water access. Resolving the issue of water access is central to enhancing human-elephant coexistence and improving human livelihoods in this area.

3. Project aims and objectives

The overall aim of this ongoing project is to enhance human-elephant coexistence by developing strategies for water access for both people and elephants in the Ruaha-Rungwa ecosystem of Tanzania through analysis of detailed scientific data on elephant use of village water sources.

The objectives of this project are to 1) analyze where, when, and how elephants use waterholes on village land, and 2) to develop recommendations for managing access to water sources for both people and elephants. This project will help to reduce elephant impacts on local communities, as well as ensure that elephants continue to gain access to a crucial resource for their survival. For instance, camera trap data on elephant activity patterns will help us recommend safe hours for human access and use of village water sources.

Previous research from Kenya suggests that elephants avoid peak hours of human activity at water sources to reduce contact with people. If we find similar results in our project area, we can illustrate how an understanding of elephant behaviour can be used to reduce contact between people and elephants. The project will also help us to identify cases where separate water sources for people and elephants should be invested in, and to make recommendations for village land use planning, such as the layout and location of village homesteads and farms relative to water sources.

4. Methodology

We are using camera traps (remotely triggered cameras) to detect and photograph elephant visits to village water sources. Cameras were deployed along five trails to water sources in three villages (Malinzanga, Kitisi, and Tungamalenga). Each village selected one community member to act as a local elephant monitor who was trained in deploying and operating the camera traps. Cameras were deployed in September 2018 and will be operational through December 2019.

We conducted monthly checks of camera traps to replace batteries, download images, and to ensure correct camera placement. Camera trap images are stored and processed in a dedicated photo database. Photos are tagged using ExifPro software to identify species, group type, party size, direction of movement, and signs of stress. We assigned unique event IDs to detections of one or more elephants when images were > 15 minutes apart.

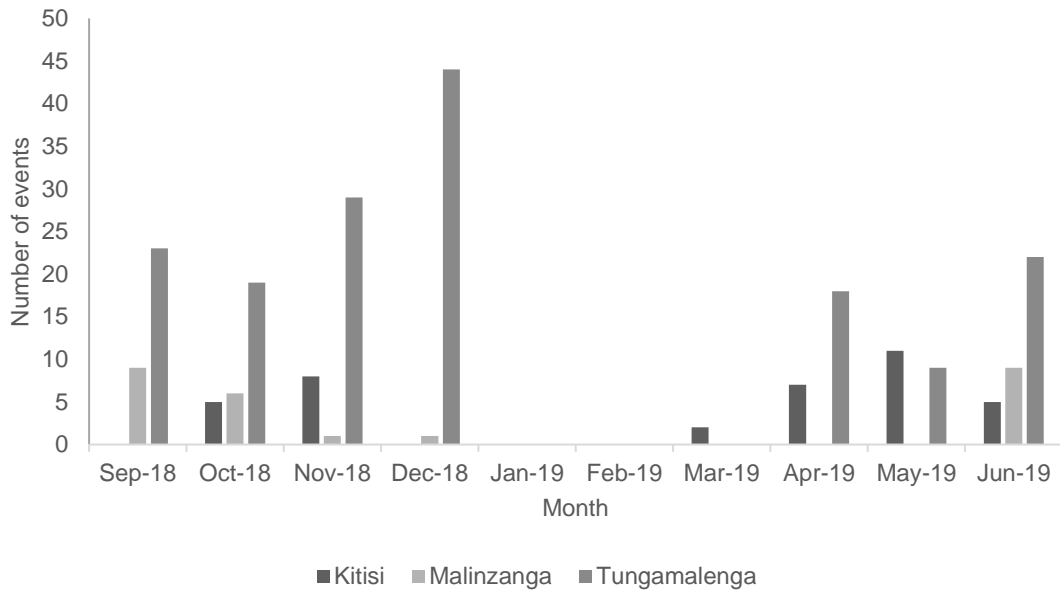
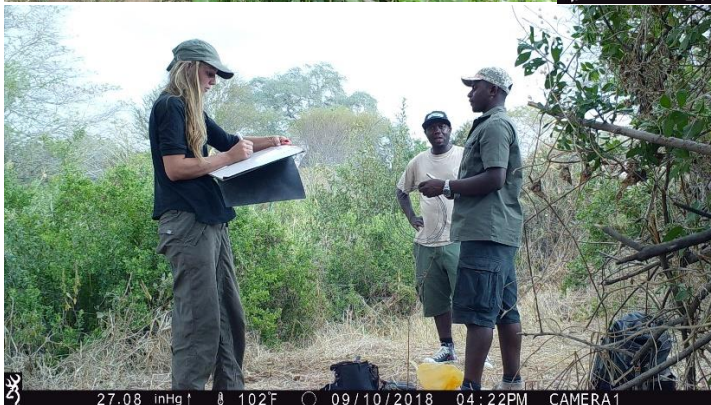
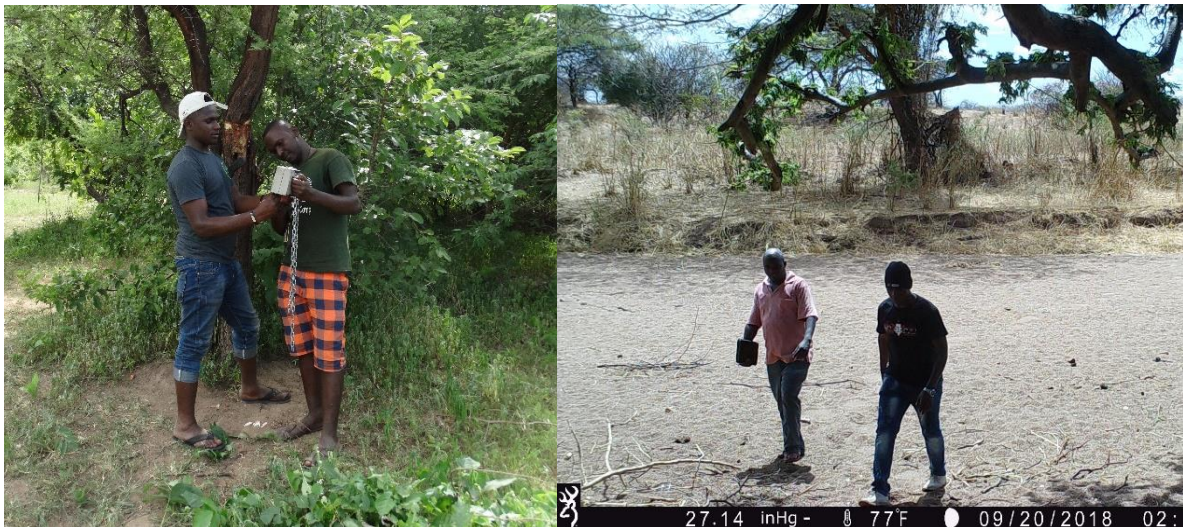


Figure 1. Number of events by month and village

A total of 228 events were detected by the camera traps between September 2018 and June 2019. 164 events occurred in Tungamalenga village, 38 events occurred in Kitesi village, and 26 occurred in Malinzanga village. 181 events (80%) occurred during the dry season (September-December 2018 and June 2019) and 47 events (20%) occurred during the wet season (January to May 2019).



Setup and checking of camera traps with camera monitors

5. Preliminary results

Results from the first 10 months of data collection are presented below.

5.1 Spatial and temporal patterns in water use

Elephant use of the focal water sources varied in regularity by village. Elephant activity was recorded on 19 nights for Malinzanga village, 27 nights for Kitisi village, and 50 nights for Tungamalenga village over a data collection period of 291 days. Thus, the daily probability of elephant use of water sources was 0.07 for Malinzanga, 0.09 for Kitisi, 0.17 for Tungamalenga.

In 79% of cases, there was a period of 0 – 3 days between subsequent captures of elephants. This result was driven primarily by regular visitation of focal water sources in the dry season months. Long periods between subsequent elephant captures occurred only during the wet season. In particular, elephant use of focal village water sources was very low during the peak wet season months of January, February, and March.

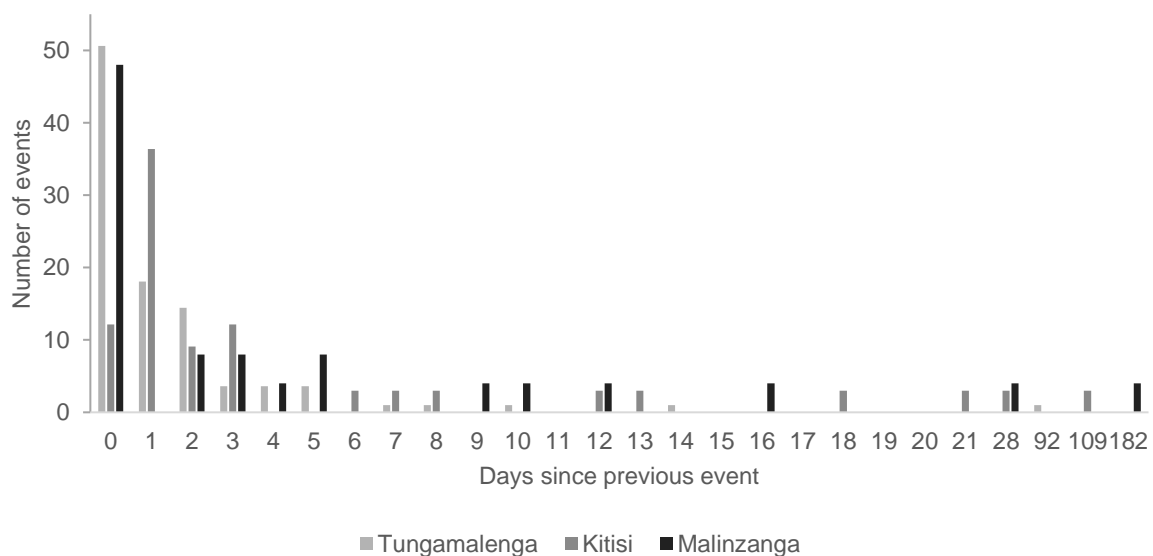


Figure 2. Number of days since previous event

Camera captures reveal a distinct pattern of elephant movements toward and away from water sources on village land. Movements toward water sources are concentrated between 19:00 and 23:00, with a peak between 20:00 – 20:59. Movements away from water sources and back towards adjacent protected areas are concentrated between 00:00 and 04:59, with a peak between 3:00 and 3:59.

Most elephant activity occurs before sunrise and after sunset. However, there is risk of overlap with human activity between the early hours of the morning (05:00 – 08:59) and early evening (18:00 to 21:59), when movement of people and livestock occur.

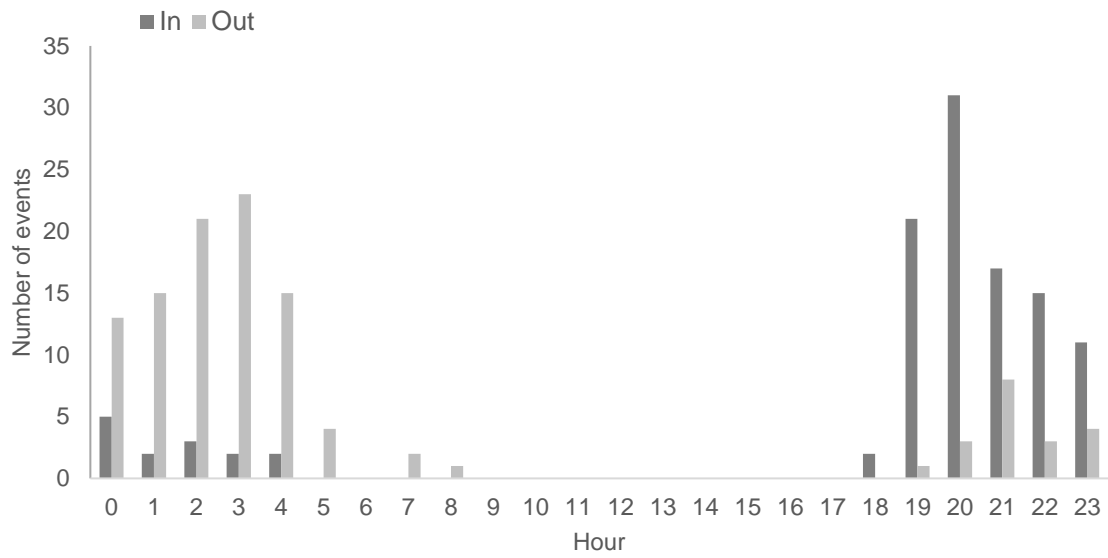


Figure 3. Number of events per hour by direction of travel: In (towards water) or Out (away from water)



Elephant bulls heading towards water source (top) and away from water source (bottom)



While most elephant detections occurred at night, a handful occurred during daylight hours

Overall, the activity patterns of bulls and cow-calf groups were similarly nocturnal. However, there was greater movement towards water between 00:00 and 04:59 for cow-calf groups (33% of cow-calf events) than for bulls (10% of bull events). There was also more movement away from water earlier in the night for-calf groups (37% of cow-calf events) than for bulls (18% of bull events). This suggests that cow-calf groups may head to water sources later and leave water sources earlier than bulls.

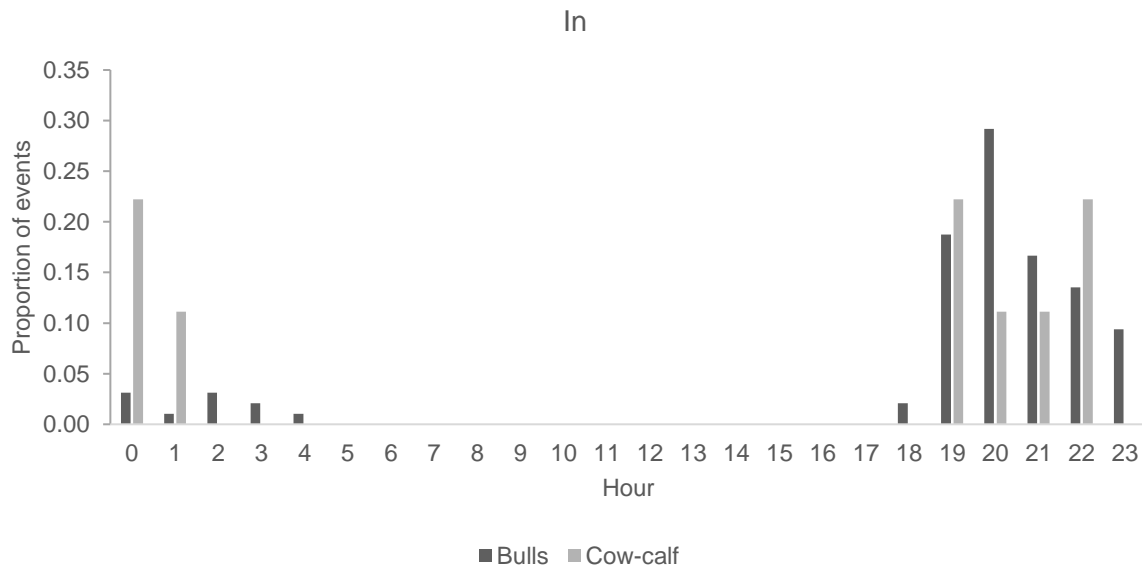


Figure 4. Number of events per hour towards water (In) for bulls and cow-calf groups

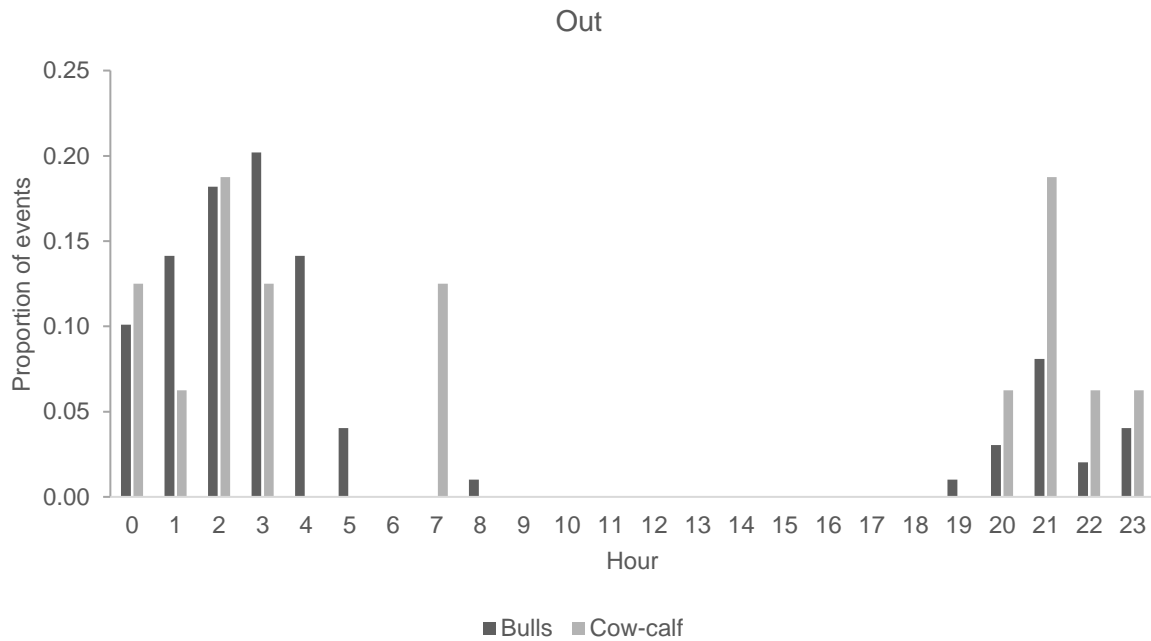


Figure 5. Number of events per hour away from water (Out) for bulls and cow-calf groups

5.2 Group size and composition

The majority of events (88%) captured by the camera traps involved elephant bulls. 72% of events involved bull groups, and 16% of events involved lone bulls. Cow-calf groups comprised 9% of events, and mixed groups only 3%. These results are suggestive of greater risk aversion by female-led cow-calf groups.

Cameras revealed variation in group composition by village. In Tungamalenga village, 100% of captures were of lone bulls and bull groups. In Malinzanga village, 77% of detections were of lone bulls and bull groups, and 15% were of cow-calf groups. In Kitisi village, lone bulls and bull groups made up 41% of detections, while cow-calf groups made up 43% of detections. This variation in group composition may be related to the distance between water sources and nearest human presence. In Tungamalenga village, the focal water source is very close to human households (<500m), while in Kitisi village, the nearest household is several kilometres from the focal water source.

Table 1. Group composition of elephant captures (all events)

Group type	Bull group	Lone bull	Cow-calf group	Mixed group
Number of events	164	36	20	8
% of events	72	16	9	3

Table 2. Group composition of elephant captures by village (all events)

Village	% Bull group	% Lone bull	% Cow-calf group	% Mixed group
Kitisi	19	22	43	16
Malinzanga	35	42	15	8
Tungamalenga	90	10	0	0

Group size ranged between 1-31 individuals for bulls and 2-16 for cow-calf groups. Mean group size was 7 individuals (median 5) for bulls and 9 individuals (median 10) for cow-calf groups. For bulls, group size ranged between 2 and 10 individuals for 57% of events, and over 10 individuals for 27% of events.

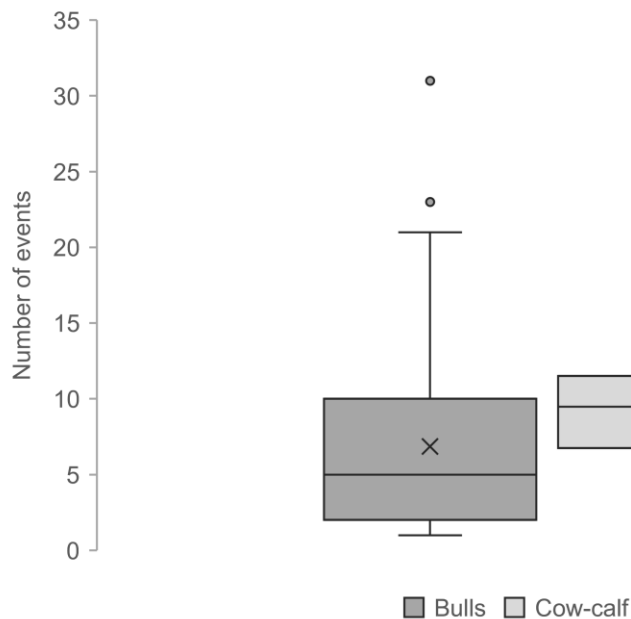


Figure 6. Group size distribution for bulls and cow-calf groups

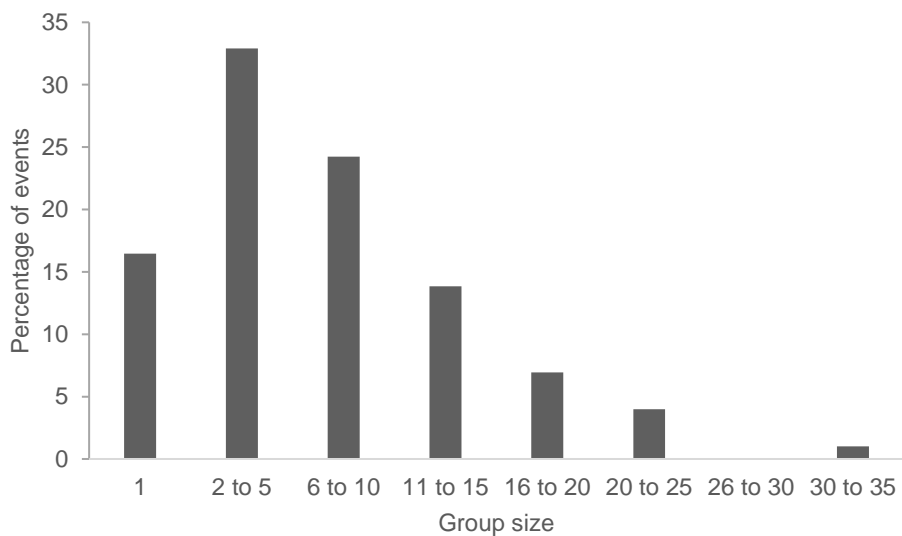


Figure 7. Variation in bull group size

5.3 Repeat use of water sources

Individual identification of elephants from camera trap images is ongoing to enable study of individual elephant visitation patterns to focal water sources. Repeat use of water sources has been observed for several individuals so far, including multiple bulls in Tungamalenga village and a cow-calf group in Kitisi village. The water source in Tungamalenga village is of special importance to bulls, with a median of 10 and average of 13 bulls using the water source per night. In one night,

it was visited by 36 unique bulls, and, on 16 occasions, 20 or more bulls visited the water source in one night. The focal water source in Kitisi is of importance to at least two cow-calf groups.

6. Upcoming outputs

A report presenting project findings and recommendations for human-elephant coexistence strategies and interventions will be shared with Village, District and Regional government, as well as protected area managers and STEP's partners in the region. I will also share results with village communities via Swahili language presentations and dissemination of posters. A scientific publication is also anticipated as part of the J. Smit's PhD thesis.

7. Acknowledgments

I would like to thank the Tanzania Wildlife Research Institute, Commission on Science and Technology, Tanzania National Parks Authority, and the village governments of Kitisi, Tungamalenga and Malinzanga villages for permission to carry out this research. I would like to thank Kepha Mwaviko, Peter Mtyana, Kelvin Madege, Lameck Mkuburo, Innocent Kisanyage (Chogela Guide School), Leonard Fidelis (Mkuyu Guide School), Kinyozi Madinda, Ramadhani Mduda, and Michal Smielak for their valued assistance with this study. For funding and in-kind support, I am indebted to Jana Robeyst Trust Fund (which supported purchase of camera traps), Southern Tanzania Elephant Program, the University of Stirling, the United States Fish and Wildlife Service African Elephant Fund, and Jo and Nik Harris. Finally, I would like to thank Professor Phyllis Lee, Professor Hannah Buchanan-Smith and Dr. Trevor Jones for their guidance on research design and implementation.



Cow-calf group with infant captured on one of the village camera traps