PROGRESS REPORT

NUBIAN GIRAFFE CONSERVATION ASSESSMENT IN MWEA NATIONAL RESERVE AND RUMA NATIONAL PARK, KENYA

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Introduction

Among the giraffe (sub)species found in Kenya, Nubian giraffe (*Giraffa camelopardalis camelopardalis*) are the most endangered, with an estimated 478 individuals remaining in the country (Fennessy et al. 2015). In fact, the Kenyan Wildlife Conservation and Management Act of 2013 and the IUCN Red List lists Rothschild's giraffe – now Nubian giraffe according to a recent study (Fennessy et al. 2016) – among '*endangered*' wildlife in the country that require urgent conservation attention. Nubian giraffe were saved from near extinction in Kenya through conservation translocation efforts in the 1980s. Giraffe subpopulations were moved into protected areas where numbers were critically low or locally extinct, including Ruma National Park (NP) and Mwea National Reserve (NR).

In March 2017, the African Fund for Endangered Wildlife Kenya Ltd (AFEW) and the Giraffe Conservation Foundation (GCF) initiated surveys to gather new data and update the conservation status of Nubian giraffe in Ruma NP and Mwea NR. There are an estimated 177 giraffe in Ruma NP (KWS pers. comm.), while aerial surveys conducted in November 2017 indicated that Mwea NR is home to an estimated 32 giraffe (KWS pers. comm.). Both populations have previously received giraffe from the Giraffe Center in Nairobi to augment their numbers. Currently, the giraffe population in Ruma NP is assumed to be increasing, while the status of the population in Mwea NR is unknown following an outbreak of anthrax in 2011 that killed 11 giraffe. As such, there is a critical need to better understand the two contrasting wild Nubian giraffe populations and their habitat in Kenya to provide informed conservation management decisions. This report highlights the progress of field research efforts conducted in June and July 2017.

The objectives of this study are as follows:

a. Establish individual identification databases of giraffe in Ruma NP and Mwea NR;
b. Determine the relative population abundance in Ruma NP and Mwea NR using road-based photographic mark recapture surveys and pattern recognition software;
c. Update the translocation history of giraffe moved for conservation purposes to Ruma NP and Mwea NR.
d. Monitor the health status of giraffe in Ruma NP and Mwea NR;
e. Provide data to update future IUCN Red List (re)assessments of Nubian giraffe; and
f. Provide conservation management recommendations on Nubian giraffe in Ruma NP and Mwea NR

Data generated from study provides recommendations for future conservation management, including translocations of giraffe, and critical information that is needed to inform policy makers, conservation managers and other stakeholders make informed pro-active measures to sustain the Nubian giraffe in Ruma NP and Mwea NR, and more broadly in Kenya.

Methodology

The methodology was geared towards photographically marking individual giraffe during a given survey, then recapturing them in subsequent surveys to estimate their abundance in each of the two survey areas. We randomly drove along the pre-determined transects within the survey areas at a speed of 30km-40km/hr to ensure maximum detection and encounter of giraffe. Our aim is to drive each of the transects 20 times taking photos of giraffe sighted within a 200m width of the transect. One researcher took photos of the right side of the giraffe using a Nikkon CoolPix P900 Camera and communicated the accompanying metadata to a researcher who recorded and marked the GPS way points. The metadata collected during the surveys included; number of individuals, age, sex, signs of snaring and giraffe skin disease (GSD), time of sighting and photo number. Individuals were aged based on height estimation and age-associated behaviours. During these surveys, we prioritised the right-side images of individual

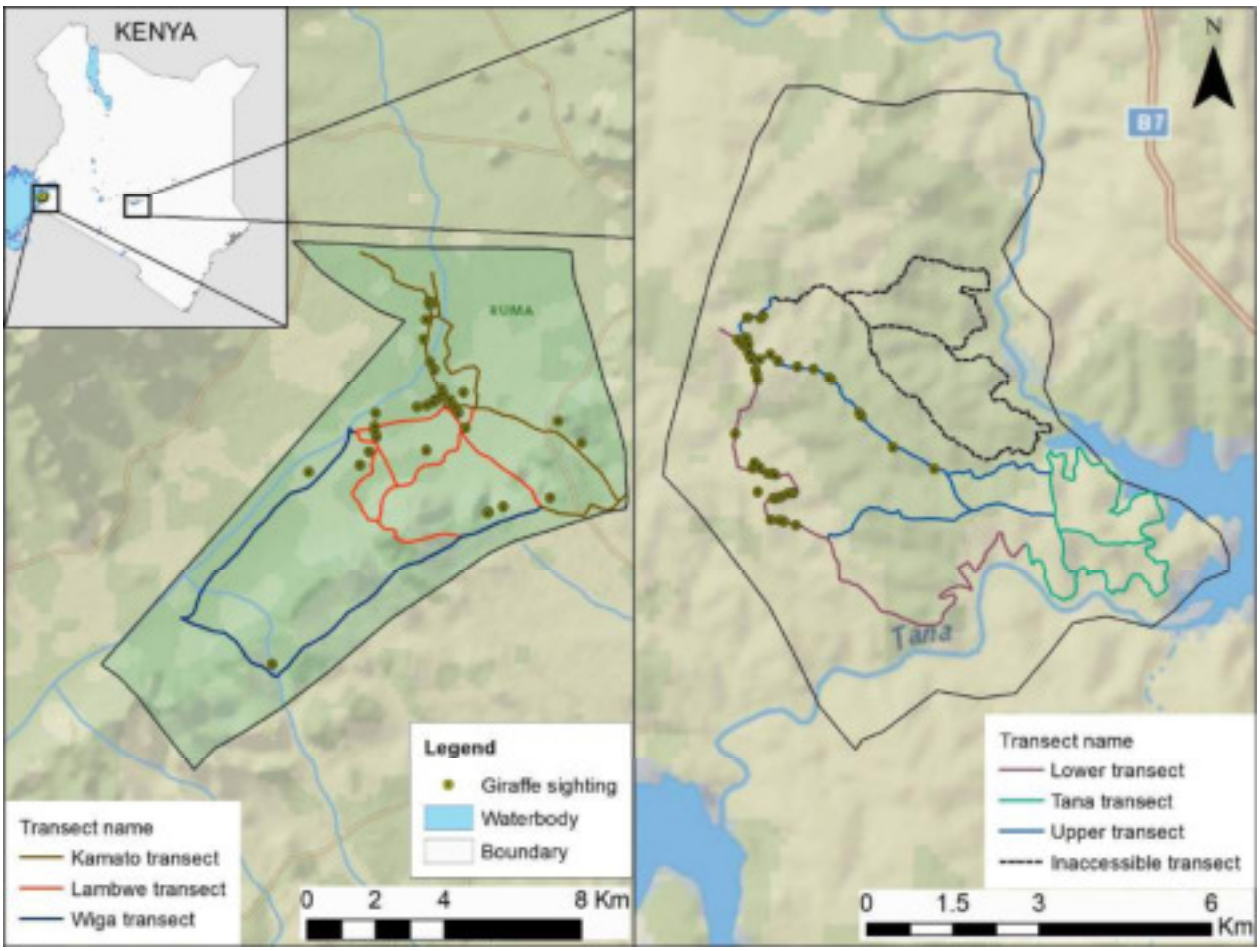

Fig. 1: The road transects in the survey areas in Ruma NP (Left) and Mwea NR (Right), and giraffe distribution during the two surveys in June and July 2017.

giraffe for WildID analysis to maintain consistency in our efforts to identify individual giraffe (Bolger et al. 2012; Muneza et al. 2017). We discarded blurry images and photos that had the right side of giraffe blocked by thick vegetation. We then cropped the remaining images and analysed them individually

using WildID to identify unique giraffe. Wild-ID characterised giraffe spot patterns in the images and assigned similarity scores of the images ranging from 0.000 to 0.9999. We selected the top-ranked image as the matching pair and further inspected each pair visually before proceeding to avoid false acceptance. When in doubt, we inspected the top 5-ranked images and selected the photograph with the highest ranking that could be visually matched. The results from the photographic analysis via application of Wild-ID yielded the encounter histories of giraffe by referring to the GPS coordinates of the corresponding image recorded during our surveys.

Results

We took a total of 760 images from 233 sightings of giraffe in Mwea NR and 2,392 images from 985 sightings in Ruma NP. After filtering and cropping, 549 images from Mwea NR and 1,268 from Ruma NP were suitable for WildID analysis. The largest herd of giraffe observed in Mwea NR comprised of 23 individuals (range: 1-23) and the average herd size was six individuals. In Ruma NP, the largest herd we recorded was comprised of 76 individuals (range: 1-76) and the average herd size was 21 giraffe.

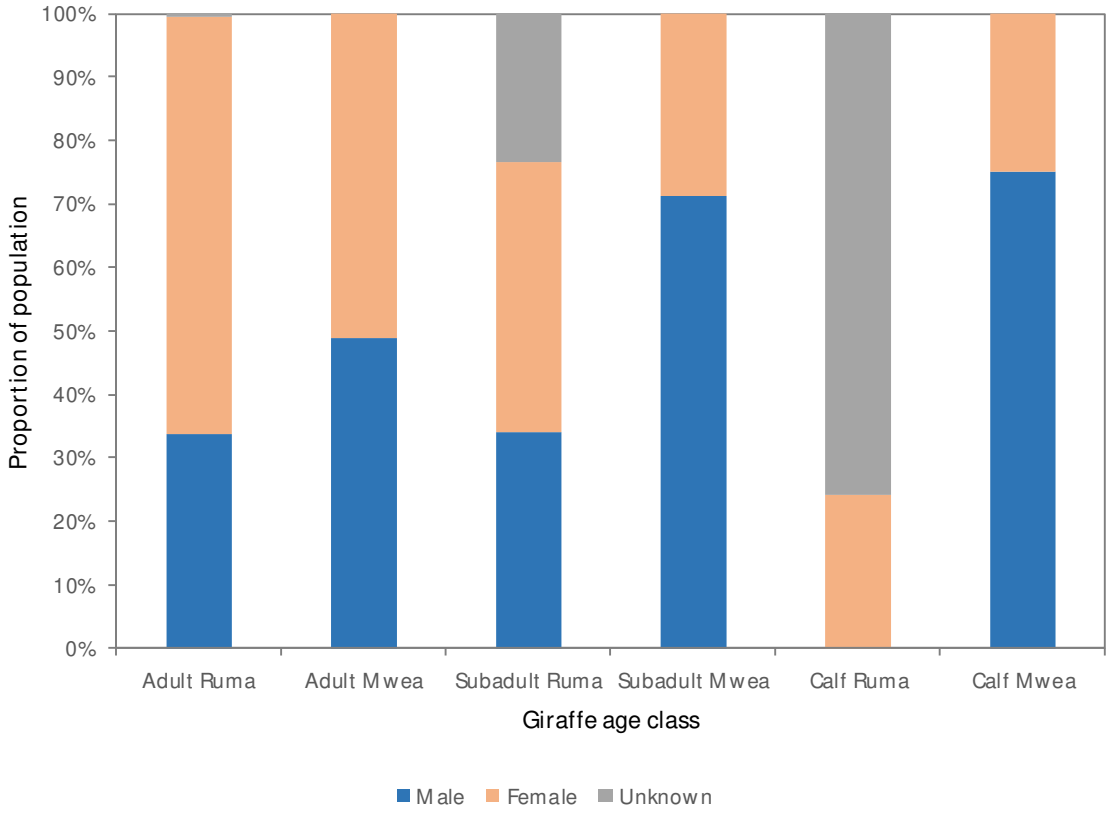

Fig. 2: Population structures of giraffe in Ruma NR and Mwea NP.

Using WildID analysis, we identified 56 and 340 unique giraffe in Mwea NR and Ruma NP, respectively. Of the 56 individual giraffe observed in Mwea NR, 20 were adult males, 21 adult females, 5 subadult males, 2 subadult females, 6 male calves and 2 female calves (Fig. 2). In Ruma NP, the individuals

observed thus far comprise of 68 adult male giraffe, 132 adult females, 32 subadult males, 40 subadult females and 7 female calves (Fig. 2). There were 61 individual giraffe whose sex could not be determined, which included 1 adult, 22 subadults and 38 calves (Fig. 2). Based on these data, the giraffe population density (per km^2) is 1.16 for Mwea NR and 2.83 for Ruma NP. Thus far, we have surveyed each of the Mwea NR transects 20 times, while in Ruma NP, we have surveyed both Kamato and Lambwe transects 11 times and Wiga transect 9 times.

We found no giraffe with signs of GSD in Mwea NR and only one female giraffe had GSD lesions in Ruma NP (Fig. 3). However, we recorded one male giraffe with a large tumour below the middle ossicone in Ruma NP (Fig. 3), which we communicated to the lead scientist of the Park. Additionally, we observed only two giraffe with snare injuries in Mwea NR whereas no signs of snare injuries were recorded in Ruma NP. One of the two snared giraffe in Mwea NR had a severe injury and was limping. The giraffe was subsequently treated by KWS vets to minimise risks of infection from the wound.

Fig. 3: Giraffe skin disease lesions on the neck of a female giraffe (left) and a tumour growth on the middle ossicone of a male giraffe (right) in Ruma NP.

As part of this study, we sought to update the translocation history of giraffe in both Mwea NR and Ruma NP. Using WildID, we could identify one male giraffe ('Ibrahim') that was translocated to Mwea NR from the Giraffe Center in Nairobi in 2011 (Fig. 4). There is ongoing search of images taken during the translocations to compare with images taken during surveys.

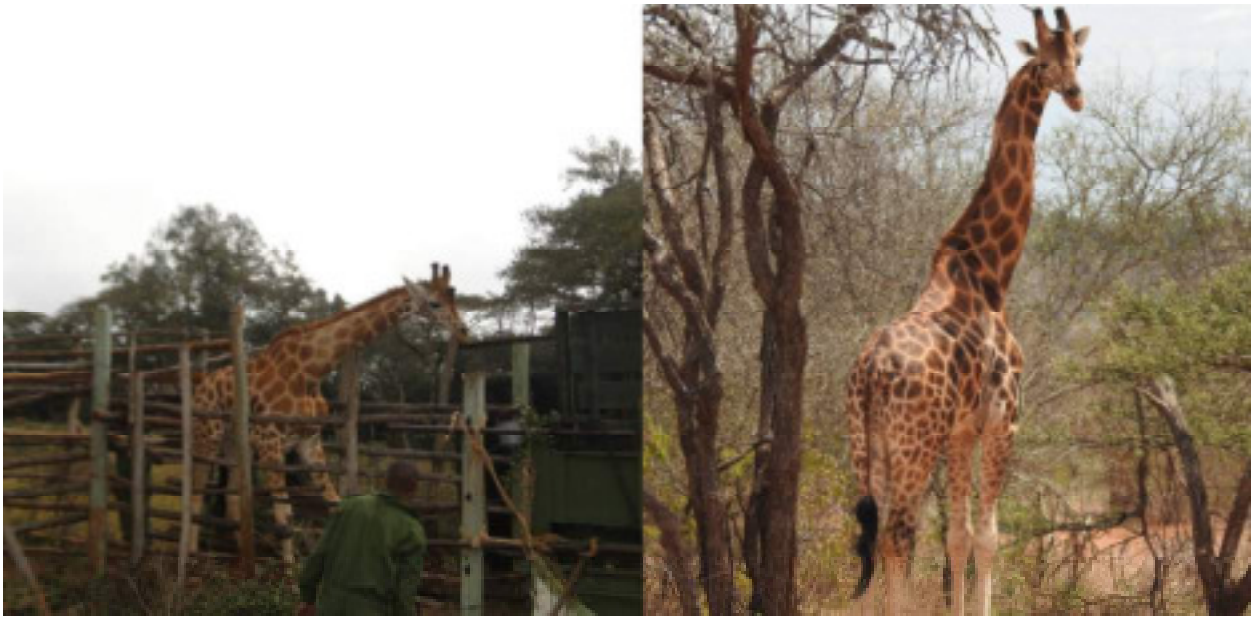

Fig. 4: Ibrahim being loaded in the translocation lorry in 2011 (left) and Ibrahim in Mwea NR in 2017 (right).

Discussion

Between March to November 2017 we completed 20 surveys in each of the transects in Mwea NR, and our results indicate that the population is recovering after a breakout of anthrax in 2011 (Kaitho et al. 2013). In total we have identified 56 unique giraffe, which represents an increase of 69.7% since 2011. In Ruma NP, the total of 340 unique individuals that we have identified thus far is an increase of 330.8% since 2003, where the estimated giraffe population was 79 individuals (Awange & Ong'ang'a 2005). Our results show that there are more giraffe compared to the current estimate of 177 giraffe (KWS pers. comm). The methodology we used allowed us to cover more ground using available road networks searching for giraffe and taking photos of as many giraffe as possible. Additionally, we randomized the time of the day that we surveyed for giraffe in order to determine the number of giraffe in each protected area. Previous studies relied on total counts (census, aerial surveys) but these methods rely on the visibility of the target species (Jachmann 2001). For instance, aerial surveys found 11 giraffe in 2012 and 32 in 2017 in Mwea NR (KWS pers. comm.) but previous studies have shown that the number of giraffe in 2011 was estimated at 33 giraffe (Kaitho et al. 2013). Our methodology, which includes a mixture of line transect surveys, photographic mark-recapture methods and pattern recognition has been proven to be more precise (Jachmann 2001; Lee and Bond 2016) and shows that there are more giraffe in Mwea NR and Ruma NP than initially thought and our results provide insights on the population structure of both populations. Given that there is a lack of information on the abundance and demography of Nubian giraffe in Kenya, we propose that conservation managers and ecologists use photographic mark-recapture surveys to generate data on the structure of Nubian giraffe populations around Kenya to inform their management.

The Mwea NR population has an almost 1:1 ratio of male to female adult and subadult giraffe. However, in Ruma NP we observed more females than males, with both adult and subadult females accounting for 54% (n=172) of the total population recorded thus far while adult and subadult males form 32% (n=100) of the population (Fig. 2). A higher proportion of females in a population allows a faster growth rate (Johnson 1994; Lenz et al. 2007), and likely why the population has grown significantly in recent years. Both Ruma NP and Mwea NR have very high densities (per km^2) of giraffe at 2.83 for Ruma and 1.16 for Mwea. This, coupled with the increasing trend of the local giraffe populations, indicates that the two protected areas may be unable to support long-term increasing population numbers. However, there is limited information on the number of giraffe that a given area can support without adversely affecting the environment. As such, we recommend further studies examine the factors that influence the carrying capacity of giraffe in their range habitats.

During our study, we did not record any giraffe in the Tana Transect or southern portion of the Lower Transect in Mwea NR though there were signs of giraffe presence over time e.g. tracks and fresh droppings. We hypothesise that giraffe use these areas to drink from the nearby Kamburu Dam, Tana River and Thiba River, especially during the dry season and when the water troughs are empty. We commonly observed giraffe in the northern sections of the Tana and Upper transects, where most the water troughs are located. We did not observe any major variations between where the giraffe feed during the wet and dry seasons. However, when water levels receded during the dry season, large game including elephant and giraffe were able to cross the river. We recorded tracks of elephant on the riverbeds, which could potentially fuel human-wildlife conflicts. Additionally, poachers have easier access to the reserve when water levels recede (KWS pers. comm). We only recorded two adult giraffe with snare injuries (Fig. 5), of which one required intervention from KWS vets. Poaching was listed as one of the major threats that wildlife face in Mwea NR (KWS pers. comm) but it is not clear whether giraffe are the preferred source of meat for the neighbouring communities. We were unable to access the northern portion of Mwea NR, which also borders village land due to a broken bridge. There are community settlements adjacent to Ruma NP as well but the Park is completely fenced and intensely patrolled due to the presence of the critically endangered black rhino (*Diceros bicornis*) and the rare roan antelope (*Hippotragus equinus*). We did not record any snare injuries on the giraffe in Ruma NP and our observations indicate that Nubian giraffe is the most common large mammal in the Park. Importantly, our preliminary results indicate that Ruma NP is home to largest population of Nubian giraffe in Kenya (>60%). Hence, it is vital to continue monitoring this population as well as study and document the human attitudes, perceptions, and cultural values of Nubian giraffe in communities that live adjacent to protected areas to better understand the anthropogenic factors that fuel giraffe poaching and record instances of giraffe snaring and mortality.

Fig. 5: Adult female giraffe with a wound from a snare injury on the hind leg in Mwea NR.

The giraffe in both populations appear in good health with very good body conditions. We did not observe any signs of GSD in Mwea NR, while only one giraffe in Ruma NP had GSD lesions of the neck, consistent with the manifestation of the disease in Nubian giraffe (Muneza et al. 2016). However, from casual observations during our surveys, we recorded that the giraffe in Mwea NR had more ectoparasites compared to the Ruma NP population. We hypothesised that this was caused by the smaller number of oxpeckers in Mwea NR compared to Ruma NP, which has a higher diversity of birds that feed on insects. We also observed three giraffe with tumours on the upper regions of the forelimbs in Mwea NR though they did not exhibit any difficulties in moving. It is unclear whether these inflammations are linked to GSD (Muneza et al. 2016) or perhaps biting insects. Our study was limited to identifying signs of infection on the dermis of giraffe, therefore further studies that involve the collection of blood, muscle tissues and ectoparasites are required to better understand the pathophysiology of potential disease outbreaks.

Additionally, collecting such samples will provide additional information on the taxonomy and genetic diversity of the two giraffe populations. During our surveys, we observed several giraffe with coat patterns that resembled those of Masai giraffe (Fig. 6). With the support of GCF, KWS vets have subsequently collected tissue samples from Mwea NR, with Ruma NP to still be sampled, and the results from the analysis will inform future management policies and translocation opportunities in Kenya. These studies also present future opportunities to study genetic relatedness in giraffe populations. Given the differences in biodiversity and climate between Ruma NP and Mwea NR, we also recommend that additional studies focus on the community ecology of the two protected areas to better understand inter- and intraspecific interactions with a particular focus on disease ecology.

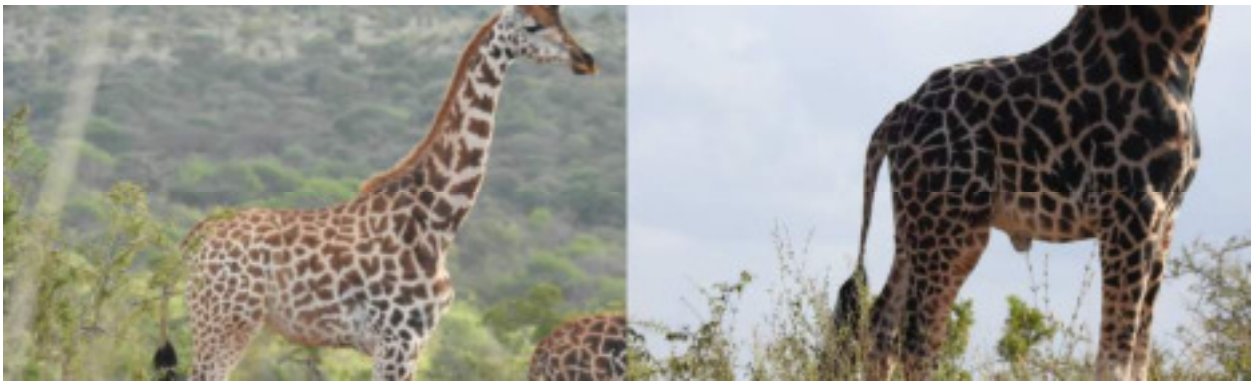

Fig. 6: Two Nubian giraffe observed with coat patterns resembling Masai giraffe in Mwea NR.

Understanding intraspecific interactions of giraffe will allow managers to better understand how they are using their habitat. For instance, while our results show that the average herd size of giraffe in Mwea NR is six, we commonly observed a herd of 12-13 individuals near the main gate, and the largest herd we observed comprised of 23 individuals. The same situation applied to Ruma NP where we observed a large herd of 74 individuals but it was more common to observe smaller herds of 15-20 individuals dispersed around the Park. This is normal for giraffe given the fact that they exhibit fission-fusion behaviour and group membership is constantly shifting (Fennessy 2009). It was common to observe lone males or in much smaller herds of 1-3 individuals. Male giraffe normally have a larger home range and move more often compared to female giraffe (Fennessy 2009; VanderWaal et al. 2014). However, little is known on the extent of the home range and detailed use of habitat by giraffe in small fenced protected areas. For instance, a study conducted in Ol Pejeta Conservancy (364 km^2) showed that the average home range of adult male giraffe was 95.7 km^2, 110.0 km^2 for subadult males, 64.2 km^2 for adult females, and 70.5 km^2 for subadult females, in a population of 212 reticulated giraffe (VanderWaal et al. 2014). Our study focused on determining the abundance of giraffe in both Mwea NR and Ruma NP and as such we did not study how far the animals move in both protected areas. Given that Mwea NR and Ruma NP have high densities of giraffe, it is important to understand the home ranges and space use of the two giraffe populations considering the proposed developments in the study areas to increase tourism opportunities (KWS pers. comm.).

Our study indicates that the two populations are healthy and have an increasing trend. Ruma NP specifically, has a young population. While we had difficulties determining the sex ratio of calves and subadults due to the long grass in Ruma NP, our results indicate that both age classes combined account for 41% of the population ($n_{subadults}$ = 94; n_{calves} = 45; Fig. 2). The climate in Ruma NP allows for sufficient annual rainfall and green vegetation throughout the year. As per our observations, Ruma NP is an ideal habitat for giraffe and we anticipate that the population will continue to increase at a fast rate. Therefore, in time, translocation of giraffe should be considered to reduce competition for space and mates. Translocation is an important conservation tool as evidenced by the fact that these two populations are increasing, after receiving giraffe from the Giraffe Center (Fig. 4) and other conservation areas. Concerns have been raised regarding inbreeding and low genetic diversity for the populations and

as such translocations, even though expensive and logistically challenging, could be a solution to these problems following appropriate assessment.

Next Steps

1) The results highlighted in this report are complete for Mwea NR where we completed 20 surveys for each transect. We are yet to complete 20 surveys for the Ruma NP transects and we intend to conduct additional photographic mark-recapture surveys in Ruma in January 2018 to generate the final results.

2) Use historic photos of giraffe from the Giraffe Center to track individuals translocated to Mwea NR from the Giraffe Center.

3) Prepare and upload images for use with Wildbook for Giraffe when launched

4) Prepare final report to be submitted to relevant authorities.

REFERENCES

Awange, J.L. & Ong'ang'a, O. 2005. Lake Victoria: Environment, Resources and Ecology. Springer Heidelberg, Berlin, Germany. ISBN 978-3-540-32575-8

Bolger, D.T., Morrison, T.A., Vance, B., Lee, D. & Farid, H. 2012. A computer-assisted system for photographic mark-recapture analysis. *Methods in Ecology and Evolution* **3**: 813-822.

Fennessy, J. 2009. Home range and seasonal movements of *Giraffa camelopardalis angolensis* in the northern Namib Desert. *African Journal of Ecology* **47**: 318-327.

Fennessy, S., Fennessy, J., Muller, Z., Brown, M. & Marais, A. 2015. Rothschild's giraffe (Giraffa Camelopardalis rothschildi) Conservation Status Report. IUCN SSC GOSG.

Fennessy, J., Bidon, T., Reuss, F., Kumar, V., Elkan, P., Nilsson, M.A., Vamberger, M., Fritz, U. & Janke, A. 2016. Multi-locus analyses reveal four giraffe species instead of one. *Current Biology* **26**: 1-7.

Jachmann, H. 2001. Estimating Abundance of African Wildlife: An Aid to Adaptive Management. Kluwer Academic Publishers, Boston. ISBN: 978-1-4615-1381-0.

Johnson, S.D. 1994. Sex ration and population stability. *Oikos* **69(1)**: 172-176.

Kaitho, T., Ndeereh, D. & Ngoru, B. 2013. An outbreak of anthrax in endangered Rothschild's giraffes in Mwea National Reserve, Kenya. *Veterinary Medicine: Research and Reports* **4**: 45-48.

Lee, D.E. & Bond, L.B. 2016. Precision, accuracy, and costs of survey methods for giraffe *Giraffa camelopardalis*. *Journal of Mammalogy* **97(3)**: 940-948.

Lenz, T.L., Jacob, A. & Wedekind, C. 2007. Manipulating sex ratio to increase population growth: the example of the Lesser Kestrel. *Animal Conservation* **10**: 236-244.

Muneza, A.B., Montgomery, R.A., Fennessy, J.T., Dickman, A.J., Roloff, G.J. & Macdonald, D.W. 2016. Regional variation of the manifestation, prevalence, and severity of giraffe skin disease: A review of an emerging disease in wild and captive giraffe populations. *Biological Conservation* **198**: 145-156.

Muneza, A.B., Linden, D.W., Montgomery, R.A., Dickman, A.J., Roloff, G.J., Macdonald, D.W. & Fennessy, J.T. 2017. Examining disease prevalence for species of conservation concern using non-invasive spatial capture- recapture techniques. *Journal of applied ecology* **54**: 709 – 717.

VanderWaal, K.L., Wang, H., McCowan, B., Fushing, H. & Isbell, L.A. 2014. Multilevel social organization and space use in reticulated giraffe (*Giraffa camelopardalis*). *Behavioral Ecology* **25(1)**: 17-26.

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