The Impact of Human Disturbance on Reticulated Giraffe Populations on Group Ranches and Conservancies

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Summary

The future of wildlife conservation depends on today's youth. The inaugural Kids Twiga Tally served to bolster the knowledge of, and enthusiasm about environmental conservation among the children of Laikipia County, Kenya. Children from various schools assisted in photographing reticulated giraffes in 2 different separate and distinct locations. Those locations were Mpala wildlife conservancy, as well as the group ranches of Kijabe and Imotiok. The goal was to determine the population densities of giraffes, based on sex ratios and age structures. The study aimed to determine the area(s) that giraffes thrive the most, on group ranches, or conservancies.

At the outset of the study we made 2 predictions, the first prediction was that a higher density and quality of trees on conservancies will support more giraffes, and the second was that more infants and juveniles will be found on group ranches because of lower predator pressure. Both of these predictions proved to be correct.

The census conducted estimates from a sight-resight analysis over two consecutive days, using Image Based Ecological Information System (IBEIS) software that there are 9.5 giraffes/km^2 on the conservancy, and 2.0 giraffes/km^2 on the group ranches. In order to determine why that might be, we looked at the vegetation in the areas in which the study took place. Conservancies had a significantly higher density of trees, as well as significantly greener trees. We also found through lion tracking data that there are far fewer lions in the area that roam onto the group ranches than are present on the conservancy.

On the first day, (the day of the Kids Twiga Tally), over 70 schoolchildren, from 8 different schools, which consisted of both urban and rural institutions. There was a total of 1,339 photos taken and analyzed using the IBEIS software. Once data was collected, it was analyzed using IBEIS to determine how many "unique" individual giraffes were photographed over the two days, versus how many re-sightings of giraffes there were from day 1 to day 2. This data will help to estimate the number of giraffes within Laikipia County, and perhaps serve as a guide to estimating the number of reticulated giraffes within all of Kenya.

Introduction

The first ever Kids Twiga Tally promoted the importance of conservation and need for community involvement to preserve the animals that call the Kenyan landscape home. The reticulated giraffe was utilized to illustrate the need for conservation because it is an ideal indicator species. The presence or absence of giraffes can tell biologists a lot about the state of a given landscape. The population numbers of giraffes in a particular area can indicate what the status of the vegetation (specifically trees) is, what the access to water is like, what the risk of predation to other wildlife and livestock is, and the overall level of risk to the environment from human disturbance. With the assistance of local schoolchildren, we set out to answer the question, "Are giraffe populations higher on wildlife conservancies or group ranches, and why?"

We teamed up with local schoolchildren to survey the populations of giraffes on conservancies and group ranches in Laikipia County, Kenya to better understand the impacts that giraffes have on the environment, and the impact that human disturbance has

on the presence of giraffes. Schoolchildren play a pivotal role in determining the future for wildlife and wild lands. The children were encouraged to act as "citizen scientists," and open their minds to the importance of the world around them, with a particular emphasis on conservation. At the start of day 1, when the question of "Who wants to be a scientist?" was posed to the children, only five raised their hands. However, by the morning of day 2, when that same question was posed again, and after seeing and understanding the impact they can have through collecting and analyzing real scientific data, every child raised their hand. The involvement of children through citizen science is crucial for helping them understand the impact that they can have on the world around them now, and in the future.

The children were given cameras fitted with GPS tracking capabilities to photograph giraffes and record where the photos were taken. They split into groups and were sent along with teachers and undergraduate students from Princeton and Columbia Universities to 2 different locations. Of the 2 locations, Mpala is wildlife conservancy, and Kijabe and Imotiok are group ranch areas. The children were asked to observe and record (through their pictures) what they saw at the 2 different locations, and then help to compare the differences between what they saw on a conservancy versus a group ranch. The photos taken were then to be entered into the Image Based Ecological Information System (IBEIS) software to determine how many unique individual giraffes were captured in photographs, and then how many of those were recaptured by the team of undergraduate students the following day.

IBEIS software is a program designed to recognize individual animals such as zebras and giraffes by their unique patterns. It has the ability to match photos of individual animals input into the system with existing photos of the same animal in the database. This system, which was demonstrated to the children, completes the practice of matching individual animals in a fraction of the time that it would take using nothing more than the naked eye. This also assists biologists in learning about the range of different animals, the type of habitats that they are most likely to be found in, and more.

The study also looked at the vegetation in the 2 different habitats in order to determine if it will have an impact on the composition of males, females and juveniles, as well as the level of predators. Tree height, tree density, and tree quality (amount of green on the trees) was measured. Tree height could potentially have an affect on the composition of males and females, as males tend to feed with their heads at a 180-degree angle, while females feed with their heads at a 135-degree angle, thus males would prefer taller trees. Tree quality could also play a key role in the amount of lactating mothers with offspring present in a given area. Mothers have to decide if feeding in an area where trees are more sparse but predators are less dense is best, or if feeding where there is an abundance of high quality trees but a higher numbers of predators is more feasible.

Predictions

1. A higher density and quality of trees on conservancies will support more giraffes.

2. There will be more infants and juveniles found on group ranches because of lower predator pressure.

Methods

This population study of giraffes was conducted over a 2-day period. On day 1, children from local schools, their teachers, as well as undergraduate students and adults were provided GPS enabled digital cameras and split up into groups to photograph giraffes in 2 different areas. The 2 areas were Mpala wildlife conservancy, as well as the group ranches of Kijabe and I
motiok. The goal on day 1 was to photograph as many giraffes as possible. Those photos would then be compared to photos taken on day 2.

On day 2 the undergraduate students from Princeton and Columbia Universities set out to cover the same ground that was covered on day 1. The goal was again to photograph as many giraffes as possible. Once all the photographs were collected, they were then uploaded to a computer and sorted through to filter out any unusable photos. Unusable photos were those that would not be analyzable by IBEIS software. The photos were then uploaded to IBEIS and meticulously sorted through to determine all the unique individuals and all those individuals that were sighted multiple times. We then compared the photos taken on day 1, against the photos taken on day 2. The photos were then sorted through to see how many individuals that were photographed on day 1 were also photographed on day 2, as well as how many individuals that were photographed on day 1 were not photographed on day 2 and vice versa. By doing this, and separating the results for each of the 2 separate areas that were looked at, we can estimate population levels in each area, and determine what areas are the most ideal for giraffe populations.

In order to test the quality of the 2 different environments (a conservancy versus a group ranch), we analyzed photos to determine how many trees were within the immediate area of a giraffe. We then looked at height, and categorized the trees as being taller than the giraffe, chest high on the giraffe, or below chest high. We then looked at the trees in each photo to determine whether there were a high percentage of green leaves on the trees within the immediate area.

Results

On the first day of data collection, (the day of the Kids Twiga Tally), over 70 schoolchildren, from 8 different schools, which consisted of both urban and rural institutions. There was a total of 1,337 photos taken and analyzed using the IBEIS software. After computing the data retrieved over the 2-day period, and running all photos collected through IBEIS, it was determined that there were 39 unique individual giraffes photographed at the conservancy on day 1, and 89 on day 2. Only 9 giraffes photographed on day 1 were re-photographed at the conservancy on day 2. Between day 1 and day 2, there was approximately 39.52 km^2 of land surveyed on the conservancy. This led to a mean estimate of 376 giraffes on the conservancy, with a standard deviation of ± 178. We determined that the estimated density of giraffes found on conservancies is 9.5 giraffes/km^2.

After computing the data for the group ranches, there were 20 unique individuals photographed on day 1, and 28 at the group ranches on day 2. There were 7 giraffes photographed on day 1 that were then re-photographed on day 2. Between day 1 and day 2, there was approximately 40.0 km^2 of land surveyed on the conservancy. This led to a

mean estimate of 80 giraffes on the group ranches, with a standard deviation of ± 35. We determined that the estimated density of giraffes found on group ranches is 2.0 giraffes/km^2.

Based on the data collected, there are approximately 5 times more giraffes estimated to be living on the conservancy than on the group ranches. Although there is a significantly higher number of giraffes on the conservancy overall, it was found that 43.9% of the giraffes on the group ranches are juveniles and infants, whereas only 23.7% of the population on the conservancy were juveniles or infants. When we looked at why this could be, one reason considered was that there is a lower risk of predation on group ranches. We looked at the most recent data on 19 collared lions in the region, which was provided by http://africanlion.cisr.ucsc.edu, and we found that there was only 1 out the 19 collared lions that ventured onto the group ranches in the last month in the last month. It should also be noted that during the time the data was collected she was tracked in the northern section of Mpala conservancy.

We then conducted a Fisher's Exact Test comparing the percentage of males to the percentage of females on both the conservancy and the group ranches. We found no significant result (p value = .4708) (Figure 1).

We also conducted a Chi-Square test (Figure 2) comparing Adults to Juveniles and Infants on the conservancy as well as the group ranch, and we found that there was a significant difference in the number of observed juveniles and infants on the group ranch when compared to the expected (there was a p value < 0.05)

After calculating the number of trees within the immediate area of giraffes in both the conservancy and the group ranches, we found that there was no significant difference in tree height between the two areas (Figure 3). However, there was a significant difference in the tree density (Figure 4), as well as quality of trees in the two areas (Figure 5).

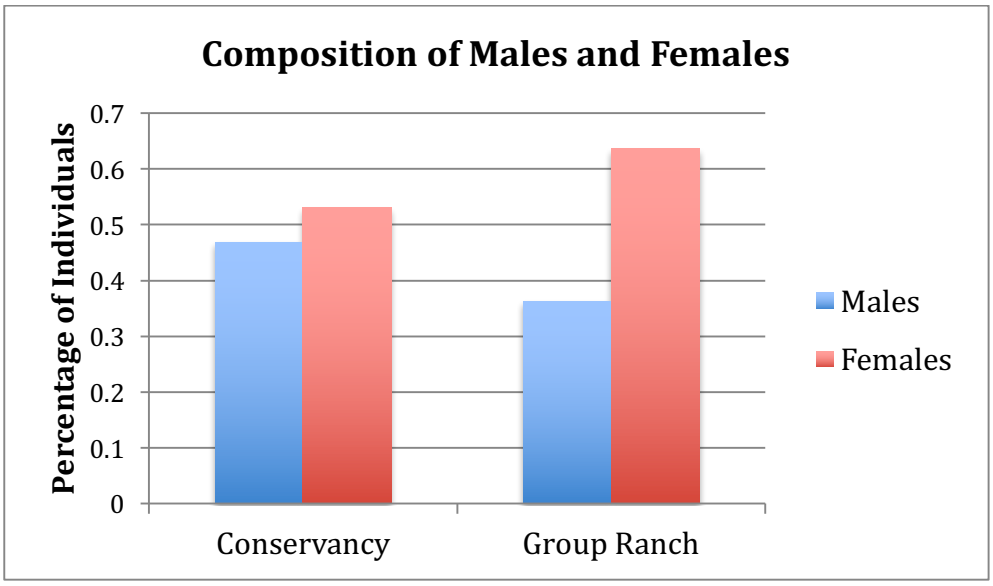

Figure 1. The results of a Fisher's Exact Test comparing the percentage of males to the percentage of females on both the conservancy and the group ranches showed no significant result (p value = .4708)

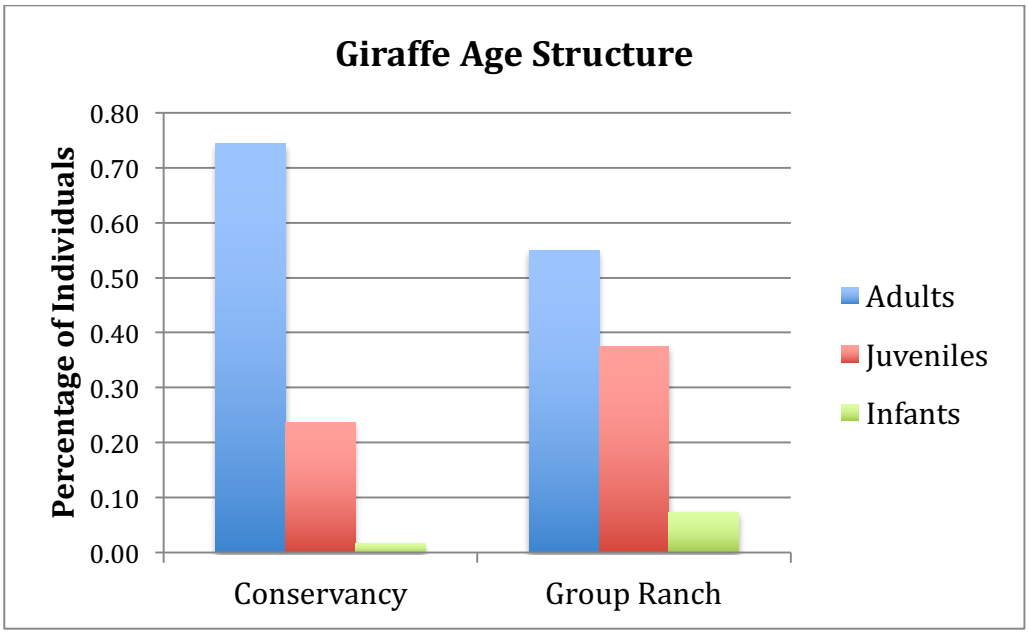

Figure 2. A Chi-Square test showed that there was a significant difference between the observed number of juveniles and infants on group ranches, and the expected number (p value < 0.05)

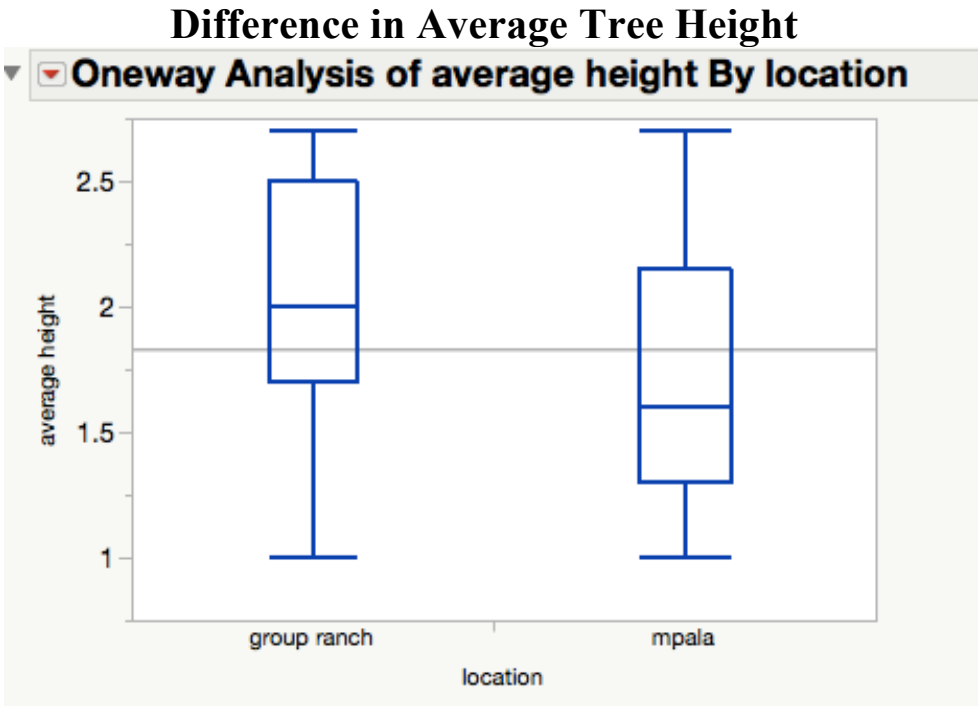

Figure 3. We found no significant difference in tree height between the two locations. There was a mean of 1.83 tall trees per between the two locations. The mean for group ranches was 2.0 with a standard error of 0.12, while the mean for Mpala was 1.7, with a standard error of 0.11. t Ratio = 1.84

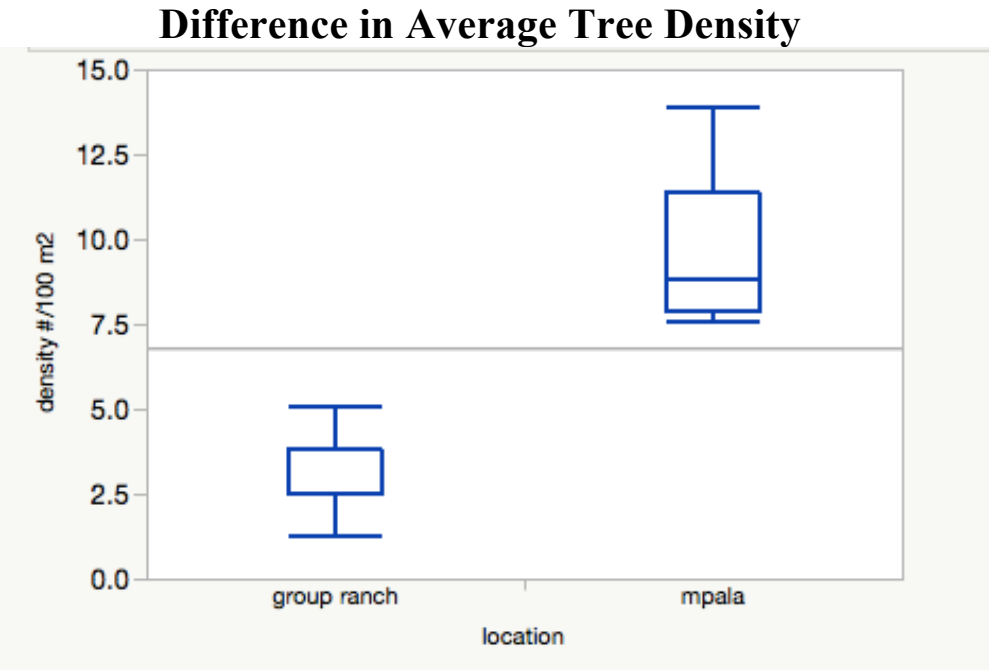

Figure 4. We found a highly significant difference in tree density between the two locations. The mean for group ranches was 3.6 with a standard error of 0.37, while the mean for Mpala was 9.8, with a standard error of 0.36. Probability > t = <.0001

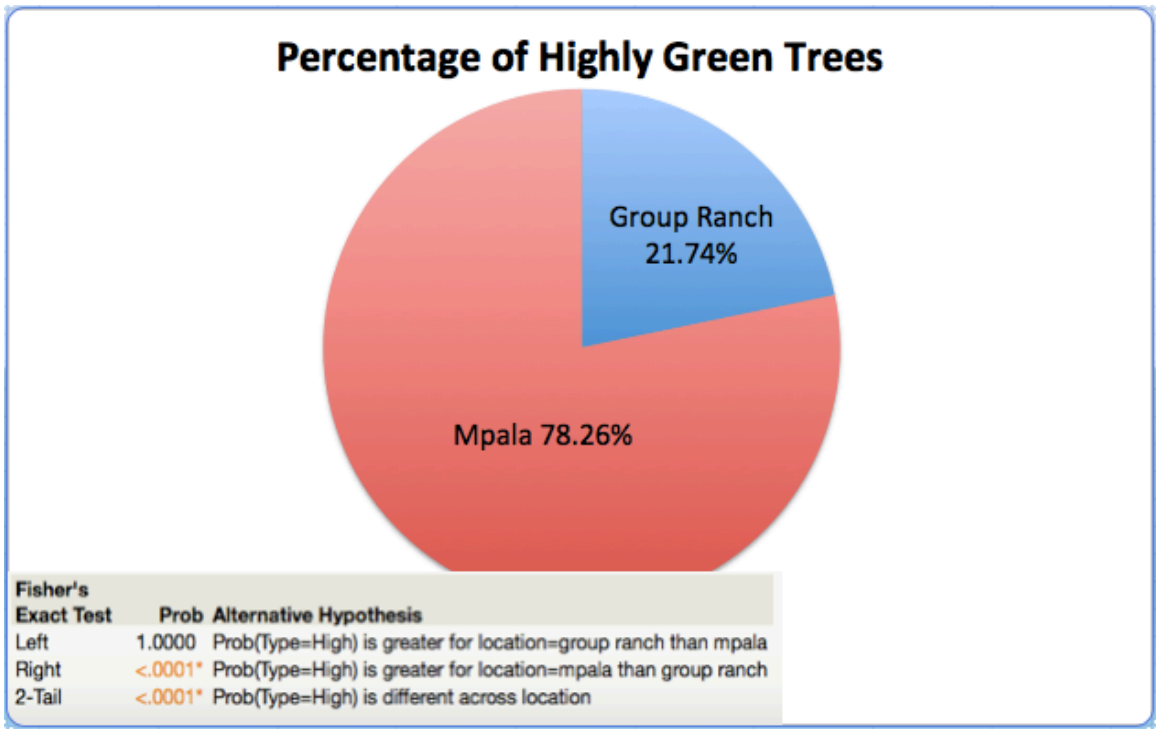

Figure 5. We found a highly significant difference in tree quality (amount of greenness) between the two locations. Probability > t = <.0001

Discussion

The results of this study have multiple biological implications. It appears that the lack of trees, other vegetation, and water on group ranches may play a significant role in the numbers of giraffes that are able subsist on that landscape. We had predicted that due to human disturbance and overgrazing of the land by livestock (livestock which also consumes much of the only water that is accessible to wildlife), that there would be far fewer giraffes found on group ranches than on conservancies; this prediction was proven to be accurate.

The overuse of land by pastoralists for their livestock has had detrimental affects on wildlife. Due to overgrazing, as well as trees being harvested to produce charcoal, the land has been laid to waste, and left giraffes with few resources needed to survive. As browsers, giraffes rely on trees as their main source of food. This would explain why lands such as conservancies, which have very minimal human disturbance, and a higher abundance of trees, have exponentially higher numbers of giraffes found on them.

If pastoralist communities and group ranches wanted to see an increase in the number of giraffes found on their lands, they could do so by making a few key changes. The first change would be to conserve the trees that are currently found on their land, as well as planting additional ones. Furthermore, by controlling where cattle graze, and not allowing cattle to graze freely, they could control overgrazing of vast areas. Finally, by limiting and organizing access to water, and avoiding a tragedy of the commons, whereby each rancher tries to stretch the availability of resources for their livestock to the limits of sustainability and beyond, there will be water available for both the livestock and wildlife such as giraffes. Because giraffes receive much of their required water intake from the leaves they eat, conserving enough water to meet their requirements should be easier than for many other animal species. Additionally, we found no significant difference between tree heights in the two areas, however, there was a significant difference in the tree density and quality. While both the conservancy and the group ranches had a similar number of tall trees for giraffes to feed upon, the majority of the trees (roughly 80 percent) on the group ranches were either dead or dying. If the trees in a given area are bare, the height will not make a difference, which is certainly a contributing factor to the small number of giraffes found on the group ranches compared to those observed on the conservancy.

Our second prediction, which was that there would be more mothers with juveniles and infants found on the group ranches, was proven to be accurate, most likely due to reduced predator pressure on group ranches. Our prediction was proven to be correct, we found that 43% of the giraffe population on the group ranches was comprised of juveniles and infants, while only 24% of the giraffe population at the conservancy was juveniles and infants. It appears that mothers may be more concerned with predation of their offspring than having the necessary resources required for growth and proper nutrition. Predators are often deterred by the presence of humans, and in this instance, by ranchers and herders who are tending to their livestock, which is generally the sole source of income in pastoralist communities. Although it was found that there is significantly higher quality and density of trees at the conservancy, the risk of predation is higher, and therefore mothers may be more inclined to raise their offspring in an area where that risk

is minimized, even if that means a potential lack of food and water. The issue still remains however, that if you don't have enough food and water to subsist, than you and your offspring may not survive. Therefore, it may be more astute to go where you know you have the resources you need, even if that means there is chance of a predator killing your offspring. While there are less predators found on group ranches, the issue of environmental degradation through overgrazing, tree harvesting, and other potential affects that may stem from the human disturbance still remain.

Conclusion

An increase in environmentally sustainable practices by pastoralist communities on group ranches has the potential to have a profound impact on wildlife conservation in Kenya. The implementation of more controlled methods for livestock grazing and watering, coupled with a decrease in tree degradation, will not only attract more giraffes to the ranchlands, but grazing herbivores as well. These grazing herbivores, which act as environmental lawnmowers, can improve the health of the grass by grazing it down lower than cattle can, allowing for more sun and moisture to reach the ground and thus spurring the growth of more nutritious grasses, which can then be consumed by grazing cattle. Furthermore, improved methods to bolster conservation will allow animals with large home ranges, such as giraffes, to travel outside of conservancies for food.

In addition to habitat degradation for giraffes and other herbivores on group ranches, the fact that there are more juveniles and infants per population on the group ranches enables us to infer what the level of predators in that area is like. The level of predators would be lower on group ranches, not only due to a lack of resources, but also because of human presence. These were all important scientific lessons to share with the children that assisted with data collection

Through assisting in hands on data collection, and getting a first-hand look at how science functions, children can act as "citizen scientists." They can aid in the promotion of conservation and more environmentally sustainable practices. This is paramount if we wish to preserve the wildlife in Kenya and beyond for future generations. By inspiring children to want to take part in biological research, and showing them that they can make a difference, some may develop a passion for science and decide to pursue that passion towards a career in environmental biology and conservation. If we do not stimulate a desire to conserve in the youth today, there may be little left to conserve in the future.