Planned Grazing in Lewa Conservancy: Can Livestock Enhance Wildlife Conservation?

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Introduction

Planned Grazing

Cattle production and conservation were long thought to be mutually incompatible goals as it was assumed cows and wildlife both compete for common resources. However, recent research into planned grazing schemes have shown that cattle grazing, if done properly, can actually benefit wildlife.

Lewa has implemented a planned grazing scheme with two components: (1) Rotation and (2) "Bunching." Rotating cattle between plots of land prevents overgrazing and ensures that some vegetation lies fallow. Bunching cattle inhibits their selectivity and ensures that they consume good quality and low quality vegetation alike.

Planned grazing schemes with bunched and rotational components have three aims:

1. Improve Rangeland (vegetation quality/quantity)
2. Improve Wildlife Usage
3. Improve Livestock Production

Theoretical Ecological Cascade Effect

Ideally, rotational bunched grazing can positively impact vegetation, and, in turn, benefit wildlife. Studies show that, to a certain extent, grazing grass promotes faster regrowth and opens up low-lying vegetation to sunlight. Increased access to nutritious, low-lying plants attracts a diversity of wildlife, particularly small to mid- sized animals with mixed diets that rely on nutrient dense vegetation (See Figure 1 below for cascade diagram).

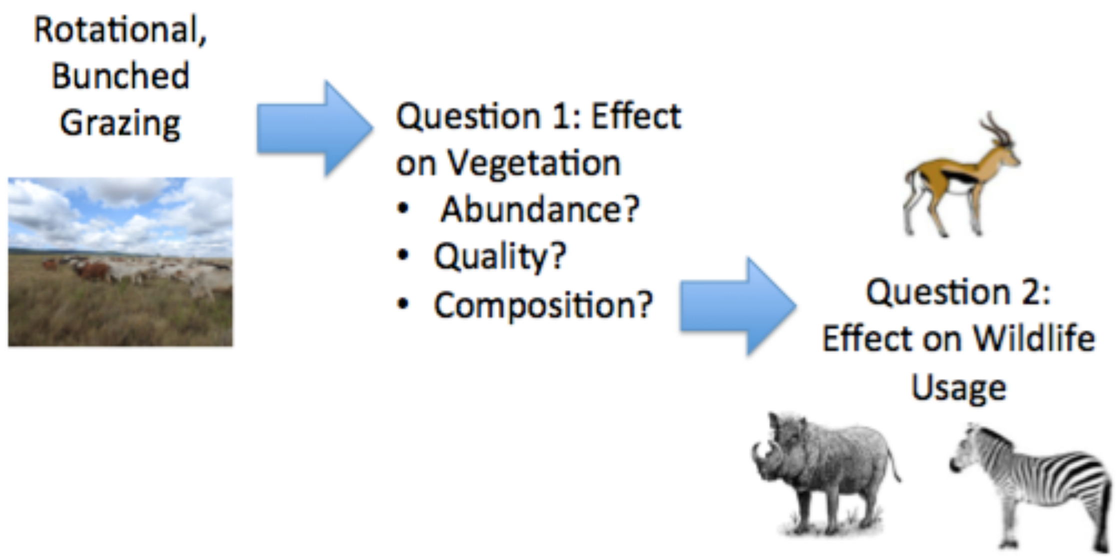


Figure 1. Planned Grazing: Ecological Cascade Effect.

Predictions

Based on ecological theory, we predict the following effects:

Hypothesis 1: Planned grazing will affect vegetation abundance, quality, and composition

Hypothesis 2: Planned grazing will affect the species, numbers, and guilds of wildlife on the landscape

Methods

Measurements

To address our first question on vegetation effects, we examined abundance, quality, and composition in various sites with the pin-drop method. This test involved dropping a pin every meter along a 25 meter transect and observing what touches the pin and recording the height of vegetation at each drop. We collected data on two transects at each site. To estimate biomass abundance we measured the height of vegetation at each site using a meter stick. We also computed hits per pin (number of plant parts in contact with the pin at each drop, averaged across all transects), which reflects vegetation density.

To assess nutritional quality of vegetation, we used two proxy values—% green and % leaf. Respectively, these represent the percentage of pin hits that were green relative to brown and that were leaves relative to stems. Green vegetation is highly digestible and leaves offer more nutrition than other parts of the plant. We also

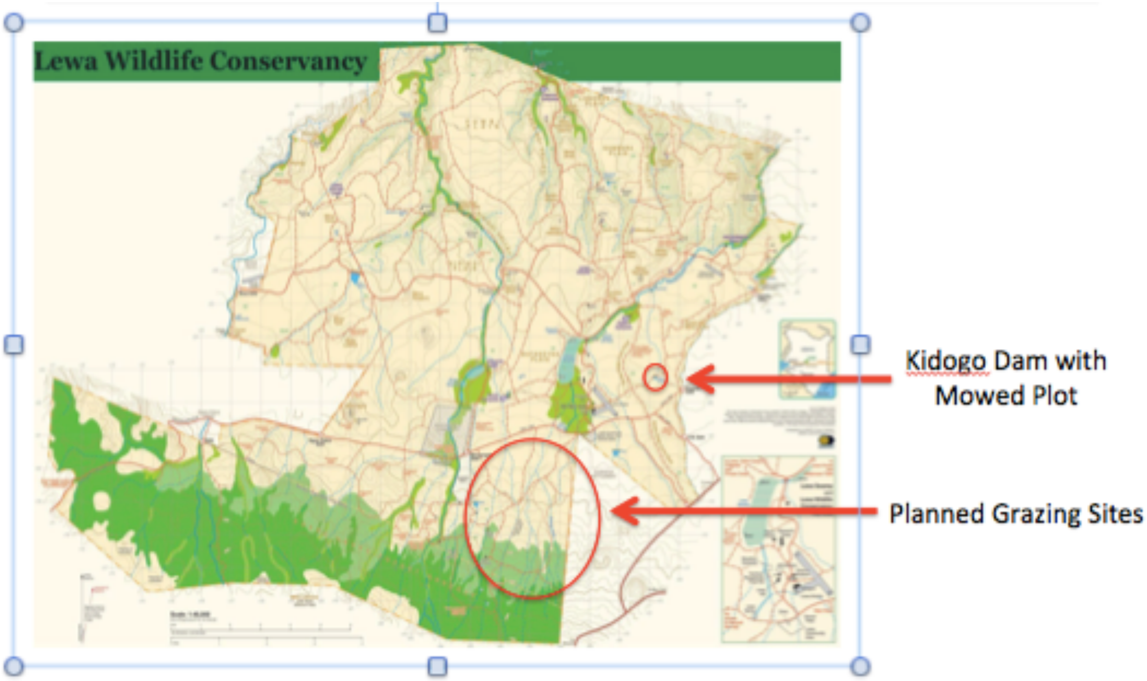
examined composition of vegetation by calculating % forbs as compared to grass (% of pins that hit forbs per plot).

To address our second question regarding the impact of planned grazing on wildlife we used three different methods. We observed animals at various sites to get a sense of the number, species, and guilds of wildlife that occupy various locations. To obtain 24-hour, instantaneous surveillance we set up Reconyx camera traps that detect wildlife movement. In addition, we conducted dung counts to obtain more long-term information on wildlife use of the land. We surveyed .2 hectare (2000 m^2) for wildlife dung at each site.

Figure 2. Camera Trap Photographs of Plain Zebra and Grant's Gazelles.

Comparisons

To gauge the effect of planned grazing at Lewa, we examined 2 different planned grazing plots. One plot was grazed Dec 26th through Jan 2nd, while the other was grazed more recently, from February 24th through March 2nd. We chose plots that were grazed at different times to see how the effects of planned grazing change over time. As a baseline comparison, we also examined two ungrazed plots (See Appendix for GPS locations of study sites). These plots were determined to be comparable in topography and tree cover in order to control for other variables that might affect wildlife distribution. Due to the close proximity of control and grazed plots, we assume that animals' movement to one plot type over the other is only influenced by difference in how grazing affected vegetation (See Figure 3).



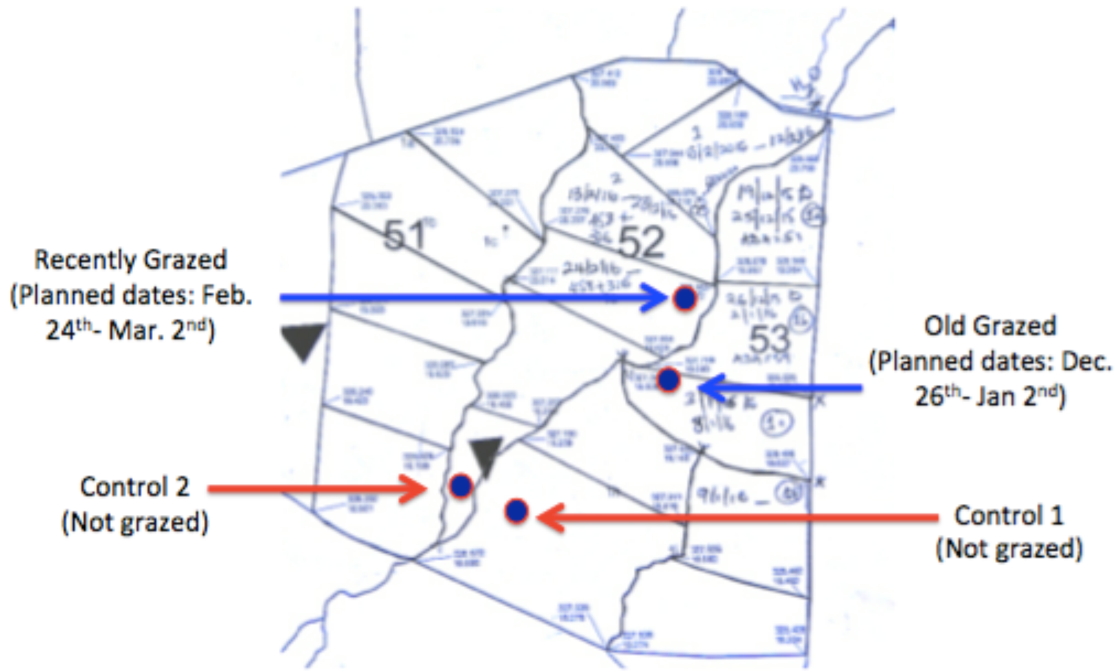


Figure 3. Maps of Planned Grazing Sites and Control Sites within Lewa Conservancy.

Findings

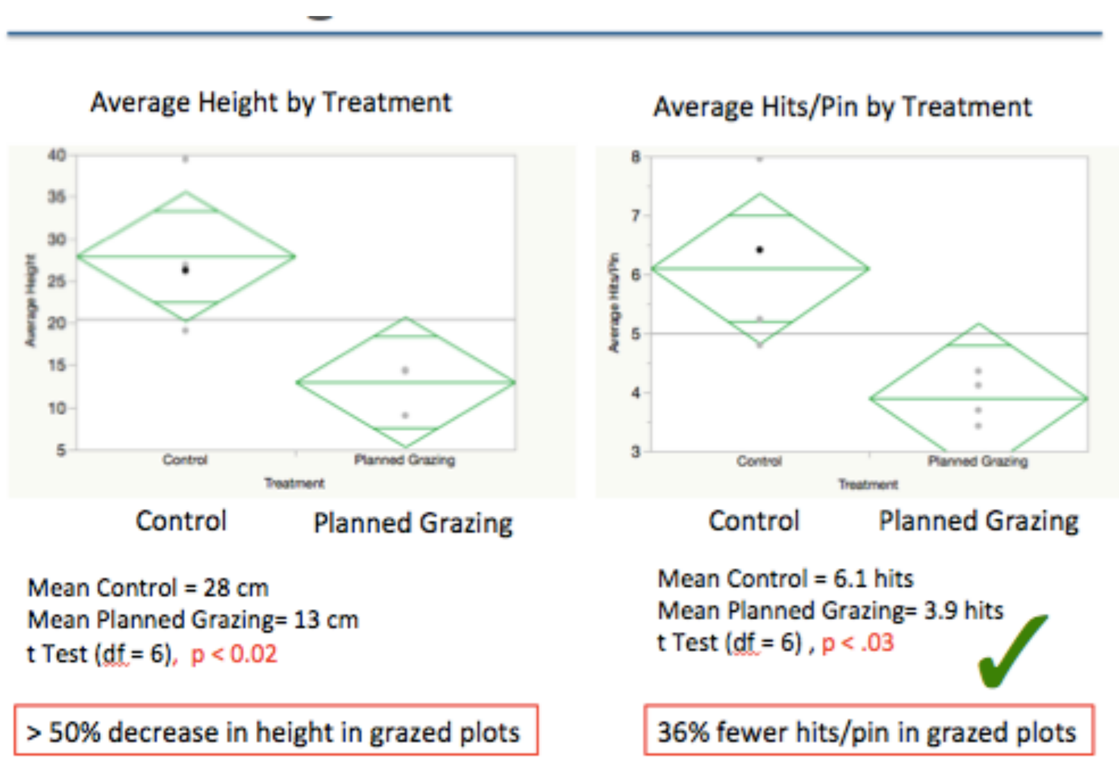
Question 1: Effect of Planned Grazing on Vegetation

First, we compared both control sites against both grazed sites, regardless of how recently the grass was grazed, to see how grazing impacts vegetation. Vegetation height and hits per pin are both indicator variables for biomass density (See Figure 4).

Biomass was measured by averaged heights of vegetation at pin drops and average hits/pin. As expected, there is less biomass in planned graze plots—about 50% decrease. In the United States, some integrated schemes set a 30% vegetation height remainder as the benchmark for "move out" height. In other words, when biomass has decreased 70%, cows should be rotated. This suggests that, at Lewa, cows can be left in plots for longer to maximize livestock productivity, without harming the land.

Figure 4. Biomass Comparison between Control and Planned Grazing Sites.

Cutting biomass back can stimulate faster regrowth, given sufficient rainfall. It might seem that a decrease in total vegetation would reduce food available for wildlife, but this is not necessarily true. A decrease in vegetation height might reduce total available biomass in the short-term. However, cutting back biomass, especially overgrown, "rank" grass allows low-lying vegetation to flourish. This attracts certain wildlife (browsers, mixed feeders), who then have access to nutritious low-lying vegetation.



Vegetation Quality

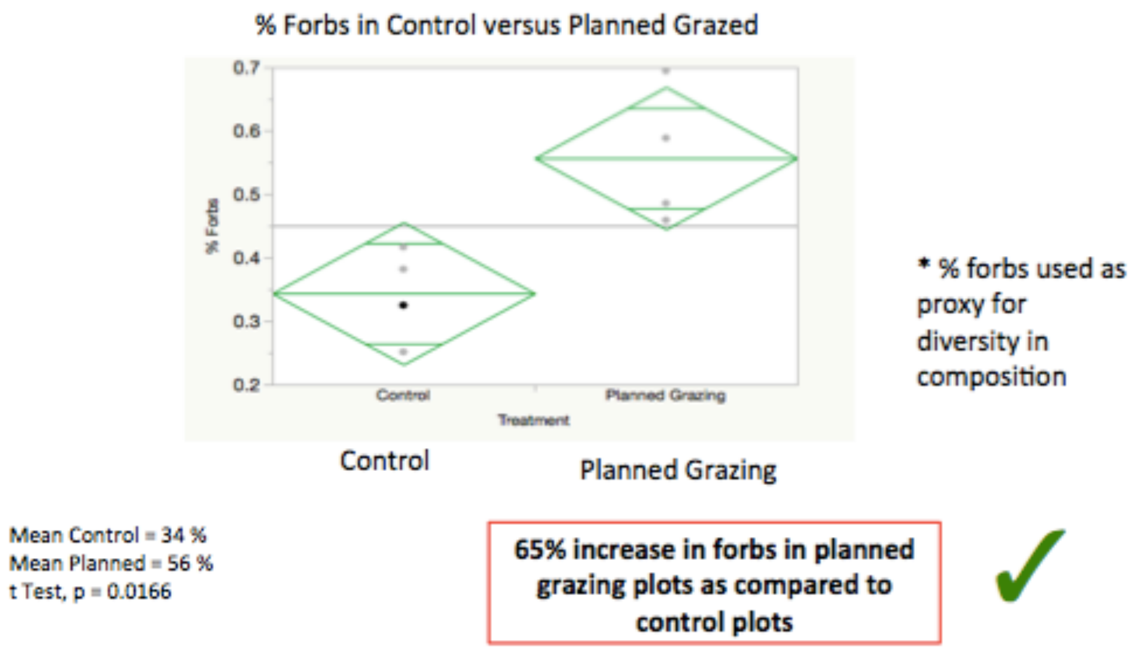
To determine how planned grazing affects vegetation quality, we used the indicator variables of % green and % leaf. When we dropped our pin, we measured the percentage of hits that were green, using "greenness" of vegetation as a proxy for digestibility. Furthermore, we measured the percentage of pin hits that were leaves. % leaves gives an indication of how nutritious the available plant matter is for wildlife, as leaves are more nutritious than stems.

There was no significant change in quality, as measured by % green and %leaf. Therefore, planned grazing has not had an immediate effect on the vegetation quality. In the long-term, with rainfall, we would expect that the initial reduction in biomass (especially of old growth which is low in nutrient quality and high in indigestible fiber) would stimulate new growth, which may be greener and of higher nutritional value.

Vegetation Composition

To compare vegetation composition between grazed and control plots, we used % forbs as an indicator variable for diversity. (This statistic represents the nu5mber of forbs relative to grasses from pin-drop analysis.) Notably, there was a stastisitcally significant increase in forb abundance between control and grazed plots (65% increase in forbs) (See Figure 5). Forbs are important in meeting the nutritional needs of wildlife with mixed diets.

Figure 5. Quality Comparison as Indicated by Percent Forbs.



On What Time Scale Do the Effects of Planned Grazing Operate?

Next, we wanted to compare these significant findings between an older grazed site and a more recently grazed site, to see how quickly planned grazing effects change. Because we only had 2 sites, and 2 transects per site (limited sample size and timeframe) we can't compute statistical tests. However, we established a rule of thumb, whereby a 10% difference in means suggests change might be happening (See Figure 6).

Figure 6. Time Comparison in Vegetation Impacts.

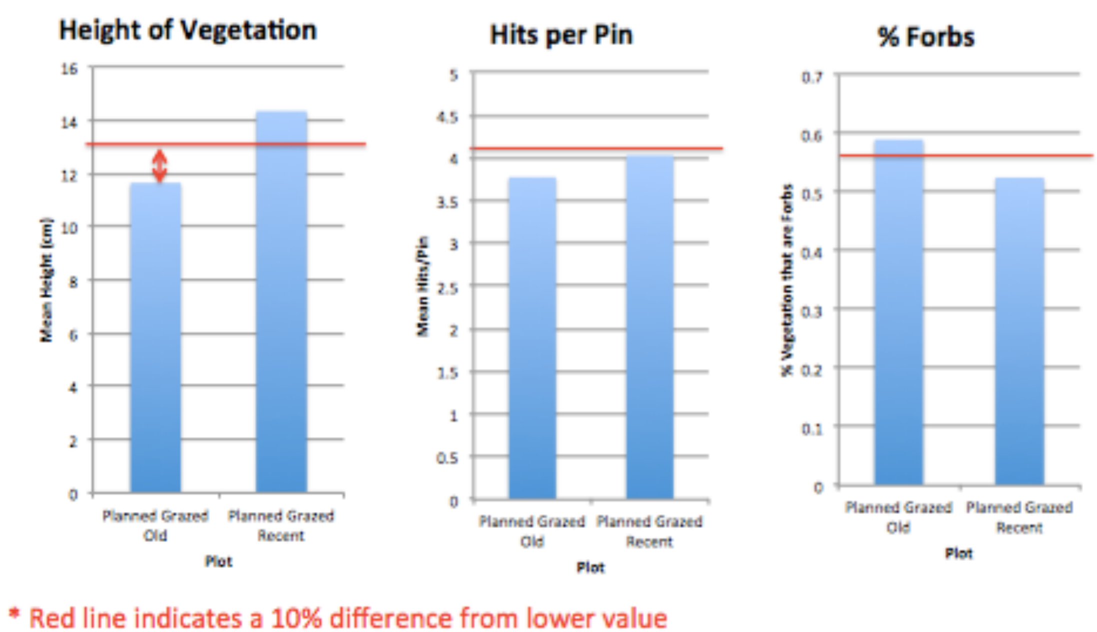
There is a > 10% increase in vegetation height between old and recently grazed plots (23% higher vegetation at recent site). There were 10% more forbs in old grazed site—likely total biomass was reduced in both plots allowing forbs to flourish in greater sun exposure. At first, it may seem surprising that there is more biomass at recently grazed sites. However, there are two possible mitigating factors:

1. Livestock may be leaving recently plots earlier

2. Wildlife grazing at old grazed sites has kept average vegetation

height down

To better understand the time scale of planned grazing effects, there should be assessment measurements such as a productivity cage. A productivity cage is a device that can be place over vegetation after cows have grazed a plot. It will prevent wildlife from grazing beneath the cage and thus serves as a baseline comparison of vegetation growth pre-wildlife interactions.



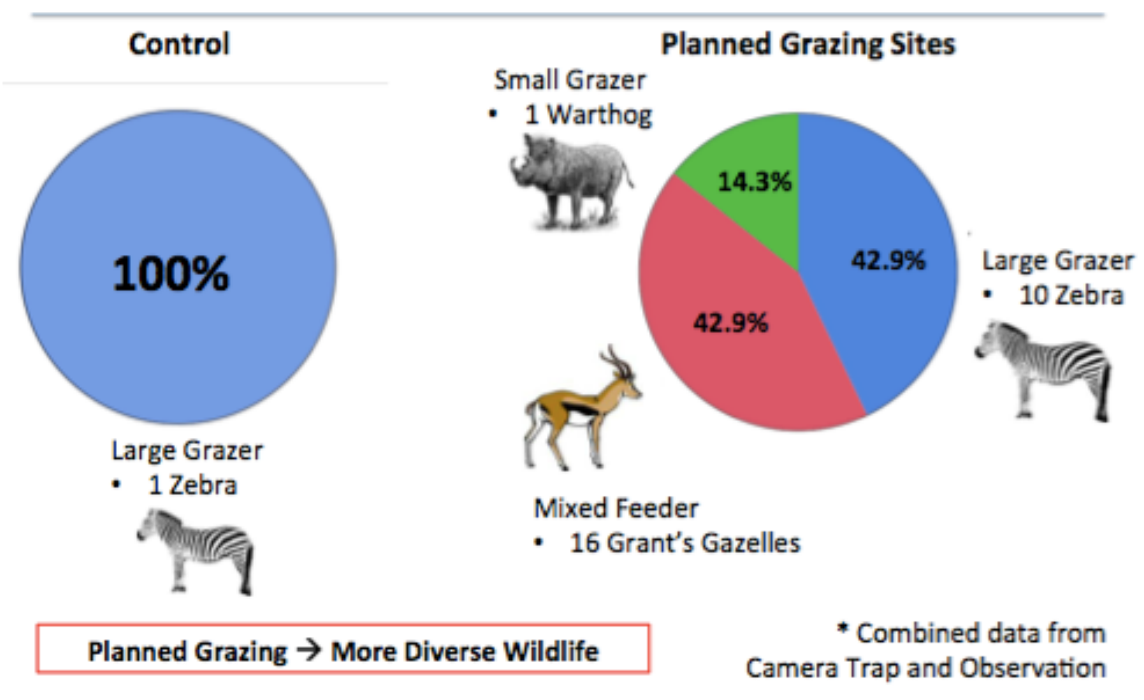
Question 2: How has Planned Grazing Influenced Wildlife at Lewa?

Our combined data from camera traps and observations showed a difference in the numbers and types of wildlife that were drawn to different plots. In the planned site, we saw a greater diversity of wildlife species. We observed larger grazers (zebra), mixed feeders (Grant's gazelles), and small grazers (wart hogs) but only a large grazer (zebra) in the control plots. Small grazers, such as warthogs, can eat grass, but require higher quality grass.

Figure 7. Animal Distribution between Sites.

This distribution is because animals see the landscape differently. Body size determines energy requirements, which determines feeding style. Large grazers, such as zebras, can eat high quantities of lower quality food. Therefore, it makes sense that we saw them in control plots, where grass is abundant, and perhaps lower quality. However, they can also eat grass in the planned grazing sites. Small grazers, such as warthogs, can eat grass, but require higher quality grass. Mixed feeders need more variety and are thus likely attracted by the greater percent forbs in the grazed sites.

We counted dung within a .2 hectares section of each site. We only found recent dung (< 1 week old) in planned grazed sites. We also found more "old" dung within the planned grazed sites. "Old" is still relatively recent (within one month), and grazing scheme began more than one month ago. This shows that even slightly older wildlife dung is more abundant in planned grazed sites. In general, it seems that planned grazed sites support a more wildlife, in addition to a more diverse range of wildlife



Furthermore, the recent dung in planned grazed sites was from Grant's gazelles and zebras. Therefore, our dung counts are in agreement with our camera trap/observational data.

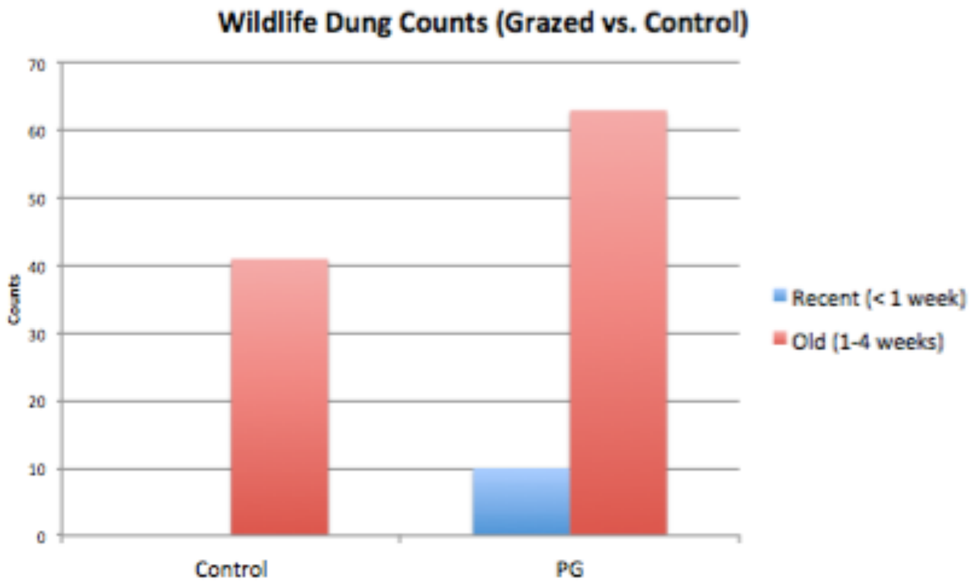
Figure 7. Wildlife Dung Counts.

Current Planned Grazing Practice at Lewa

Regarding our first two questions, we found that wildlife usage of rangeland on planned grazed sites may be affected by the vegetation abundance and composition at these sites. However, in analyzing the effect of planned grazing on vegetation and wildlife usage, we assume an ideal system where cattle are both rotated and bunched, effectively. We have yet to analyze the current state of planned grazing practice, which ultimately determines the extent to which the grazing system can meet its goals (3 way improvement: improved rangeland, improved wildlife, improved livestock production)

We examine the two central components to planned grazing scheme at Lewa: rotation and bunching. As mentioned above, rotation prevents overgrazing, leaving fallow land for wildlife. Studies show that cutting grass (through grazing) stimulates faster regrowth and also up low-lying vegetation to sunlight, thus promoting an increase in vegetation diversity. “Bunching” is also critical as it limits cattle’s freedom to selectively choose what they eat. Ideally when bunched, movement is restricted, so that they indiscriminately eat good and poor quality vegetation alike.

We observed that both rotation and bunching methods may not be reaching their full potential to meet Lewa’s goals. We saw a discrepancy between the grazing rotation schedule and actual locations of herds. Furthermore, we saw that planned grazing herds were not always as bunched as would be ideal to maximize vegetation improvements.



Measuring Cattle Bunching

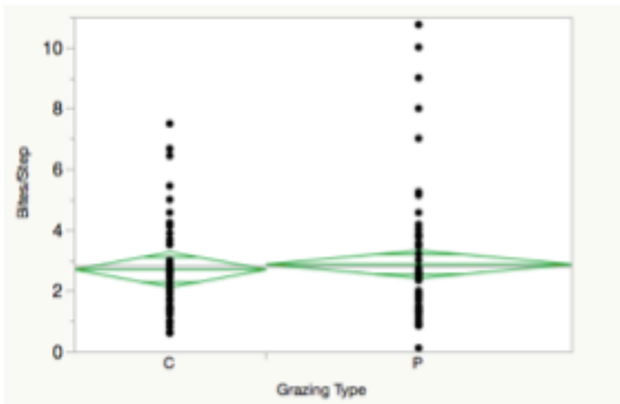
We sought to quantify the effectiveness of bunching in planned grazing herds. To assess whether planned grazing led to reduced selectivity in the NRT (North Rangeland Trust) planned grazing herds, we compared their grazing patterns to which are allowed to graze on Lewa property in a “business as usual” manner and NRT (North Rangeland Trust) planned grazing herds selectivity. We use community herds as a baseline of comparison because they have no specific structured grazing schedule.

In order to assess selectivity, we measured bite/step ratio and compared means between community and planned grazing herds. If cattle’s movement is limited by bunching, we would expect a higher ratio of bites/step in planned grazing herds than in community cows

We counted bites/time and steps/time for three samples of each grazing type and used these values to calculate mean bite/step ratios. For statistical analysis, we grouped data from separate samples to calculate mean bite/step ratio by grazing type (n=48 for community; n=77 planned; Total = 126) (See Figure 8).

1. No difference between bites/second (t = 1.9; p > 0.05; ns; n= 122)
2. No difference between steps/second (t=1.4; p > 0 .15; ns; n=122)
3. No difference in bite/step ratio (t=.2; p > 0.83; ns; n=122)

Comparing Bite/Step Ratio in Planned Grazed Herds and Community Herds



Community Grazing (n=47) Planned Grazing (n = 75)

- **Comparable bite/step rate = similar level of grazing selectivity**
- **Planned grazed herds moving too quickly?**

Figure 8. Cattle "Bunching" as Measured by Bite/Step Ratio. (t=.2; p > 0.83; ns; n=122) Mean C = 2.71, Mean P = 2.88 Removed 1 data point for community grazed cattle and 2 data points for planned grazing points which were extreme outliers

We can see from the spread of the data (Figure 8) in planned grazing herds that, in some instances, bunching might be successful. However, it doesn't seem to be

happening with enough consistency to affect the centrality of the data in such a way that it is different from the baseline (as measured by bite/step in community cows).

Executive Summary

Our data revealed that overall, planned grazing improve rangeland (vegetation). Grazing decreased net biomass, which may increase access to low-lying vegetation for small-animals and increase sunlight exposure to allow new plant growth. We did not observe a change in vegetation quality, perhaps due to limited rainfall at the study sites. While livestock can cut back less nutritious, overgrown vegetation, rainfall allows new shoots to sprout.

We observed a change in vegetation composition as measured by a 65% increase in forb growth between the control and grazed plots. Increase in forb growth attracts animals with mixed diets leading to diversified wildlife usage.

In fact, we observed a correlation between forb growth and wildlife abundance and diversity. Our study found mixed feeders (e.g. Grant's gazelles), small-bodied grazers (e.g. warthogs), and large-bodied grazers (e.g. zebras) at the grazed sites. At control sites we only observed large grazers. Based on our vegetation analysis, it seems that a greater diversity in vegetation (as indicated by % forbs) can support a greater variety of species. Our findings are in agreement with ecological first principles, which purport that wildlife will perceive the landscape differently according to body size and energy requirements.

Our study found positive impacts of planned grazing on vegetation (particularly forb growth) and wildlife usage. However, current planned grazing practices could be further enhanced to better reach Lewa's goals. Rotation may be effective at preventing cattle from overgrazing—although could still be better organized through improved communication. Tight "bunching," a critical component in limiting cattle's grazing selectivity, was not always implemented.

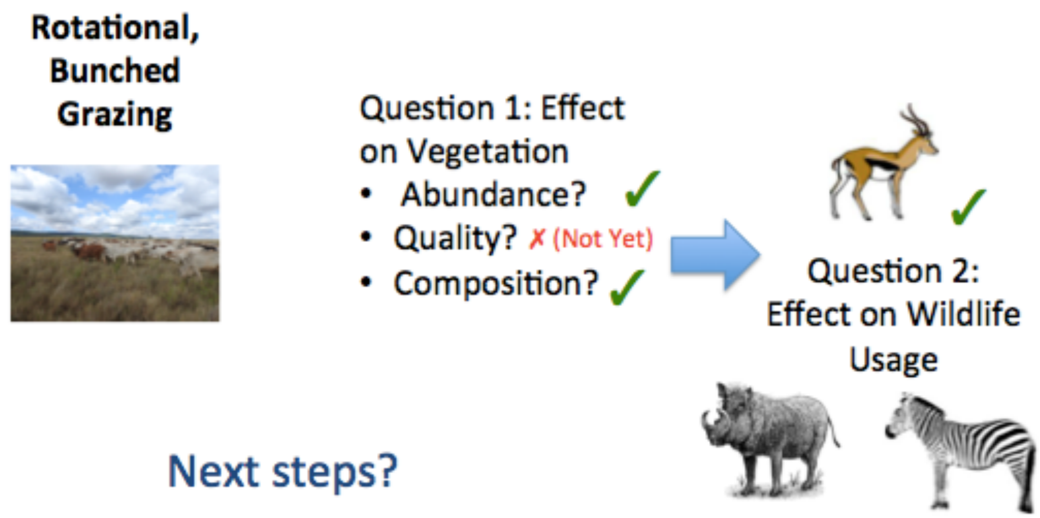


Figure 9. Research Summary.

Recommendations

- Add permanent control plots that remain ungrazed to measure long-term effects of planned grazing at Lewa

- Introduce Productivity Cages： Comparison of productivity and consumption post-grazing

- Improve "bunching"： Ensure that cattle are managed by two herders since there are inherent difficulties in containing large herds

- Adhere to Rotational Schedule

- Improve communication between herders and management. Ensure herders understand in conservation goals in addition to livestock production goals.

Acknowledgements

Dr. Daniel Rubenstein, Jennifer Schieltz, Josphat Mwangi

Finally, special thanks to Lewa Wildlife Conservancy for hosting us and supporting our research.

Appendix

- Planned Grazed Recent: Camera Trap #43 facing north at GPS UTM 37N - EW 0327987, NS 0019957
- Planned Grazed Old: Camera Trap #51 facing South at GPS UTM 37N - EW0327804, NS 0019474
- Control 1: Camera Trap #46 facing South at GPS UTM 37N - EW 0327085, NS0019102
- Control 2: Camera Trap #44 facing north at GPS UTM 37N - EW 0326862, NS 19046