Earthwatch Annual Report 2017 fielding season

Monitoring, understanding and managing the impact of large scale mammal re-introductions in Majete Wildlife Reserve, Malawi

PI: Dr Alison Leslie

Department of Conservation Ecology & Entomology

University of Stellenbosch, South Africa.
To All of You Intrepid 2017 field season volunteers….

Thank you, thank you thank you…what an incredibly, amazing field season we had! Once again we could not have achieved all we did without your help. Not only did you all contribute financially…..your willing hands, enthusiasm, humour and smiles also kept the research team in high spirits throughout the fielding season. We had a bumper of a fielding season and managed to collect a huge amount of very valuable data.

2017 was again full of wonderful happenings in Majete Wildlife Reserve:
There was another number of additions to the lion pride, Shire (the original female) gave birth to 3 new cubs in July and Elizabeth (Shire’s eldest daughter) also gave birth to 3 cubs in September.

After becoming a “bread basket” for wildlife in 2016, when 550 antelope (waterbuck, kudu, sable, eland and zebra) were translocated from Majete to Liwonde National Park and Nkhotakota Wildlife Reserve, Majete has done it again! In 2017, 154 elephants were translocated from Majete to Nkhotakota Wildlife Reserve. Additionally, another 345 animals of various species (waterbuck, sable, kudu, eland and zebra) were translocated to Nkhotakota, Liwonde National Park and to a few newly established game farms in Malawi. This is a dream come true for Majete. The rehabilitation and management of both Liwonde and Nkhotakota were taken over by African Parks towards the end of 2015.

A number of the rhinos transmitters were replaced, and over and above everything else that happened in 2017, 2 masters students successfully graduated and another 2 students commenced with their studies in Majete.

The endless hours you spent assisting us with waterhole sessions to identify, count and sex animals, changing camera trap cards and sorting through what has now amounted to 100 000’s of camera trap photographs, driving transects in order to count animals, participating in school visits, helping repair vehicles, dish washing….to mention but a few of the happenings…..is so much appreciated.

Thank you for providing us with a very necessary supply of batteries for all our camera traps and for your incredibly generous donations of items for the local schools. Your generosity was over-
whelming. For those of you who are connected to our projects facebook page - we hope you enjoyed the photos and noticed the kids happy faces on receiving stationary items.

African Parks are continuing to grow their portfolio of rehabilitated and managed parks and the organizations aim is 20 parks by 2020. Please help spread the word about African Parks and the wonderful work they are doing (www.african-parks.org).

We hope to have some of you join another of our teams in the not too distant future...and if not, do send a friend or two!

Thank you for all your support and the wonderful encouraging words.

Warmest regards from
Alison and the entire research team

Dr. Alison Leslie
Senior Lecturer and Wildlife Specialist
Department Conservation Ecology & Entomology
University of Stellenbosch, South Africa.
Tel: +27-21-808-2487
Cell: +82 896 0068 Email: aleslie@sun.ac.za
The Majete Wildlife Research Programme is an independently run research programme based at the Department of Conservation Ecology & Entomology, Faculty of Agrisciences, Stellenbosch University, South Africa. The research programme is being undertaken in collaboration with African Parks (Pty) Ltd and the Lilongwe University of Agriculture and Natural Resources (LUANAR). The research programme is partially funded by the Earthwatch Institute.

SUMMARY

- Assisted with translocation 154 elephants to Nhkotakota Wildlife Reserve
- Blood and tissue sampled and took numerous measurements from 124 of these elephants for a PhD looking at olfaction and kin recognition in African elephants
- Assisted with translocation of 345 animals to Nhkotakota, Nyika, Liwonde, and other private game farms (including waterbuck, kudu, sable, eland and zebra)
- Shire’s 3 new cubs born in July 2017 and Elizabeth’s 3 new cubs born in September 2017
- Assisted African Parks with implantation of radio transmitters in all adult rhinos’ horns
- Hosted 8 Earthwatch teams, including 45 volunteers from all over the world
- 2 master students graduated: i) Ecology of three apex predators in Majete Wildlife Reserve, ii) Ecology of Boehm’s zebra in Majete Wildlife Reserve

GOALS, OBJECTIVES, AND RESULTS

Objective #1. Assessing and modeling the population dynamics of various re-introduced herbivore species.

This greater project commenced in June 2013 with an initial focus on the population ecology, distribution and diet of impala and waterbuck within the reserve. These two species are so called “aggressive” species as they are very successful, currently rapidly increasing in numbers and thriving in the park. Monitoring of populations of the various herbivore species will provide the data necessary for the development of models that can be used to make predictions about the impacts of potential future management interventions, for example, the removal of excess herbivores from Majete for further re-stocking programs elsewhere. This project was completed in 2015 and in 2016 another project under this specific objective commenced. This project was undertaken by Charli de Vos and involved studying the ecology of zebra in Majete. Charli completed her studies in 2017 and graduated with an MSc in Conservation Ecology.

The following is the abstract from the completed thesis which is available in its entirety from Stellenbosch University’s library (http://hdl.handle.net/10019.1/102624)

Ecology of plains zebra (Equus quagga) in Majete Wildlife Reserve, Malawi.

By Charli de Vos

Abstract

Zebras occur throughout Africa and are responsible for sustaining the dynamics and overall well-being of the environments they reside in. However, zebras have experienced significant range reductions and restricted access to water and forage, as well as population declines within the last 100 years, contributing to the recent enlistment of plains zebra (Equus quagga) from Least Concern to Near Threatened on the IUCN Red List. In Majete Wildlife Reserve (MWR), located in southern Malawi, wildlife was almost completely extirpated from the reserve by 1985. In 2003 African Parks (Pty) Ltd. together with the Malawi’s Department of National Parks and Wildlife (DNPW) aimed to restore the reserve to its former glory. Fences were constructed, law-
enforcement was improved and wildlife was reintroduced, including 174 plains zebra (hereafter referred to as zebra). More than ten years after the species’ initial reintroduction, zebra have successfully established within MWR. Prior to this study, no long-term monitoring was conducted on MWR’s zebra post reintroduction. In this study, zebra demographics, diet, waterhole usage and behaviour was investigated.

The demography of zebra was determined with the use of an individual side-stripe database and an aerial survey. Of the estimated 571 zebra currently in the reserve, 243 were individually identified. Over the last few years, the population appears to have transitioned from the slower growth rate expected immediately after translocation to the rapid annual growth rate indicative of an approach toward carrying capacity. Adult zebra in the reserve currently exhibit a biased sex ratio of 1.0:0.8 (female:male). Population structure and organization is similar to established zebra populations; however the formation of herds (multiple bands associating with each other) was never observed in MWR. In addition, stable isotope analysis was conducted to examine the seasonal diet of the species. Results confirmed that zebra are predominantly grazers that occasionally browse (trees, shrubs and forbs), even given the dominance of browse (dicotyledonous trees and shrubs) in the miombo woodland environment of Majete. The proportion of browse consumed, however, varied significantly among the seasons, with only 1.5% browse consumed during the late wet season compared to 10.2% in the late dry season.

Artificial waterhole usage by zebra was studied with the use of camera traps. Waterholes were predominantly visited at 09:00, 13:00 and 14:00. However, when natural surface water decreased and more animals aggregated around artificial waterholes, it appeared that zebra shifted their visitation time to avoid interspecific competition around these waterholes. Finally, the diurnal time budgets of this species indicated that family bands allocate 41.8% of their time to feeding behaviour, followed by resting (18.5%), locomotion (10.9%), vigilance (7.5%), maintenance (2.7%) and social behaviour (1.4%). In comparison, bachelor bands allocated 27.0% to vigilance behaviour, followed by locomotion (21.0%), feeding (18.4%), resting (15.4%), maintenance (6.4%) and social behaviour (2.4%). It is unknown if the relatively small amount of time spent feeding was compensated for nocturnally or is indicative of low graze availability during the dry season.

Based on the findings of this study, issues facing the conservation of zebra within MWR were identified and conservation and management options are presented.

Objective #2. Implementation of a predator monitoring program to assess the species success and their impact on various prey species.
This project was initially started by African Parks when the first four leopards were introduced in 2011. These leopards were collared with satellite collars and released. An additional two leopards were collared and re-introduced in early 2012 and towards the end of 2012, three adult lions, of which two were satellite collared, were also re-introduced into Majete. GPS data were collected from the animals on a daily basis. However, by mid-2013 all but one remaining collar had stopped working (battery life depleted). In October 2013 a trapping session was conducted and collars were removed from three leopards. These were the individuals that were tagged/collared as sub-adults and had subsequently grown, so this had to be done so as to avoid the collars becoming too tight. We currently have a very large database with all the satellite data and camera trap photographs and we commenced with analyzing these data in 2016. Additionally, a new predator ecology study commenced in early 2016 (see below) and was successfully completed at the end of 2017. However, this larger predator study is a long-term research project which will continue focusing on predator/prey associations, home-range overlaps and the interactions between lions, leopards and hyenas, as all these factors change regularly. This is crucial to understand particularly when competing top predators are confined to small to medium sized fenced areas.

The following is the abstract from the completed thesis which is available in its entirety from Stellenbosch University’s library (http://hdl.handle.net/10019.1/102619)
Ecology of three apex predators in Majete Wildlife Reserve, Malawi.

By Willem Briers-Louw

Abstract

Apex carnivores play an important role in the ecosystem by regulating prey via predation. Anthropogenic influences have resulted in rapid range and population reductions of large carnivores across the African continent. These carnivores are often reintroduced into protected areas to compensate for human-induced losses, restore ecosystem functioning and promote eco-tourism.

Majete Wildlife Reserve in Malawi is a prime example, as human persecution resulted in the extirpation of large carnivores, with the exception of a small spotted hyena (*Crocuta crocuta*; hereafter hyena) population. As from 2003, African Parks attempted to rectify this problem by restoring and developing the reserve. Between 2011 and 2012, three lions (*Panthera leo*) and six leopards (*Panthera pardus*) were reintroduced. The aim of this study was to describe the ecology of the apex predators and to determine whether the felid reintroduction was successful or not.

Lion and leopard movements and home ranges were determined using GPS collars. The reintroduction of felids was considered successful. This was based on: (1) reduced post-release movements; (2) lack of homing tendencies; (3) breeding success; and (4) population persistence. Mean home ranges of lion (380.45 ± 117.70 km² [SE]) and leopard (495.08 ± 80.99 km²), were the largest on record for any reintroduced felid in Africa, which was likely due to a low competitor density. Thus, we expect home range sizes to decrease with an increase in conspecific density.

Population abundances and densities were estimated with the use of camera traps. The known lion population increased to eleven individuals in five years, while the leopard population was estimated at 11 (range = 9–17). This indicates population persistence and growth. Both founder populations were small and require additional translocations to maintain genetic diversity. Hyena density (2.62 hyenas/100 km²) and clan size (5.33 ± 0.67) were the lowest estimates in any woodland habitat and comparable to arid areas. This may be explained by decades of direct persecution and poaching of their prey, or a naturally low density.

Predator diets were described and compared by means of scat analysis. Lion and hyena exhibited a high dietary overlap of medium to large herbivores. Using Jacobs’ preference index, both species preferred warthog (*Phacocoerus africanus*) and waterbuck (*Kobus ellipsiprymnus*). Hyenas selected a broader range of prey, likely reducing competition with lions (which almost exclusively selected only four species). In contrast, leopards occupied a lower dietary niche, which consisted mainly of small-to medium-sized ungulates. These findings indicate that the three apex predators use resource partitioning to reduce competition.

This study suggests that reintroduction is a viable tool for re-populating large carnivores in protected areas in Malawi. The current predator population appeared to have a minimal impact on prey populations due to their small population size. We recommend long-term monitoring of predator-prey dynamics as the predator populations increase to prevent major ecological imbalances. Finally, we encourage management to focus energy and resources on the formation of a managed carnivore metapopulation to establish a genetically viable carnivore population within Malawi.
Objective #3. Determining the impact of megaherbivores (elephant, buffalo and rhino) on the habitat.

This project commenced in 2011 with a student from Stellenbosch University studying the “Woody vegetation change and elephant water point use in Majete Wildlife Reserve: implications for water management strategies”. The project was completed at the end of 2013 (the abstract was provided in the 2013 field report). A new project, undertaken by Frances Forrer commenced in 2015, and was completed in December 2016. See the 2016 fielding season report for a thesis link.

In 2017 two further megaherbivore projects commenced in Majete.

1. The Ecology of Black rhino (*Diceros bicornis minor*) in Majete Wildlife Reserve, Malawi. By MSc candidate, Anel Olivier (see progress report under Objective #5 below).

2. Olfaction and kin recognition in African elephants (*Loxodonta africana*). By PhD candidate Katharina Von Dürckheim.

Objective #4. Studying the population dynamics and distribution of spotted hyena.

This study was completed in December 2016, however monitoring of the hyena population continues via camera traps and population data will be updated on an annual basis.

The following is the abstract from the completed thesis which is available in its entirety from Stellenbosch University’s library (http://hdl.handle.net/10019.1/98847)

**The ecology of spotted hyena, *Crocuta crocuta*, in Majete Wildlife Reserve, Malawi.**

By Francois Retief

**Abstract**

The management of predators plays an important role in conservation management today because of the intensive management requirement of small fenced off protected areas. Apex predators such as spotted hyena, *Crocuta crocuta*, are situated at the top of food chains and have the ability to influence the composition and density of meso-predators and herbivores. Knowledge of apex predators through research can assist in effective management decisions which will ensure ecosystem functioning.

Majete Wildlife Reserve (MWR) in the south of Malawi, is a 700km² reserve, which had no information on the resident spotted hyena population until this study. The aims of this study were to gather and make available as much information as possible on the ecology of this apex predator in the reserve for management purposes.

A total of 47 camera traps were stationed throughout the reserve for 22 months from 2013 - 2015 and from these data population size, the number of clans (groups), home range size and activity patterns were determined. Faecal analysis was performed to identify the preferred species preyed upon.

The reserve has two small, low density resident spotted hyena populations, each with a large home range. These are distinct traits of hyenas residing in arid regions with a clumped resource distribution. The activity patterns of MWR hyenas were similar to East African hyenas in some aspects but peaks in activity differed between the two populations. A total of 17 prey species were identified, with some obvious preferred species.

Based on the results from this study, it is recommended that management should make decisions which would favour an increase in the hyena population. At this stage, further lion, *Panthera leo*, reintroductions should be avoided, as they are the number one competitor of spotted hyena. Both prey and hyena numbers should be monitored in the future to determine whether the hyena population might be in an Allee effect, in which case hyena reintroduction may be considered to restore the balance. It is also suggested that local communities should be educated about hyenas and their role in the environment. This would increase the protection of hyena clans outside the reserve boundaries. These populations are needed for genetic diversity in the MWR hyena population since contact between the populations has been found. Genetic diversity is important for the long term conservation of small populations such as the spotted hyena population in MWR.
Objective #5. Studying population performance and habitat use of black rhinoceros.

This project is in collaboration with African Parks, Majete and their rhino monitoring scouts. The scouts are currently conducting all the field work and we as a research team provide scientific monitoring advice and will help with the analysis of all the data. Throughout 2013 and 2014 monitoring was on a daily basis to achieve between 30 - 35 rhino tracking outings per month. Rhino trackers have a camera to take photographs of each sighting as evidence of which rhino they have seen as far as possible. Sightings are recorded on a daily basis and a sighting of each individual is attempted per week.

Majete Wildlife Reserve revamped the rhino monitoring program in 2015 and an additional 2 rhino scouts were added to the team bringing the total to four. In 2015 a number of the sub-adults were ear-notched by the African Parks Majete team and one calf was born in November 2015. In 2016 a fourth year Conservation Ecology student from Stellenbosch University studied rhino activity patterns and drinking behaviour based on over 30 000 camera trap photographs (see the 2016 fielding report for the attached PDF of the study).

In 2017, a new rhino ecology study was undertaken by MSc candidate, Anel Olivier. This study is due for completion by the end of 2018.

Please see the most recent progress report below.

The ecology of black rhino (*Diceros bicornis minor*) in Majete Wildlife Reserve, Malawi.

Anel Olivier  
**MSc Project Progress Report**  
Dept. Conservation Ecology & Entomology  
University of Stellenbosch

**Supervisor** Dr Alison Leslie

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**Introduction**

The Critically Endangered African black rhino (*Diceros bicornis*) has been burdened by selfish human activities throughout the 20th century (Emslie 2012). Due to augmented illegal rhino horn trade and continuous habitat loss, by 1995 the black rhino population had declined by about 97.6% (Emslie and Brooks 1999; Emslie 2006). Intensive conservation and anti-poaching efforts allowed for an increase in black rhino numbers to between 5,042 and 5,455 by 2015. With total population numbers still very low and patchily distributed, they are far from out of danger of extinction. In an effort to fight the war against poaching, black rhinos are currently translocated between protected areas and reintroduced to areas where they previously occurred, in order to manage genetic viability of meta-populations and expand their range (Knight and Kerley 2009; Emslie 2012). In Malawi, the southern-central black rhino (*D. bicornis minor*) was confirmed extinct in 1992 and first reintroduced into Liwonde National Park...
in 1993 (Emslie and Brooks 1999). In 2004, black rhino were also translocated to Majete Wildlife Reserve (MWR), a protected area managed by African Parks, to establish a second population in Malawi as part of the larger metapopulation.

It is very important to address environmental requirements when managing an introduced black rhino population (Emslie and Brooks 1999; Muya and Oguge 2000). Feeding ecology, habitat selection and demographics are increasingly accepted as vital foundation building blocks for black rhino populations and habitat management (Shaw 2011; Buk and Knight 2012). Despite the fact that ecological research is still too often overlooked in the race against time, it has valuable long-term conservation and management implications. Therefore, this study aims to fill the knowledge gaps in the ecology of the reintroduced black rhino population in MWR, by focusing on feeding ecology, waterhole use, ranging behaviour and carrying capacity. This study ultimately contributes to long-term habitat and population management that will ensure a healthy black rhino stock in MWR and in Malawi.

**Objective 1: Diet composition and browse availability**

The objectives of this chapter include: i) to determine diet composition of the black rhino, ii) rank the principal browse species, iii) assess relative availability of black rhino browse plants, and iv) rank preferred browse species.

1. **Diet Composition**

   **Methods:**

   Diet data for black rhino are obtained by the “feeding track observation technique”, also known as backtracking. This is done by tracking fresh rhino trails and recording the visible feeding signs, as described by numerous previous studies (Hall-martin et al. 1982; Ganqa et al. 2005; Van Lieverloo et al. 2009; Buk and Knight 2010). While on a trail, each plant showing black rhino feeding signs (characteristic 45° angled bite mark) is identified to species level and the number of cuts (browse marks) on each plant is counted. Principal browse species, defined as the plant species that forms the most dominant part of the black rhino’s diet, are calculated for each season and for the full duration of the study. This is done by calculating what percentage each plant species contributes to overall diet. The calculated relative proportion scores are used to compile a list that reflects the rank of importance/browse intensity.

   **Preliminary Results:** A total of 94 browse species have been recorded during backtracking fieldwork to date, 35 more species than previously recorded in Majete Wildlife Reserve (Gyöngyi 2011).

   During the dry season (August to October 2017) a total of 20 backtracks were completed, with 5 627 cuts recorded from 49 different browse species. The 5 most dominant browse species in black rhino diet in the dry season included (from most to least important) *Diploplyrus condylocarpon*, *Allophylus africanus*, *Grewia bicolor*, *Diospyros zombensis* and *Philenoptera violacea* (Fig 1). These 5 principal browse species make up 81.2% of overall diet in the dry season.

   During the early wet season (November 2017 to January 2018) a total of 39 backtracks were completed, with 5 751 cuts recorded from 75 different browse species. The 5 most dominant browse species in the early wet season included (from most to least important) *Dalbergia melanoxylon*, *Dichrostachys cinerea*, *Diploplyrus condylocarpon*, *Acacia nigrescence* and *Karomia tettensis* (Fig.1). These 5 principal browse species make up 62.6% of overall diet in the early wet season. Backtracking will also be conducted in the peak wet season from February to April 2018.
2. Browse Availability

Methods: A browse availability (BA) score expresses the relative availability of black rhino browse species in each vegetation type, by measuring the absolute browse volume (m³). This method is based on the widely accepted Visual Assessment of Black Rhino Browse Availability Version 3 (Adcock 2006). Sampling plots were randomly placed within each of the four primary vegetation types in Majete. The reserve was initially divided into three functional working sub-areas (Fig 2). Each plot has a volume of 800m³, measured as 20m (length) x 20m (width) x 2m (height). All plants in the plot are identified to species level, and canopy cover (m²) and canopy depth (m) are determined for each plant.

The absolute browse volume of the individual plant is calculated by multiplying the canopy cover by depth. The total browse volume for a species is calculated as the sum of all the absolute browse volumes measured for that species. The %BA score, representing the percentage contribution of a species to the browse availability, is calculated for each plot. The overall %BA score for each vegetation type is calculated as the average of the %BA scores attributed to each plot, within that vegetation type and/or sub-area. Preferred browse species, the plant species that rhino would preferentially select while feeding regardless of its availability, is calculated by dividing the percentage that the species contributes to the rhino’s diet by the percentage availability (%BA score) of that species in a rhino’s habitat.

Preliminary Results: A total of 82 vegetation plots, with a total of 5180 individual plants measured, were placed throughout Majete Wildlife Reserve during the early to mid-dry season, June to August 2017. As presented in Table 1, the average area-weighted browse availability was calculated as %BA=2.65 in the Woodland < 250m, %BA=2.37 in the Woodland 250-400m, %BA=1.59 in the Woodland > 400m, and %BA=0.87 in the Savanna area. The overall percentage browse availability score for Majete Wildlife Reserve was calculated as 7.47%. Further analyses will be conducted to determine species-specific %BA scores and preferred browse species ranking after all unknown plant photos and samples have been identified.

Objective 2: Black rhino waterpoint use

The objectives of this chapter include determining: i) which waterpoints are utilized most often by black rhino, and ii) the time of day when black rhino prefer to visit a waterpoint.

Methods: There are ten artificial water points (AWP’s), fed by solar-powered boreholes, and 14 perennial natural springs and pools (Fig 3). All ten AWP’s and two natural springs that are known to be used by black rhino, were surveyed. Camera traps, widely accepted as a wildlife survey technique (Rowcliffe & Carbone 2008), were placed at waterholes and springs in order to make inferences on black rhino waterpoint use. The cameras are triggered by movement and temperature and were set at 1-minute intervals between consecutive photos. The photos were downloaded to a computer and data captured by collecting all photo ‘sightings’ of black rhino and recording the following in a database: date, time, waterhole location, number of black rhinos, including individual ID’s where possible (all the rhinos are ear-notched).
**Preliminary Results** The time of day black rhino most prefer to visit waterpoints in MWR is in the early morning and late afternoon (Fig 4). The most waterpoint visits by black rhino were recorded from 5-6am and at 6pm. The waterpoint most often visited by black rhino is Nthumba waterhole (WH), followed by Pende 1 WH and Nakamba WH (Fig 5). It is possible that black rhino spend more time at Nthumba and Pende1 WH’s due to the low levels of human disturbance in these areas. However, this is preliminary as not all camera trap photos have yet been captured. The waterpoints that are not utilized by black rhino are either very close to human activity, including Thawale and Heritage waterholes, or are placed in habitats not often utilized by black rhino, including Pwadzi WH and spring, and Diwa WH.

![Figure 3: A map of all waterpoints in MWR.](image)

3. **Objective 3: Ranging behaviour and habitat use**

The objectives of this chapter include to: i) determine the sizes of home and core ranges for each individual black rhino as well as the average sizes for sex and age classes, ii) construct a geo-referenced map of all individual black rhino ranges, and iii) analyse black rhino habitat selection relative to vegetation type and waterpoint availability.

**Methods:** Experienced rhino trackers locate the black rhino on foot every day to record data, including GPS location, rhino ID, date, and condition of the animal. Data records obtained by the tracking teams range between four and five sightings per individual rhino per month. Because home ranges can vary in size and location over time, home range data are treated as annual sample sizes. These aspects are important in order to keep home range studies standardized (Plotz et al. 2016).

The GPS points are captured in ArcGIS 10.4.1 software for further analyses. The adaptive local convex hull ($\alpha$-LoCoH) method, a non-parametric kernel method, is used for home range estimates (Getz et al. 2007). The $\alpha$-LoCoH 50% core (the area where the black rhino would spend most of its time) and 95% home range is calculated for each individual, as well as for sex and age classes.

Space use of black rhino is analysed relative to habitat selection based on two main resources, water and food. To assess the influence of waterpoint availability on habitat use, home ranges are superimposed on a waterpoint raster layer (created with the Euclidean distance tool in ArcGIS 10.4.1) to calculate the distance of these waterholes from their core ranges. The determined home and core ranges are also superimposed on the existing MWR vegetation map to determine the preferred vegetation types in which the black rhino spend most of their time. A professional in ArcGIS analyses will be consulted at Stellenbosch University for this home range study.
4. **Objective 4: Ecological carrying capacity for black rhino in MWR**

The objective of this chapter is to estimate the ecological carrying capacity (ECC) and maximum reproductive carrying capacity (MRCC) for black rhino in MWR, and determine the implications for sustainable habitat and population management.

The RMG Black Rhino Carrying Capacity Model (Adcock 2001), as a task for the SADC Regional Programme for Rhino Conservation, will be applied to estimate the carrying capacity for black rhino in Majete Wildlife Reserve. The ECC and MRCC will only be calculated at the end of the fieldwork period after May 2018 to include a full year’s worth of rainfall data, etc. The information from this and the previous chapters will be used to provide black rhino habitat and population management suggestions to ensure the future of this small but vital population.

**References**


Objective #6 (included as of 2017). Ecological impact of large herbivores on vegetation in Majete Wildlife Reserve.

This is a new Majete Wildlife Research Programme objective that commenced in 2017, and will be added to over the years.

Progress report:

Ecological impact of large herbivores on vegetation at selected artificial watering points in Majete Wildlife Reserve

MSc candidate, Kayla Adriana Geenen

Chapter 1: Introduction

Herbivore-vegetation dynamics is a vast and well explored topic within the savanna ecosystem (Makhabu 2005; Redfern et al. 2006; Asner et al. 2009; Buitenwerf et al. 2011; Treydte et al. 2013; Staver and Bond 2014). Herbivores play a role as a major disturbance (top-down effect) as well as a core focus in conservation (Maron and Crone 2006; Riginos and Grace 2008; Fuhlendorf et al. 2009; Schippers et al. 2014). The alteration of herbivore populations in order to keep an ecological balance may be highly contradictory, too many or too few herbivores could cause detrimental effects to ecosystem functioning through changes in vegetation structure and composition. Herbivores including buffalo, elephant, zebra, giraffe and many other ungulates have contributed to structural changes present in different African landscapes (Skarpe 1990; Mosugelo et al. 2002; De Garine-Wichatitsky et al. 2004; Birkett and Stevens-wood 2005; Riginos and Grace 2008; Hamandawana 2012; Morrison et al. 2016). These structural changes in vegetation are usually exaggerated around a water source due to trampling and overgrazing. Despite this, there have been few studies focusing on water use by wildlife as well as the relationship between herbivores and vegetation surrounding artificial water points.

Water is a vital aspect of life and has the ability to drive animal ecology, behaviour and distribution. (Hayward and Hayward 2012). Water is often supplemented for two main reasons in conservation areas. These include the boosting of herbivore population sizes as well as to enhance biodiversity through the increase of habitat heterogeneity. An additional reason for the placement of artificial water points is to enhance wildlife viewing for tourism (Farmer 2010).

The management of water requires an important understanding of the impacts of supplementation on the ecosystem. Herbivores, especially those that are primarily water-dependent, tend to be in close proximity to water. This is exaggerated especially during the dry season when natural surface water is scarce (Owen-Smith 1996; Smit et al. 2007). This congregation around water points results in the trampling and overgrazing of the surrounding vegetation, forming gradients of utilisation. Vegetation within these gradients becomes scarce and over utilised with an increase in proximity to a water source, forming a piosphere effect. Piosphere theory states that degradation surrounding a waterpoint is determined by the trade-off between water and forage requirements of the animals. The size of this degradation is limited by the distance herbivores travel between drinking events, relating to quality and quantity of the forage surrounding a waterpoint (Smit et al. 2007; Farmer 2010; Šmilauer et al. 2015). Water point impact is understood and visualised by circular piospheres with emphasis on the degradation level around a single waterpoint and the probability of the merging of piospheres. The greatest degradation occurs closest to the water point followed by a zone of change to a point where it tails off and shows its true ecological potential (Graetz and Ludwig 1978).

Seasonal variation is observed as water dependent herbivores tend to congregate around permanent water sources during the dry season, while dispersing into areas away from perennial water sources during the wet season (Thrash and Derry 1999; Thrash 2000; Young et al. 2009). Vegetation surrounding these water sources is therefore relieved of the severe grazing pressure during the wet seasons. The placement of AWP’s away from perennial water sources allows for further wet season dispersal ranges relative to the dry season concentration areas. Vegetation situated near AWP’s needs to be relieved of grazing pressure during the wet season for the recovery from dry season grazing and trampling to occur. This requires a region with sufficient food and situated at a distance from water, to attract herbivore populations. Regions lacking this recovery period may experience a coalescence in vegetation degradation, causing a short-term increase in herbivore abundance and a drastic decrease during drought periods. Animal populations may therefore fail to regain their former levels during the intervals in between (Owen-Smith 1996).

This study therefore aims to explore the damage to vegetation and soil surrounding artificial water points (AWP’s) within Majete. This will aid in determining the extent of the piosphere effect surrounding AWP’s and how these AWP’s may be better managed to decrease this affect by exploring which waterholes are utilised the most by the various species, during both the wet and dry seasons and within the various areas of the reserve.
Study area

Majete Wildlife Reserve, covering 70,000ha, is situated in the Lower Shire valley region of southern Malawi (Figure 1). The western region of the reserve consists of the highest terrain as steep undulating hills and river valleys. The eastern section experiences a decrease in altitude and the terrain is relatively flat. There are two perennial rivers transecting the reserve, the Shire River and Mkurumadzi River. Seven AWP’s were selected for this study based on their position within the reserve, the surrounding vegetation types and altitude. Two of these AWP’s will be studied independently due to their differing altitudinal gradients. These include Diwa within the Namisepha region and Phwadzi in the south-western section. Pende 1 and Nhumba will be compared due to their placement in the same vegetation type (savanna). Thawale, Nkamba and Nsepete AWP’s will be compared as they are all situated within the sanctuary region which is dominated by woodland < 250m. Expected annual precipitation ranges between 700-1000mm in the western highlands and 680-800mm in the eastern lowlands, with a wet season from November until early April (Malawian Department of Climate Change and Meteorological Services). Majete is primarily woodland dominated and vegetation types fall within the Miombo woodland ecoregion (Wienand 2013).

Figure 1: The location of Malawi on the African continent and the position of Majete Wildlife Reserve within Malawi. The various regions within the reserve and perennial water sources are also shown (shapefiles provided by African Parks).

Over 2550 individual animals from 14 species were reintroduced into Majete at different stages. The 140km² sanctuary area was initially fenced in 2003 for the wildlife reintroduction. The remaining area of the reserve was fenced in 2008. This was followed by the removal of the internal sanctuary fencing by September 2011, allowing the animals to disperse into the newly opened area of the reserve.

Water management is a controversial issue within African savanna conservation areas. This issue should be managed as such to increase herbivore numbers as well as vegetation or habitat heterogeneity. Artificial water points (AWP’s) are perennial water sources for herbivore species, which can change vegetation surrounding these sources through herbivory and trampling. This study has been initiated to better understand the impacts of herbivores on the vegetation surrounding the artificial water points within a given reserve, Majete Wildlife Reserve.
Chapter 2: The Piosphere effect on vegetation surrounding artificial water points (AWP’s) within Majete Wildlife Reserve

Aims and objectives

- To investigate the impact of large herbivores on vegetation surrounding artificial waterholes in Majete Wildlife Reserve, Malawi
  - To determine vegetation change surrounding waterholes using fixed point photography over a five year period
  - To assess the structure of woody and herbaceous vegetation from the waterhole to a circumference 2000m from the waterhole
  - To establish the ecological index of herbaceous vegetation surrounding the AWP

Methods and materials

Three transects starting at the AWP and measuring 2000 m in the direction of N, SW and SE, will be used to determine woody and herbaceous vegetation communities (Thrash et al. 1993). This transect length was chosen as most water dependent species congregate in close proximity to a water source during the dry season, contributing to the piosphere effect. Vegetation structure and composition will be investigated within 20m x 20m plots placed at 0m, 50m, 150m, 300m, 500m, 1000m, 1500m and 2000m from the waterhole, in the three mentioned directions. Previous studies have found a greater rate of change closer to AWPs, therefore intervals within 1km of the AWP will be smaller than those exceeding 1km (Owen-Smith 1996).

Sampling for woody vegetation and percentage herbaceous vegetation cover will take place during the dry season (July to November) as accessibility is easier. Herbaceous sampling will take place during the wet season (February to April) as this is the flowering period of most herbaceous species, making species identification possible.

The percentage herbaceous basal cover within each plot and transect will be measured by using the Step-point technique (Evans and Love 1957; Owensby 1973). This technique involves recording observations along a walking transect at specified intervals (steps), where a pin is projected at the mark on a boot and into the vegetation. The plant base or ground cover intersected by the point is recorded and referred to as a ‘hit’. In this study steps will be taken every 1m within a 10m x 10m plot with a resultant 100 points measured. The cover of a species is then calculated using the following equation:

\[
\text{Cover of Spp A} = \left( \frac{\# \text{ hits Spp A}}{\text{total \# points}} \right) \times 100
\]

Dominant woody species (trees and shrubs) within the plots will be identified to species level, followed by recording estimated vegetation cover in <2m, 2-3m, 3-5m and >5m height categories.

5. Preliminary results

The cover of bare ground is at its highest (58%) at the edge of the AWP compared to 2000m away (Figure 2). An increase in percentage cover of the herbaceous layer is seen at 50m, 150m, 1500 and 2000m from the AWP. An increase in bare ground is noted at 300m, 500m and 1000m from the AWP, this however is still < 50% cover.
The general trend seems to be that vegetation less than 3m in height increases with an increase in distance from water (Figure 3). Vegetation 3-5m high increases with an increase in distance from water, however, a decrease is seen at the 50m from AWP mark. Trees taller than 5m dominate from 0m - 50m from the waterhole and are least 150m from the waterhole. Vegetation less than 3m in height is absent at the edge of the waterhole. Vegetation <2m in height is most prevalent 1500m from the AWP and least at the AWP. The percentage cover of woody vegetation 2-3m in height is lowest at the AWP and highest 2000m from the latter. The percentage cover of 3-5m high vegetation is highest at 2000m and lowest at 50m from the AWP.

Figure 2. Percentage of bare ground and the herbaceous layer at various distances from Pende 1 AWP.

Figure 3. Percentage vegetation cover of the woody vegetation layer at various distances from Pende 1 waterhole.
Chapter 3: Artificial waterpoint utilisation by herbivores in Majete Wildlife Reserve

Aims and objectives

- To investigate the utilisation of artificial waterholes by select herbivores in Majete Wildlife Reserve, Malawi
  - To monitor herbivore visitation patterns at ten AWP’s from 2013 to 2018, using remote imagery and waterhole counts.
  - To establish herbivore AWP drinking behaviour patterns: hourly, daily and seasonally.
  - To classify AWP use differences between specific species and different feeding strategies (grazers, browsers and mixed feeders).
  - To determine a relative rank of water dependency by comparing water point use with the relative abundance of species in the area.

Methods and materials

Waterhole visitation rates between seasons will be monitored via camera traps. Each of the seven AWP are monitored by a single camera trap. Photographs from these camera traps will be sorted and analysed for visitation rates of herbivores during the wet vs dry season. We will assess camera trap data for the wet season in 2016, 2017 and 2018; and for the dry season in 2015, 2016 and 2017. Furthermore, this will be sorted into the percentage grazers vs browsers visiting each AWP. This will provide data on which AWP’s are utilized the most at various times of year by different species. Aerial survey data is available for the 2015 dry season as an indication of species abundance within various regions of the park.

Preliminary results

For this purpose of this progress report one waterhole as an example, namely Pende 1, will be used as a case study. Seventy-eight days of camera trap photos were analysed for the 2017 wet and dry season at Pende 1 AWP. A total of 2,910 species sightings were recorded for the wet season and an astonishing 32,623 sightings for the dry season (Table 1). This is an indication of a marked increase in AWP utilisation during the dry season for all species combined.

Table 1. Total observations of each species during the sampling period.

<table>
<thead>
<tr>
<th>Species</th>
<th>Wet</th>
<th>Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warthog</td>
<td>569</td>
<td>9064</td>
</tr>
<tr>
<td>Impala</td>
<td>95</td>
<td>4141</td>
</tr>
<tr>
<td>Elephant</td>
<td>1103</td>
<td>2876</td>
</tr>
<tr>
<td>Zebra</td>
<td>342</td>
<td>1890</td>
</tr>
<tr>
<td>Nyala</td>
<td>11</td>
<td>1277</td>
</tr>
<tr>
<td>Sable</td>
<td>53</td>
<td>3404</td>
</tr>
<tr>
<td>Buffalo</td>
<td>639</td>
<td>4386</td>
</tr>
<tr>
<td>Kudu</td>
<td>20</td>
<td>2294</td>
</tr>
<tr>
<td>Bushbuck</td>
<td>2</td>
<td>871</td>
</tr>
<tr>
<td>Eland</td>
<td>53</td>
<td>1387</td>
</tr>
<tr>
<td>Waterbuck</td>
<td>17</td>
<td>732</td>
</tr>
<tr>
<td>Black Rhino</td>
<td>6</td>
<td>179</td>
</tr>
<tr>
<td>Hartebeest</td>
<td>0</td>
<td>122</td>
</tr>
<tr>
<td>Total</td>
<td>2910</td>
<td>32623</td>
</tr>
</tbody>
</table>
An overall peak in the dry season for drinking was seen between 09:00 - 09:59. Drinking steadily increases before this time period and steadily decreases thereafter. During the wet season a peak was seen between 10:00 - 10:59 and the majority of drinking was seen between 08:00 and 14:59 (Figure 4)

![Graph showing frequency of observations of all species at Pende 1 during the various time sampling periods.](image)

**Figure 4.** Frequency of observations of all species at Pende 1 during the various time sampling periods.

For the browsers, an additional 173 black rhino, 869 bushbuck, 2274 kudu and 1266 Nyala were observed drinking at the AWP during the dry season (Table 1). During the dry season, black rhino tend to avoid the waterhole during the middle of the day, with drinking peaking from 18:00-18:59. Drinking occurred in late afternoon to early evening, peaking from 16:00-16:59 (Figure 5A). During the wet season, only two bushbuck were seen drinking between 17:00-17:59. Drinking during the dry season peaked from 11:00-11:59 and bushbuck were recorded for all time periods (Figure 5B). Drinking occurred mostly during the daylight hours. Kudu drinking peaked from 10:00-10:59, 13:00-13:59 and 16:00-16:59 during the wet season and from 09:00-09:59 during the dry season. Water was utilised more frequently during the daylight hours than the evenings in dry season (Figure 5C). Nyala were seen drinking mostly between the daylight hours of 06:00 to 17:59 during the dry season. A drinking peak was observed from 07:00 to 08:59 and 15:00 to 17:59 during the wet season and from 11:00-11:59 during the dry season (Figure 5D).
Figure 5. Frequency of observations of the browsers A) Black rhino, B) Bushbuck, C) Kudu and D) Nyala at Pende 1 during the various time sampling periods.
For the mixed feeders, an additional 1,334 Eland, 1,773 elephant and 4,046 impala were observed during the dry season (Table 1). A peak drinking for eland was seen from 07:00-07:59 during dry season and from 14:00-14:59 during the wet season. AWP use remained high from 07:00 to 10:59 during dry season and from 13:00 to 14:59 during wet season (Figure 6A). Elephant drinking times peaked from 10:00-10:59 during the wet season and from 11:00-11:59 during the dry season. Overall AWP use occurred during the middle of the day (Figure 6B), steadily increasing before noon and gradually decreasing for both seasons. Water use for elephant and impala were similar for the dry season (Figure 6B & C). Impala drinking peaked from 10:00-10:59 during both the wet and dry season, however, a second peak is seen from 15:00-15:59 during the wet season. Impala only utilise the waterholes between 10:00 to 15:59 during the wet season and from 06:00 to 14:59 during the dry season (Figure 6C).

**Figure 6.** Frequency of observations of the mixed feeders A) Eland, B) Elephant and C) Impala at Pende 1 during the various time sampling periods.
For the grazers, a total of 1,548 more observations were recorded for zebra during the dry season (Table 1). Drinking peaked from 13:00-13:59 during the wet season and from 11:00-11:59 during the dry season. Waterhole utilisation remained high from 07:00 to 11:59 in the dry season and from 13:00 to 14:59 in wet season (Figure 7A). 3,351 more sable observations were recorded in the dry season (Table 1). Water utilisation was high from 07:00 to 11:59 but peaked from 09:00-09:59 during the dry season. Wet season showed a peak in water utilisation from 09:00-09:59 and 11:00 to 12:59 (Figure 7B). 3,747 more observations were recorded for buffalo during the dry season (Table 1). Drinking times for buffalo in the wet season were scattered throughout the day with peaks observed from 16:00-16:59 followed by 13:00-13:59. A similar pattern was seen during the dry season, however, the peak was seen from 08:00-08:59 and 12:00-12:59. AWP use remained high from 07:00-18:59 (Figure 7C). A total of 715 observations were recorded for waterbuck during the dry season (Table 1). AWP use by waterbuck peaked from 10:00-10:59 during both the wet and dry season. The wet season AWP use also experienced peaks from 13:00-13:59 and 15:00-15:59. AWP took place from 10:00-15:59 during the wet season and from 06:00-15:59 during the dry season (Figure 7D).

A) Zebra

B) Sable

C) Buffalo

D) Waterbuck

Figure 7. Frequency of observations of the Grazers A) Zebra, B) Sable, C) Buffalo and D) Waterbuck at Pende 1 during the various time sampling periods.
Hartebeest were not observed utilising the AWP during the wet season. This could be due to their selection natural water sources during the wet season. A total of 122 observations were recorded during the dry season (Table 1). Drinking times peaked from 08:00-08:59 and 10:00-09:59. No observations were recorded from 17:00-00:59 or from 05:00-06:59 (Figure 8).

Figure 8. Frequency of observations of Hartebeest during the dry season at Pende 1 for the various sampling time periods

There were 8,495 more observations of warthogs during the sampling hours in the dry season than in the wet season. The dry season peak drinking time period was from 09:00 - 09:59 while the wet season peak was from 10:00-10:59. AWP utilisation occurred between 08:00-16:59 during the wet season and from 04:00-19:59 during the dry season (Figure 9).

A) Warthog

Figure 9. Frequency of observations of warthog observed drinking at Pende 1 AWP during the various sampling time periods

time periods
Conclusion
This study will continue through May 2018.

References


Objective #7. Implementation of a best practice fire management strategy.

We have not as yet commenced with this study. Majete Wildlife Reserve does have a basic fire management plan and burning takes place annually from early June to mid-August. We will be revising this plan in due course now that the vegetation map has been updated.

Objective #8. Capacity building and implementation of human-wildlife conflict mitigation measures.

A number of studies have been conducted over the past few years with regards to the various local communities’ attitudes towards African Parks and Majete Wildlife Reserve in general. Community benefits provided by African Parks have been through enterprise development and infrastructural projects including: health clinics, school blocks, a maize mill, boreholes, cattle troughs and several capacity building programmes. Additionally, a resource utilization program has been established that uses a permit system that provides bordering communities regulated access into the protected area to harvest allowable natural resources such as thatching grass, bamboo and fire wood. Several hiv/aids committees and home based care groups have been established that engages volunteers from the local communities.

African Parks have also established a well-run community based natural resource management (CBNRM) program and have provided training in areas of CBRM, forestry management techniques, beekeeping, poultry and livestock production, scone baking and banana production. Several training sessions have also been conducted for reserve scouts and extension staff. There are however still many challenges ahead.

In 2015 we started a project specifically to develop a management plan for community based natural resource harvesting in Majete Wildlife Reserve. The study was undertaken by Master’s student, Claire Gordon and was completed in December 2016. See the 2016 fielding season report for more details.
In 2017 we continued with our school visiting and educational program, visiting eight village schools during the fielding season. Volunteers were given an opportunity to not only share something about Majete Wildlife Reserve and their own countries but also to learn about the life of the children in some of the remote and extremely poor areas surrounding the reserve. School choirs often put on a show and drama productions are performed. These outings are always thoroughly enjoyed by all. Throughout 2017 volunteers once again very generously brought all sorts of school goods with them to donate to various schools in the Shire Valley. Additionally in 2017 we started a new initiative which involved bringing school groups to Majete. This was funded by the research programme and involved fetching the kids by bus, taking them on a game drive in Majete and providing refreshments. We would like to expand this initiative in 2018, providing more trips to Majete.

Objective #9. Investigating the potential of payments for ecosystem services and reducing emissions from deforestation and forest degradation (REDD) as a conservation tool (this project is being driven by African Parks, Majete, but was put on hold in 2016, for several reasons.

Majete Wildlife Reserve was assessed for its potential as a REDD project by a consultant group towards the end of 2012. The results from this assessment indicated (estimated) that Majete could sell approximately 100,000 carbon credits per year. It is however, unclear what the future market for REDD will be like - and this is key in assessing the viability of a REDD project at Majete. At the current carbon prices of approximately $2 per ton, it probably would not be worthwhile for African Parks to proceed with the project, but African Parks is currently still in discussions with possible partners with the necessary expertise in the carbon markets to assess the feasibility of the project, and explore the opportunities for possible collaboration. A big challenge is the next step, which is the substantial upfront development costs involved with formally accrediting the carbon credits, and the risk of an unknown future market for these credits.

PROJECT IMPACTS

1. Increasing Scientific Knowledge

a) Total citizen science research hours

A total of 45 volunteers were at the project site for a full 10 days (excluding the 2 x travel days).

Volunteers contributed an average of 8 hours per person per fielding day = 3600 hours in total for the season.

b) Peer-reviewed publications

A number of publications are in prep/submitted/published:

- Spies, K. and A. Leslie. The diet of impala and waterbuck in Majete Wildlife Reserve using stable isotope analysis.
- Gordon, C. and A. Leslie. Medicinal plants used by traditional healers in Majete Wildlife Reserve, Malawi. (ready for submission to Journal of Ethnobiology & Ethnomedicine)
- De Vos, C., A. Leslie and J. Ransom. Time budget behaviour of plains zebra (*Equus quagga*) in Majete Wildlife Reserve, Malawi (submitted to Mammalian Biology)


c) Non-peer reviewed publications:

• Tiyende (Air Malawi and Ethiopian Airways In-flight Magazine) by field team member Kayla Geenen. Article entitled: The importance of water supplementation in conservation areas (see attached PDF).

• Several university website short articles.

d) Presentations:

• Presentations to African Parks Management at Majete Wildlife Reserve in March by two MSc graduates on their respective projects (Ecology of three apex predators in Majete Wildlife Reserve; Ecology of plains zebras in Majete Wildlife Reserve).

• Presentations at a WESM (Wildlife and Environmental Society of Malawi) meeting in Blantyre in April by two MSc graduates about their respective projects (Ecology of three apex predators in Majete Wildlife Reserve; Ecology of plains zebra in Majete Wildlife Reserve).

• Three presentations by the PI in July 2017, to Majete’s large corporate international donors who came to witness a day of the elephant translocation.

• A project progress presentation by the PI to Majete’s board members in July 2017.

• Oral presentations by three of the Majete research team members, at the Southern African Wildlife Management Symposium, held in South Africa in September 2017. Presentations by Willem Briers-Louw, Francis Forrer and Charli de Vos.

2. Mentoring

a) Graduate students

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Graduate Degree</th>
<th>Project Title</th>
<th>Anticipated Year of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kate Spies</td>
<td>MSc Conservation Ecology</td>
<td>Ecology of impala and waterbuck in Majete Wildlife Reserve, Malawi.</td>
<td>Dec 2015</td>
</tr>
<tr>
<td>Francois Retief</td>
<td>MSc Conservation Ecology</td>
<td>The ecology of spotted hyena in Majete Wildlife Reserve, Malawi.</td>
<td>Dec 2015</td>
</tr>
<tr>
<td>Claire N. Gordon</td>
<td>MSc Conservation Ecology</td>
<td>People and protected areas: Natural resource harvesting as an approach to support rural communities surrounding Majete Wildlife Reserve, Southern Malawi: A Case Study</td>
<td>Dec 2016</td>
</tr>
<tr>
<td>Willem Daniel Briers-Louw</td>
<td>MSc Conservation Ecology</td>
<td>Ecology of three apex predators in Majete Wildlife Reserve, Malawi.</td>
<td>Dec 2017</td>
</tr>
</tbody>
</table>
Charli de Vos  MSc Conservation Ecology  Ecology of Boehm’s zebra (*Equus quagga*) in Majete Wildlife Reserve, Malawi  Dec 2017

Anel Olivier  MSc Conservation Ecology  Ecology of Black Rhinoceros in Majete Wildlife Reserve, Malawi  Dec 2018

Kayla Geenen  MSc Conservation Ecology  The impact of herbivores on vegetation surrounding artificial water points within Majete Wildlife Reserve  Dec 2018

Katharina Von Durckheim  PhD Conservation Ecology  Olfaction and scent discrimination in African elephants, *Loxodonta africana*  Dec 2018

Wesley Hartmann  MSc Conservation Ecology  Elephant social networks in Majete Wildlife Reserve  Dec 2019

Sally Reece  MTech Nature Conservation  Species richness and spatial use patterns of medium and large mammals in Majete Wildlife Reserve, Malawi.  Dec 2019

### b) Community outreach

Provide details on how you have supported the development of environmental leaders in the community in which you work.

<table>
<thead>
<tr>
<th>Name of school, organization, or group</th>
<th>Education level</th>
<th>Participants local or non-local</th>
<th>Details on contributions/activities</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mavuwa Primary School</td>
<td>28/07/2017</td>
<td>10-14 Local</td>
<td>Game to teach about carrying capacity. Donated OneWorld soccer ball, vests and cones.</td>
<td></td>
</tr>
<tr>
<td>Dagalasi Village</td>
<td>1/08/2017</td>
<td>4-18 years Local</td>
<td>Game with the younger kids to teach about elephant translocations. Donated OneWorld soccer ball to local soccer team and played a game with them.</td>
<td></td>
</tr>
<tr>
<td>Kakoma Village</td>
<td>22/08/2017</td>
<td>5-10 years Local</td>
<td>Foreign animal talk and what makes Malawi special for visitors. Donated OneWorld soccer ball to local soccer team and played a game with them.</td>
<td></td>
</tr>
<tr>
<td>Mbwemba Primary School</td>
<td>12/09/2017</td>
<td>Local</td>
<td>Acted out foreign and local animals, animal talk.</td>
<td></td>
</tr>
<tr>
<td>Pende Primary School</td>
<td>10/10/2017</td>
<td>Entire school</td>
<td>Story and lesson about hyenas and how to avoid wildlife-conflict.</td>
<td></td>
</tr>
<tr>
<td>Vimi Primary School</td>
<td>31/10/2017</td>
<td>10-14 years Local</td>
<td>Story and lesson about hyenas and how to avoid wildlife-conflict.</td>
<td></td>
</tr>
<tr>
<td>Dzinthenga Primary School</td>
<td>21/11/2017</td>
<td>10-14 years Local</td>
<td>Game about animals in Malawi.</td>
<td></td>
</tr>
<tr>
<td>Changadeya Primary School</td>
<td>12/12/2017</td>
<td>10-14 years Local</td>
<td>Story about the white ring on the waterbuck (donated the story book), mimicking of different animals. Children performed choir songs, poems and a drama session regarding wildlife issues in their area.</td>
<td></td>
</tr>
</tbody>
</table>
The schools mentioned below visited Majete Wildlife Reserve and the trips were sponsored by Earthwatch volunteers and the research programme. Each visit also allowed for at least 2 teachers to join the group. Visits to the park included a game drive, a conservation talk in the conference room and education center, hands-on behind the scene experience in a nursery growing plants for rehabilitation projects, and lunch at the community-run campsite. The researchers spent as much time as possible chatting to learners on the day.

<table>
<thead>
<tr>
<th>Date</th>
<th>School</th>
<th>Number of kids</th>
</tr>
</thead>
<tbody>
<tr>
<td>15/11/2017</td>
<td>Gaga Primary</td>
<td>15</td>
</tr>
<tr>
<td>3/11/2017</td>
<td>Vimvi Primary</td>
<td>30</td>
</tr>
<tr>
<td>2/12/2017</td>
<td>Dzinthenga Primary</td>
<td>15</td>
</tr>
</tbody>
</table>

We also handed out at least two big bags full of clothing and toothbrushes, donated by Earthwatch volunteers and researchers, to the local community.

3. Partnerships

List your current active professional partnerships that contribute to your project and indicate the type of support these partners provide.

<table>
<thead>
<tr>
<th>Partner</th>
<th>Support Type(s)</th>
<th>Years of Association (e.g. 2006-present)</th>
</tr>
</thead>
<tbody>
<tr>
<td>African Parks (PTY) Ltd</td>
<td>Collaboration &amp; logistics</td>
<td>2013 - present</td>
</tr>
<tr>
<td>Cape Leopard Trust</td>
<td>Collaboration</td>
<td>2013 - present</td>
</tr>
<tr>
<td>Texas A &amp; M University</td>
<td>Academic support/collaboration</td>
<td>2015 - present</td>
</tr>
<tr>
<td>Malawi's National Commission for Science &amp; Technology</td>
<td>Logistics</td>
<td>2013 - present</td>
</tr>
<tr>
<td>Lilongwe University of Agriculture &amp; Natural Resources.</td>
<td>Collaboration</td>
<td>2013 - present</td>
</tr>
<tr>
<td>University of Colorado/Department of Fish &amp; Wildlife, USA. Dr J.I. Ransom</td>
<td>Collaboration / academic support</td>
<td>2016 - present</td>
</tr>
<tr>
<td>University of Stellenbosch. A.J Leslie publication fund.</td>
<td>Funding</td>
<td>2013 - present</td>
</tr>
</tbody>
</table>

1 Support type options: funding, data, logistics, permits, technical support, collaboration, academic support, cultural support, other (define)

4. Contributions to management plans or policies

All of the undertaken projects contribute to ecosystem and species management planning in Majete Wildlife Reserve.

<table>
<thead>
<tr>
<th>Plan/Policy Name</th>
<th>Type 2</th>
<th>Level of Impact 3</th>
<th>New or Existing?</th>
<th>Primary goal of plan/policy 4</th>
<th>Stage of plan/policy 5</th>
<th>Description of Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management plan for impala and waterbuck</td>
<td>Management plan</td>
<td>local</td>
<td>New</td>
<td>Natural resource management</td>
<td>Proposed</td>
<td>Suggested management options</td>
</tr>
<tr>
<td>Elephant management plan</td>
<td>Management plan</td>
<td>local</td>
<td>New</td>
<td>Species conservation</td>
<td>Proposed</td>
<td>Suggested management options</td>
</tr>
<tr>
<td>Hyena management plan</td>
<td>Management plan</td>
<td>local</td>
<td>New</td>
<td>Species conservation</td>
<td>Proposed</td>
<td>Suggested management options</td>
</tr>
</tbody>
</table>

2 Type options: agenda, convention, development plan, management plan, policy, or other (define)

3 Level of impact options: local, regional, national, international

4 Primary goal options: cultural conservation, land conservation, species conservation, natural resource conservation, other

5 Stage of plan/policy options: proposed, in progress, adopted, other (define)
5. Conserving natural and sociocultural capital

a) Conservation of taxa

i. List any focal study species that you did not list in your most recent proposal

<table>
<thead>
<tr>
<th>Species</th>
<th>IUCN Red List category</th>
<th>Local/regional conservation status</th>
<th>Local/regional conservation status source</th>
<th>Description of contribution</th>
<th>Resulting effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyena</td>
<td>Least threatened</td>
<td>Unknown (assumed low)</td>
<td>Dept National Parks &amp; Wildlife (pers. Comm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sable antelope</td>
<td>Least concern</td>
<td>Rare</td>
<td>Rare. Dept National Parks &amp; Wildlife</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black rhino</td>
<td>Critically endangered</td>
<td>Only one viable population (Nyika National Park) other than in Majete.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elephant</td>
<td>Vulnerable A2a</td>
<td>Unknown</td>
<td>Dept National Parks &amp; Wildlife</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ii. In the past year, has your project helped conserve or restore populations of species of conservation significance? If so, please describe below.

<table>
<thead>
<tr>
<th>Species</th>
<th>IUCN Red List category</th>
<th>Local/regional conservation status</th>
<th>Local/regional conservation status source</th>
<th>Description of contribution</th>
<th>Resulting effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elephant</td>
<td>Vulnerable A2a</td>
<td>Unknown</td>
<td>Population increase from breeding</td>
<td>154 elephants relocated to other protected areas</td>
<td></td>
</tr>
</tbody>
</table>

b) Conservation of ecosystems

In the past year, has your project helped conserve or restore habitats? If so, please describe below.

<table>
<thead>
<tr>
<th>Habitat type</th>
<th>Habitat significance</th>
<th>Description of contribution</th>
<th>Resulting effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Miombo Ecoregion (an endangered, species-rich African tropical savanna ecosystem)</td>
<td>All of the below mentioned.</td>
<td>Providing an understanding of ecosystem dynamics</td>
<td>Helping to maintain the extent thereof.</td>
</tr>
</tbody>
</table>

7 Habitat significance options: nursery, breeding ground, feeding site, corridor, migration path, refuge, winter range, summer range, spring range, fall range or other (define)

8 Resulting effect options: extent maintained, condition achieved, restored, expanded, improved connectivity or resilience
c) Ecosystem services

Indicate which ecosystem service categories you are directly studying in your Earthwatch research and provide further details in the box below.

Food and water ☒ Flood and disease control ☐ Spiritual, recreational, and cultural benefits ☒ Nutrient cycling

Details:

All research projects are related to ecosystem management and restoration. The ecological studies are all focusing on spatial ecology, diet and waterhole use.

The sustainable harvesting project certainly has cultural benefits, in particular as the medicinal harvesting of plants may be encouraged.

Indirectly the research programme will contribute to the conservation of endangered remnant east African miombo woodland.

d) Conservation of cultural heritage

Provide details on intangible or tangible cultural heritage components that your project has conserved or restored in the past year.

<table>
<thead>
<tr>
<th>Cultural heritage component</th>
<th>Description of contribution</th>
<th>Resulting effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional subsistence living</td>
<td>By quantifying the extent of natural resource harvesting within Majete (2016) A future project is planned to determine the available biomass of preferred plant species to be harvested.</td>
<td>Current harvesting seems to be sustainable and can possibly be increased to include the harvesting of medicinal plants. Additionally, the propagation of indigenous species by local communities was discussed in 2017 and could become a reality in 2018.</td>
</tr>
</tbody>
</table>

* Cultural heritage component options: traditional agriculture, artifacts, building(s), hunting ground or kill site, traditional ecological knowledge and practices, monument(s), oral traditions and history, spiritual site, traditional subsistence living

RESEARCH PLAN UPDATES

Report any changes in your research since your last proposal/annual report. For any ‘yes’ answers, provide details on the change in the ‘Details’ box.

1) Have you added a new research site or has your research site location changed? ☐ Yes ☒ No
2) Has the protected area status of your research site changed? ☐ Yes ☒ No
3) Has the conservation status of a species you study changed? ☐ Yes ☐ No
4) Have there been any changes in project scientists or field crew? ☒ Yes ☐ No

Details - provide more information for any ‘yes’ answers

Dr Frans Radloff, a senior lecturer and wildlife ecologist from the Deaprtment of Consrvation & Marine Science, Cape Peninsula University of Technology (CPUT) and Dr Craig Tambling, a senior lecturer from the Department of Zoology and Entomology, Fort Hare University, will be joining the Majete Wildlife Research Programme as project supervisors in 2018.

5) Provide details on any changes to your objectives, volunteer tasks, or methods, include reason for the change.

Two new projects will be added in 2018, however they fall within the initial proposed objectives.
ACKNOWLEDGEMENTS

As always, during any Earthwatch fielding season for a project, there are a number of organisations and people who need to be thanked and the 2017 season was no different. Thanks go to Stellenbosch University and PI Alison Leslie, for creating the opportunity. From African Parks the following people all played a vital role in making sure we could operate. African Parks CEO for Malawi, Patricio Ndadzela. Park Manager, Craig Hay and Field Operations Manager, Gervaz Tamala provided vital support to the project. Beatrice, Bookings Manager for African Parks, assisted with all campsite and recreational day bookings, Felix, SunBird manager for Thawale Lodge for allowing us access to the lodge for the waterhole counts, Mike and Henry at the campsite made sure that our volunteers were always attended to, Chitsanzo is thanked for keeping our research camp neat and tidy and Jacksonat the Heritage and Educational Centre who helps out with all sorts of logistics, from vegetable deliveries to sourcing of spares! Joseph, Carol, Dixie and Alexander, the community extension team were invaluable in organising and accompanying volunteers on school and community visits. From Law enforcement, Mr Martin Awazi and Mr Toyolo Moyo and their team of scouts are thanked for always making sure that our volunteers stayed safe in the field; in particular we would like to thank the scouts, namely: Banda, Billate, Ado, Mike, Benito, Mphatso, Gift, Misheck, John and James. A particular word of the thanks to the rhino trackers, James, Nelio and Dixon, for their incredible patience and for keeping the field crews safe when back-tracking often grumpy rhino. A special thank you to the fantastic Isaac Mlilo, mechanic extraordinaire, and his assistants Scotch and Ian, who helped us keep our vehicles running under tough circumstances. A big thank you to, to Morgane Scalbert, a Belgium research assistant extraordinaire, who gave us 3 months of her time in Majete.

Last by not least, to all the volunteers of the 2017 expedition season, thank you for providing us the opportunity to conduct our research in Malawi and for making a lasting contribution to conservation in this part of Africa. Without your financial support and additional hands, this research programme would not be possible. Your spirit and enthusiasm in the field was always inspirational and it is through your effort that we were able to collect the data we did in 2017 and hopefully long into the

Our plans for 2018:

Two new MSc students and field staff members to Majete in March - namely: Wesley Hartmann and Sally Reece.
Anel and Kayla plan to graduate in Dec 2018.
The PI is expanding the research programme to include a cheetah study in Liwonde National Park (also under African Parks management) and will also expand the current elephant project in Nkhotakota.
Majete’s plans for 2018:
Re-introduction of more lions and possibly cheetah and giraffe.
An aerial survey is planned for October
And….plenty more so keep an eye on www.african-parks.org
What started as a small student-based research project in Majete Wildlife Reserve has now become a much bigger country wide elephant monitoring programme - thanks to the incredibly generous donations of our funders, specifically the Stichting Amfortas Foundation in the Netherlands. All donations received - large and small - went to the collaring of the elephants that were translocated from Majete to Nkhotakota in July of 2017. Remaining funds will be used to monitor the translocated population going forward. The translocation itself was a tremendous team effort. We thank the Department of National Parks and Wildlife and African Parks in particular for the privilege to monitor and research these magnificent pachyderms. During the translocation itself, huge thanks go to all the hands on deck in the “hot zone” – Conservation Solutions, African Parks Staff, Tracy & Du Plessis Game Capture, funders, donors, guests, Earthwatchers, pilots, security personnel, researchers and aspiring vet students – everyone played an invaluable role in assisting the Majete Wildlife Research Team in achieving its goal: to collect data that will allow us to launch a long-term elephant monitoring program in Malawian Parks going forward.

Dankie! It was moving to see how passionately involved each and everyone was, and we are sure that those precious moments in the bush side by side with the elephants, in the heat and dust of an African day, will remain with us all. It is your vision for the future of Africa’s wildlife that made this possible, and perhaps it is fitting here to include Daniel Burnham’s words, which you may have read at one of African Parks Founders - Dr Anthony Hall Martin’s - memorial spot in Majete:

Make no little plans,
they have no magic to stir men’s blood,
Make big plans, deep into the future.
Aim high in hope and work.
Have faith,
Remembering that a noble plan
Once recorded will never die.
But long after we are gone
Will still be a living thing.
The translocated elephants

154 elephants were translocated from Majete Wildlife Reserve to Nkhotakota Wildlife Reserve in Malawi in July of 2017. Nineteen herds were translocated, which included 43 adult females, one adult male, 29 juveniles, 19 calves and 8 infants. This operation was conducted by African Parks in conjunction with the Department of National Parks and Wildlife of Malawi. This translocation formed part of the greater 500elephants.org initiative, whereby 500 elephants were translocated in family groups from overpopulated game reserves in Malawi (source reserves) to depleted (sink) reserves. The Stichting Amfortas Foundation in the Netherlands made the satellite collaring of ten matriarchs possible, and with the data collected by the Majete Wildlife Research Team under the auspices of Stellenbosch University, will allow for the establishment and maintenance of a comprehensive elephant demographic data set. This data includes the genetics and biochemical data of 120 of the 154 elephants, comprising 15 herds in total, as well as the satellite movement of the ten matriarchs and their herds. The Majete Wildlife Research Team’s aim is to use this comprehensive data set as a launching point for long-term research by African students into this translocated population, similar to what is being done in Kenya by Iain Douglas Hamilton, Cynthia Moss and colleagues of Save the Elephants. The data will be used as a basis for future reserve management decisions, as it will allow exact recording of population growth post translocation. This is important as in fenced reserves, elephant populations must be understood if they are to be controlled in line with the aesthetic, ecological and demographic carrying capacity set out by African Parks management. Further, the analysis of elephant habitat use, identification of home ranges, core zones, pathways and preferred vegetation types, crossing points and waterhole usage will allow for improved spatio-temporal management of the landscape with regards to waterhole provisioning, conservation of sensitive riparian and woodland zones, placement of tourism infrastructure and Human-Elephant Conflict mitigation strategies.

It is our wish to create a community of collaborators around the translocated elephants and their ten matriarchs, in exploring their leadership and their families’ development in a novel environment, and so providing us all with hope for the future. It is our mission to monitor and protect the translocated elephants, and to raise awareness locally and internationally of their status, by working with local and international universities, international elephant organizations, wildlife departments, scientists, citizens, communities and protected area managers.
The Majete Research Team at SU has teamed up with GIS experts at the University, and we are currently mapping the home ranges, and core zones of each matriarch and her family for the dry and the wet season. Core zones constitute the top 25% of the areas used within the home range of the elephant using the grid square method. We will further evaluate what landscape variables may determine these core zones – for example - vegetation indices, shade, proximity to rivers, roads, settlements as well as topography and slope.

These results will be available after a full year has passed (July 2018). We will also be using the hourly satellite fixes to calculate Association Indexes (AI) between the matriarchs over the last year. This will clarify which of the matriarchs tend to move with each other – and to compare this in the wet season when resources are abundant versus the dry season – when herds tend to fission along matrilineal lines. Although one would expect related matriarchs to move together, this is not always the case.

Anne 5 (above and left) movement since July 2017, and significant range expansion on 25 November 2017, when the sanctuary gates were left open along the Kasungu road and the fence was opened along the Kaombe River to allow elephants and other game to start to disperse into the sanctuary extension to the south.

This database is also being shared with the National Zoological Gardens (NZG) in South Africa, where it is being entered into a larger forensic elephant database for African elephants (see below). In the event that an elephant is poached in Nkhotakota, sample DNA can be sent to NZG by the police, and this will allow us to immediately identify the elephants and the family. This is especially relevant to the region - a recent newspaper article in Malawi highlighted the concern of Park authorities over the extinction of large game such as elephant and hippos in areas such as the Elephant Marshes in the Lower Shire River Basin due to poaching and encroachment in unprotected and under-resourced areas. Projects such as ours are crucial therefore to monitor elephant populations within protected areas.

An example of the forensic database of the National Zoological Gardens South Africa. The NZG has a copy of each of the elephants' DNA sample.
Detailed demographic data is essential for the management of wildlife species of considerable economic value and high conservation concern. The African elephant has significant commercial value with regards to ivory trade and is a flagship for tourism, yet more importantly it is a keystone species in that it affects its environment directly – by influencing canopy cover, affecting species distribution and dispersing seeds. The state of elephant populations thus is critical to the integrity of the ecosystems it inhabits. The demographic data will, we hope, form the foundation of a >20 year study of the Nkhotakota elephants in understanding elephant population processes in response to changing environmental conditions.

The genetic data allows us to understand relatedness within and across herds, as well as to mitigate against any possibility of inbreeding in future. Genetics further elucidates the social structure of the translocated population, and with the satellite data, will allow us to better understand the fission-fusion nature of the herds. The data has revealed that there are half-sisters and cousins among the collared matriarchs, so it will be very interesting to monitor how their movements through Nkhotakota resemble each other - if at all. Some of the data also is indicating that unrelated individuals may be found in a herd, possibly due to the direct benefits of sociality in a previously disturbed, and translocated population.

### DEMOGRAPHIC DATA

<table>
<thead>
<tr>
<th>Date</th>
<th>A Code</th>
<th>SV code</th>
<th>Sex</th>
<th>Ext-Age (yr)</th>
<th>Shoulder Height (cm)</th>
<th>Real age (Schroeder)</th>
<th>Weight (kg)</th>
<th>Feet circumference (cm)</th>
<th>Tusk length</th>
<th>Tusk diameter</th>
<th>Length (m)</th>
<th>Collar</th>
<th>YHF Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>05-Jul</td>
<td>MB 7</td>
<td>C85</td>
<td>f</td>
<td>25.0±0.5</td>
<td>250±20</td>
<td>30+</td>
<td>133±10</td>
<td>139±10</td>
<td>33±2</td>
<td>25</td>
<td>21±10</td>
<td>4N1B</td>
<td>20.6</td>
</tr>
</tbody>
</table>

### GENETIC DATA (RED – UNRELATED, YELLOW HIGHLY RELATED)

The genetic data allows us to understand relatedness within and across herds, as well as to mitigate against any possibility of inbreeding in future. Genetics further elucidates the social structure of the translocated population, and with the satellite data, will allow us to better understand the fission-fusion nature of the herds. The data has revealed that there are half-sisters and cousins among the collared matriarchs, so it will be very interesting to monitor how their movements through Nkhotakota resemble each other - if at all. Some of the data also is indicating that unrelated individuals may be found in a herd, possibly due to the direct benefits of sociality in a previously disturbed, and translocated population.

19 herds Related matriarchs
Introducing the Matriarchs

Anne 1 is the matriarch of a herd of ten animals, and she weighed 3035kg, and measured 2.43m at the shoulder. We estimate her to be over 35 years old. She is mother to an eight year old male, and aunt to 6 year old male. The other mature female in the herd is closely related, probably a cousin. The herd includes six males and four females. Five of the elephants were under 10 years of age. The third mature female has three offspring, a nine and a one year old male and a 13 year old female. Interestingly, our genetic analysis revealed that the 17 year old male captured with this herd, is not related to any of the animals.

Anne 2 is the matriarch of a herd of five elephants, however she may have split off from a larger group. She is related to Anne 7 and Anne 6 (half sisters or cousins). There are three calves under the age of 10 in this herd, two males and one female. Anne 2 weighed in at 2040kg and measured 2.35m at the shoulder. We estimate her to be more than 30 years of age. She is mother to the youngest and smallest calf of the translocation (less than a year and weighing 245kg), as well as mother to a six year old female. Anne 2 is supported by a female cousin who has a four year old male calf.
Anne 3 is part of a family herd of seven elephants, four of them under the age of 10. She has an eight and a 15 year old daughter, the latter has a one year old calf. This matriarch measured 2.55 at the shoulder and weighed in at 3070kg. Due to her size, she is one of the biggest and oldest matriarchs of the translocation. We assume that this herd formed part of a herd of eleven, as our records show that five other elephants split off during capture at the Njati Rd in the Sanctuary at Majete. Anne 3 is in a herd with another female that is over the age of 30, but interestingly is unrelated to her.

Anne 3 being lent a helping hand by the translocation team while in transit to her new home.

Anne 4 sadly died due to a festering snare wound in Nkhotakota. She was the matriarch of a family of 11 elephants, and was lactating at the time of the translocation. Anne 4 measured 2.43m at the shoulder and weighed in at 2930kgs. She had a five year old and a one year old calf – both males. The hopeful news is that three other females between 28 and 35 were in this herd, and their genetics indicate they are half-sisters of the deceased matriarch. We hope they will have adopted the matriarch’s calves, as both these adult females have a five year old and a one year old calf respectively. Anne 4’s collar was removed and redeployed to another herd in November. Unfortunately we have no specific details yet, but we hope to follow up with both herds as soon as we can get a PhD student set up in Nkhotakota.
Anne 5 is the matriarch of a herd of nine animals. We estimated her to be more than 35 years old, as she weighed in at 3030kg and measured 2.45m at the shoulder. She is mother to an 11 year old female, and two males. Another mature female aged 30 plus is in this herd, with three year and nine year old daughters. Another mature female – either half sister or cousin to Anne 5 – is in this herd, and she has two daughters aged three and nine.

Anne 5’s 11 year old daughter. Elephant identikits are derived from distinguishing features such as ear shape, patterns of veins, holes in ears, tusk shape and size.

Anne 6 is the matriarch to a herd of eight elephants. She weighed in at 2925kg, and measured 2.3m at the shoulder. With over 30 years of age, she is mother to one year old and four year old males. Another mature female over 28 years of age is also in this herd, and has two calves aged three and six. The two mature females are very distantly related. The very obvious tear in Anne 6’s left ear allows for quick recognition of herd and individual id.
ANNE 7

Anne 7 heads up a herd of nine animals with four mature females (post 25 years of age) but varying in degree of relatedness from unrelated to half siblings. She is a good sized female weighing in at 3045kg and measuring 2.35 at the shoulder. She has a one year old calf and is closely related to a 28 year old and a 4 year old female in her herd (cousin/aunt). Another mature female unrelated to this matriarch can be found in this herd, she has two male calves aged nine and four. The fourth mature female has a one year old female calf. Genetic data suggests that Anne 7 is closely related to Anne 2, either as half siblings or cousins.

ANNE 8

Anne 8 is part of a herd of 11 animals, with four mature females. They were part of the “Majete Research Camp Herd” that came to visit the researchers frequently. They were captured close to the research camp. Two of these mature females are her full sisters, which gives this herd a strong social structure. She weighed 3030kgs and measured 2.5m at the shoulder. Anne 8 has two daughters aged six and 11. Her sisters have daughters aged six and seven years of age, and a male calf aged three. Two additional males are found in this herd, aged eight and three.

Anne 8’s full sister gently being helped to the ground. She is younger and weighed in at 445kg less than her big sister.
Anne 9 was part of the first herd captured in Majete, she weighed 3150kg and measured 2.5m at the shoulder. We estimate her to be 30 years of age. She is part of a herd of seven animals, possibly 13. The other mature female in the herd is her full sister, and she has two daughters of her own aged 11 and 5. Anne 9 has two daughters aged nine and six, and a little male aged three.

Anne 10 is the one of the females in a large herd of 15 animals. Unfortunately we do not have data for this herd. We are hoping to collect DNA data using dung samples once we have a student in camp at Nkhotakota. This female weighed 2300kg, and two bigger females weighing 2560kgs and 2840kg were also recorded.
Movement maps of half sisters Anne 6 and Anne 9

Similar movement patterns of Anne 6 (above) and Anne 9 (below), within sanctuary (left) and after opening of sanctuary fence (right)
Since 2013 the Majete Wildlife Research Programme has run their own schools programme. Once a month throughout the Earthwatch volunteer fielding season, a school in communities surrounding the park is visited. The research team present the schools with numerous stationary and other necessary school items all very generously donated by the volunteers themselves. Volunteers get to tell learners about their respective home country’s and often schools will present a play or sing and dance for all. In 2017, the research programme sponsored a reserve visit for learners from two schools surrounding the park. A bus was hired, cooldrinks were provided and the learners finally got to see what goes on in their backyard. The Majete Wildlife Research Programme hopes to expand this undertaking in 2018.
Other collaborations

Stellenbosch University:

Building on previous demographic research conducted by Frances Forrer, Katharina and her colleagues are currently analyzing samples collected during the translocation, and collaborating with Mathematical modelers, geneticists and biochemists to unravel the complexity of the odour-gene covariance question, and establishing whether related elephants smell more similar to each other. Running the GC-MS (Gas Chromatography-Mass Spectrometry) for the three swabs (buccal, temporal and genital) revealed an abundance (over the thousands) of chemical compounds per individual. These compounds are now being consolidated and aligned according to their retention times, and once this is done, will be mathematically and statistically evaluated. The genetic relatedness among the elephants has been established using the Queller and Goodnight (1989) methods, and we are now evaluating possible partners to further analyse the MHC (Major-Histocompatibility) section of the elephant genome, which in other species has been implicated in kin-recognition. New students will be arriving in Majete in 2018 to evaluate the effects of the translocation on the remnant elephant population, looking at population structure, elephant distribution and resource use in particular.

Earthwatch Institute:

The Majete Wildlife Research Programme has been supported by Earthwatch since 2013. 100’s of volunteers have assisted the programme and two very lucky teams were able to partake in the elephant translocation project in July 2017. This Earthwatch project was listed by volunteers as one of the global top 10 for 2016! As stated by the PI of the project: “We would never be able to achieve what we do each season without our extremely valuable citizen scientists. Thank you all for your enthusiasm, hard work and wonderful humour in between”.

Click here for more information on Earthwatch.

Earthwatchers had this to say

“My favorite of the 6 expeditions I’ve done so far. Highly recommend. Dr. Leslie (Dr. Ali) and her staff are wonderful! In spite of all the things that commonly go wrong in the bush they were always upbeat, smiling and cracking jokes. Getting to help with the capture and relocation of an elephant herd was the highlight of the expedition. And that was topped off on the last night in Africa by coming across a fresh lion kill. We spent 30 minutes watching 4 lions within 80 feet of us.”

“Working side by side with wildlife conservationists dedicated to protecting and restoring Africa’s native wildlife was an inspirational experience. The expedition was extremely well run and of the highest quality. From day one, our volunteer group was welcomed and included in every facet of the research being conducted. My favorite moments included glimpsing a shy and reclusive bushbuck drinking from a waterhole at dawn, bouncing along a game trail in the back of a truck, and encountering a herd of elephants browsing noisily behind my tent. We also had the unique privilege of teaching a group of schoolchildren about elephants. (Handy to have three teachers in the group!) Upon our arrival, the local villagers literally ran up to our group smiling and waving – the friendliest people I have ever met! The most remarkable part of this expedition, however, was the obvious camaraderie between Dr. Alison, Charli, and Willem and the care taken by them to nurture our group. Meals were prepared with loving care from fresh local fruits and vegetables. Evenings often included leisurely campfire discussions and a braai. The team even built in times where we could luxuriate by the pool and enjoy the sunset over the Shire River. This was my first Earthwatch trip and it certainly set the bar very high. My recommendation is to sign up for “Animals of Malawi” as soon as possible. Otherwise you will miss out on what could be one of the best opportunities of your life. And of course the elephants walking through the campground every few days and listening to a leopard take a baboon within 100 yards of us one night were also highlights. Overall, a wonderful experience made even better by the wonderful staff.”
Wienand, J (2013). Woody vegetation change and elephant water point use in Majete Wildlife Reserve: implications for water management.


Olivier, A (in progress). The ecology of black rhino (*Diceros bicornis*) in Majete Wildlife Reserve, Malawi.

Green, K (in progress). Ecological impact of large herbivores on vegetation at selected artificial watering points in Majete Wildlife Reserve, Malawi.


Reece, S. (Starting in 2018). Spatial use patterns and species richness of medium and large mammals in Majete Wildlife Reserve, Malawi.

The Eye (Malawian magazine) articles:

The Mighty Elephants
Sustainable Harvesting Project
Majestic Zebra of Majete
Hyena Study

The Bolander (Stellenbosch newspaper): Pachyderm sleepover

IOL (Independent Online South Africa: Maties graduate makes inroads in conservation

Stellenbosch University News: Stellenbosch University’s students help with revival of Majete Wildlife Reserve

Earthwatch : Animals of Malawi in the Majete Wildlife Reserve

Wildlife and Environment Society Malawi: Talks by students

International honour for crocodile researcher (Maroela media)
The Majete Research Team and Nkhotakota Management are hoping to put African students into Nkhotakota come 2019. Until then we are hoping to raise funds for the establishment of a small research camp in Nkhotakota, similar to that of Majete. The aim is for post-graduate students to monitor elephant impact and use of core zones, as well as to sample the regional faunal and floral biodiversity by establishing predation, grazing and browsing impact of keystone species. The start-up costs are USD 85000 for the building of a camp (tents for accommodation, loo, electricity, kitchen) and a 4x4 vehicle USD 50000. Should you wish to be our partner in this, and would like to contribute towards the establishment of the Nkhotakota Research Camp, please do contact Dr Leslie.

For those of you who have never been to Malawi and are interested in visiting Majete or Nkhotakota, please click on the reserve name to explore each reserve, accommodation options, and how to get there.

For this newsletter, we have included a link to Rudyard Kipling’s famous “The Elephant Child” for your reading pleasure. Please click here to access.
Majete Wildlife Research Programme, Malawi, East Africa
Facebook: click here
Contact: Dr Alison Leslie aleslie@sun.ac.za
Department of Conservation Ecology and Entomology
JS Marais Building
Victoria Street
Stellenbosch University
South Africa
Tel: +27 21 808 4792
Fax: +27 21 808 2001