



Sample Count Aerial Surveys as a Monitoring Tool for Wildlife and Livestock: a Case Study from Laikipia County

2012 Report to:

The Laikipia Wildlife Forum

Margaret Kinnaird¹, Tim O'Brien^{1,2} and Gordon Ojwang³

¹Mpala Research Centre, Nanyuki, Kenya

²Wildlife Conservation Society, Bronx, NY, USA

³Department of Resource Survey and Remote Sensing, Nairobi, Kenya



Summary

We use sample based aerial surveys for large African mammals of Laikipia County as a test case for evaluating the approach for inclusion in a long-term monitoring program to be submitted to the Laikipia Wildlife Forum. We conducted dry-season aerial counts of five livestock species and fifteen large wild herbivore species across Laikipia County (9,666 km²) in March, 2012. These data build on an existing database of biannual aerial surveys that extends back to 1981.

In 2012, livestock were 13 times more abundant than wildlife across Laikipia County with sheep and goats outnumbering cattle by 2:1. Livestock and wildlife were unevenly distributed; livestock was concentrated in the south-west and north-west and wildlife was concentrated central portion of the district, in a swath from the south-east to the north-west. Spatial data indicated that large numbers of livestock are having a negative influence on the numbers and distribution of wildlife; 61% of all observation cells (12.5 km²) contained no wildlife.

Laikipia remains rich in wildlife and wildlife numbers are higher than when counts began in 1981. Within the last decade, however, there has been a downward trend in wildlife numbers. Declining wildlife numbers were most prevalent across lands traditionally considered 'wildlife friendly'. Although many factors, including drought, may have contributed to these declines, we believe that increasing human populations, primarily in disputed and abandoned lands, coupled with increasing densities of sheep and goats are having negative effects on wildlife species. We suggest that 'wildlife friendly' properties can no longer sustain losses on surrounding properties that act as 'wildlife sinks'.

The DRSRS bi-annual surveys provide valuable insights for wildlife management throughout Laikipia. As conservation initiatives become more widespread within the county, information on the distribution and abundance of wildlife and livestock is an essential resource for assessing the value of conservation/mitigation activities.

Introduction

Effective wildlife management in human-occupied landscapes requires cooperation and compromise among stakeholders based on information about the abundance and distribution of wildlife and livestock, range quality, and the dynamics of changes in land use. Laikipia County and the Greater Ewaso Ecosystem (Georgiadis 2011) is a human-occupied landscape comprised of private wildlife conservancies and cattle ranches managed by commercial enterprises and traditional pastoralist communities. Although the landscape has only one national park, it is home to the greatest diversity and density of wild ungulates in East Africa outside of the Serengeti-Mara park system.

Conservation efforts across Laikipia have been increasingly successful due to the combined involvement of government, private communities and non-governmental organizations. However, Laikipia still faces enormous challenges – all related to increasing human pressure, unsustainable land use practices, and declining wildlife ranges. These challenges require that we sustain long-term databases and maintain up-to-date information to understand wildlife response to land use changes and to be able to respond in the most appropriate manner.

Since the late 1960s, aerial surveys have been recognized as the most cost-effective technique for counting and monitoring wildlife and livestock numbers over large expanses of savanna and scrub-woodlands (Norton-Griffiths, 1978). Although the government of Kenya began monitoring wildlife throughout the country in the early 1970s, rising costs and shrinking budgets resulted in a decline in the frequency and intensity of monitoring surveys in most of Kenya's rangeland districts. The exception has been Laikipia County and the Greater Ewaso Landscape where the Laikipia Wildlife Forum and the Mpala Research Centre have raised funds to support monitoring since 1997.

In this report, we present the results of the 2012 aerial surveys for Laikipia. We focus primarily on the current abundance and distribution of focal wildlife and livestock species but also report patterns that are emerging over the past 30 years in Laikipia.

Methods

We conducted our aerial surveys during March, at the end of a normal dry season. We used sample methods described by Norton-Griffiths

(1978) at a cell resolution of 2.5 km x 5 km, following the same aerial transects as those flown since the 1980s.

We calculated wildlife and livestock abundances using the Jolly method (1969) for the entire county and for three major land uses: mixed agriculture, pastoral grazing and wildlife (Figure 1). Mixed agriculture refers to sampling units in which crop agriculture, livestock husbandry, and other uses occur and no single land use dominates the sampling unit. The pastoral grazing zone is a combination of group ranches, government lands, abandoned lands, absentee owner lands and other areas used by pastoralist herders. Fenced ranches are also included in this mix because fenced ranches actively exclude wildlife. The remaining ranches are categorized as wildlife areas and include wildlife friendly ranches, conservancies and rhinoceros sanctuaries.

Because of seasonal wildlife movements and the open boundaries of our survey area, our results do not present the entire wildlife picture. For example, elephants are most abundant in Laikipia after the long rains between June and September and during March may move beyond the boundaries of the County and the Greater Ewaso Ecosystem. Also, because even the most highly skilled and experienced observers are not capable of counting every animal, our data represent minimum estimates and are conservative in nature.

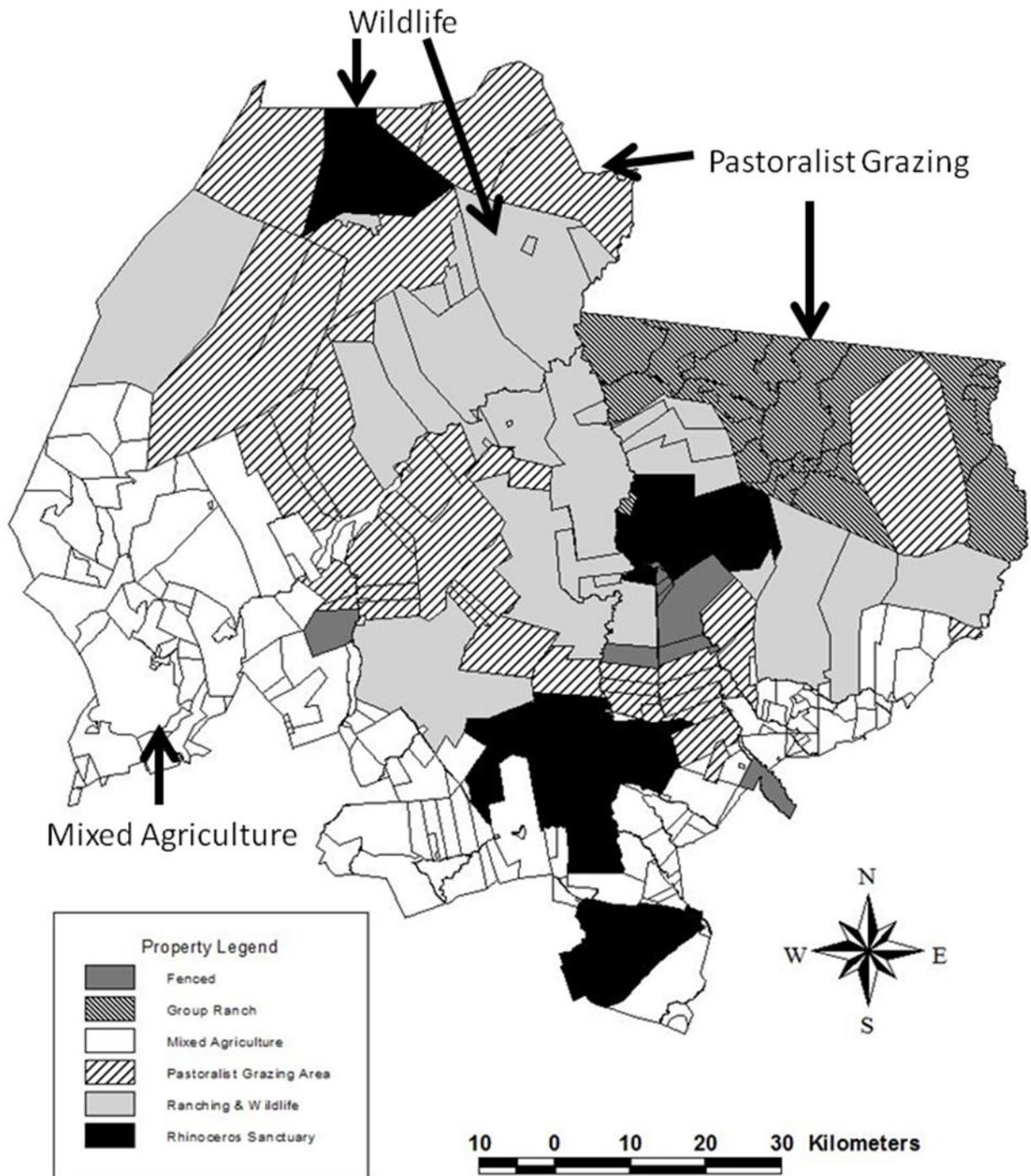
We examined long term trends in livestock and wildlife populations using an index much like a stock exchange that gives equal weight to all species and measures the percent change from initial conditions in 1981 (or any other year of interest as a benchmark). Because using absolute numbers places more emphasis on common species than rare species and makes interpretation of trends difficult, the 'wildlife index' is a more robust approach.

Results

Abundance and Distribution - 2012

Livestock are 13 times more abundant than wildlife across Laikipia County (Table 1). Sheep and goats now outnumber cattle by 2:1 – an observation that has both ecological and socio-economic implications. Sheep and goats tend to be more destructive to ASAL rangelands and their increasing numbers indicate a cultural shift among pastoralists towards a cash economy.

Figure 1. Distribution of land uses across Laikipia.



Burchell's zebra are by far the most numerous wildlife species across Laikipia, as they are in most savanna habitats. Elephants are the next most abundant species even though March is not when large numbers of elephants are found in the county. Impala follow as the next most abundant although their numbers are more than 10 times lower than Burchell's zebras. Buffalo, Eland, Grant's gazelle, and Reticulated giraffe have populations estimated to be in the thousands while the remaining 8 wildlife species populations are estimated to be less than 1000 individuals. Species like Gerenuk and Waterbuck with the fewest observations of all wildlife species are likely to be undercounted with this type of survey because they prefer riverine woodlands and thickets where they can be missed by observers.

Table 1. Population estimates for Laikipia County wildlife and livestock in 2012 and 2001. Also included is the magnitude of change between 2001 and 2012. Changes of 15% are considered within the realm of sampling error.

Species Name	Population Estimate 2012	Standard Error	Population Estimate 2001	% Change
Cattle	149,910	10,791	105,118	42.6%
Donkey	1,454	261	2,496	-41.8%
Sheep & Goats	380,312	26,041	241,867	57.2%
Camel	4,150	1,393	3,697	15.4%
Buffalo	2,071	953	1,684	23.0%
Eland	1,525	461	2,099	-27.3%
Elephant	3,493	750	1,844	89.4%
Grant's Gazelle	1,940	399	9,402	-79.4%
Thomson's Gazelle	687	216	3,918	-82.5%
Gerenuk	88	45	236	-62.5%
Giraffe	1,105	253	1,727	-36.0%
Impala	2,144	454	4,443	-51.7%
Hartebeest	359	141	1,104	-67.4%
Oryx	702	381	446	57.3%
Ostrich	226	68	576	-60.8%
Warthog	374	36	716	-60.5%
Waterbuck	59	123	150	-47.8%
Burchell's Zebra	24,887	5,853	27,544	-9.6%
Grevy's Zebra	614	222	897	-31.5%

Livestock and wildlife were unevenly distributed across Laikipia County during our surveys (Figs 2 and 3). Livestock were concentrated in the south-west where mixed-agriculture is the primary land use and on the group ranches in the north-west (Fig 1). Wildlife showed opposite patterns of distribution with the majority of observations made in the

Figure 2. Distribution of livestock across Laikipia County March 2012.

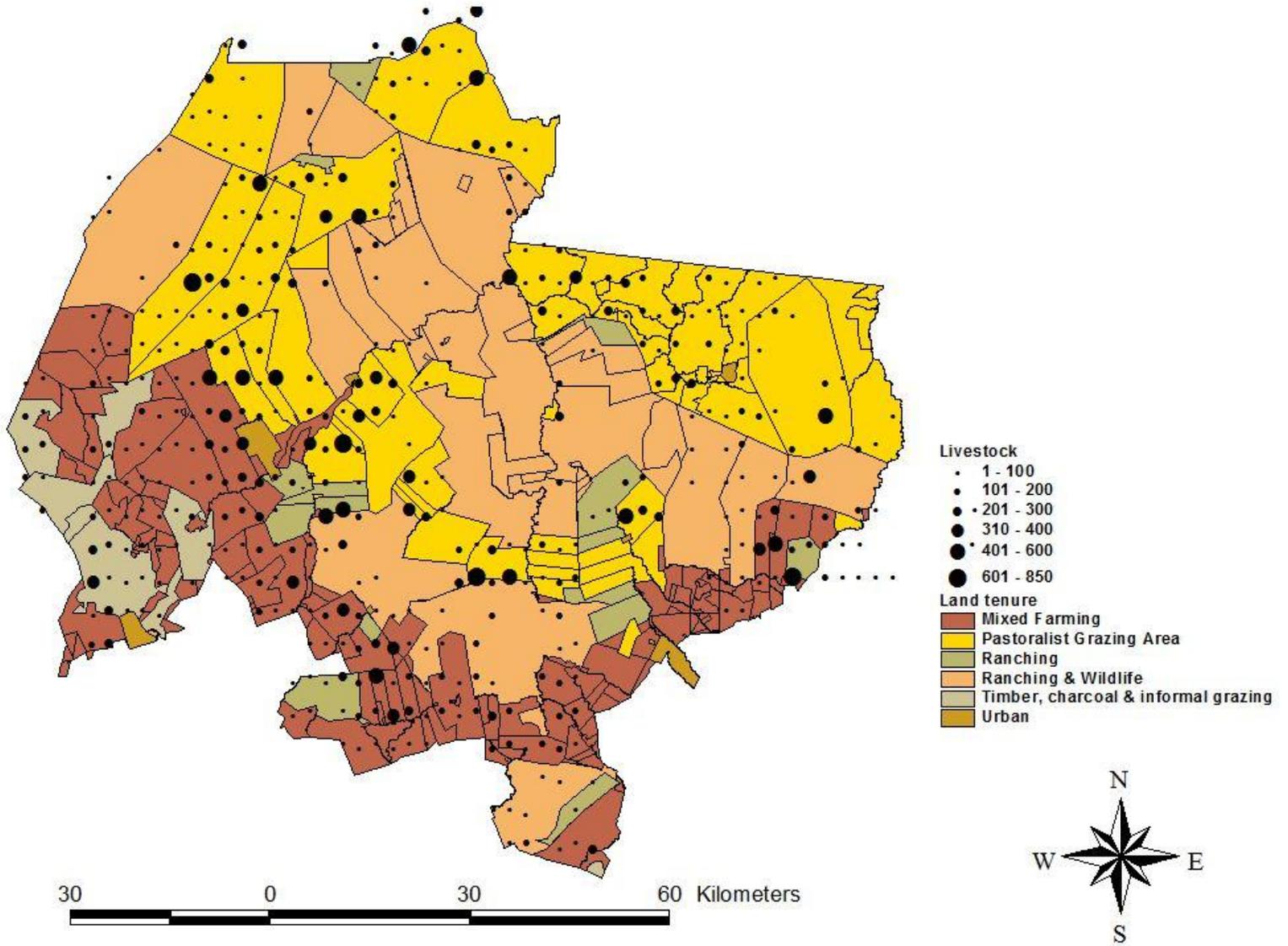
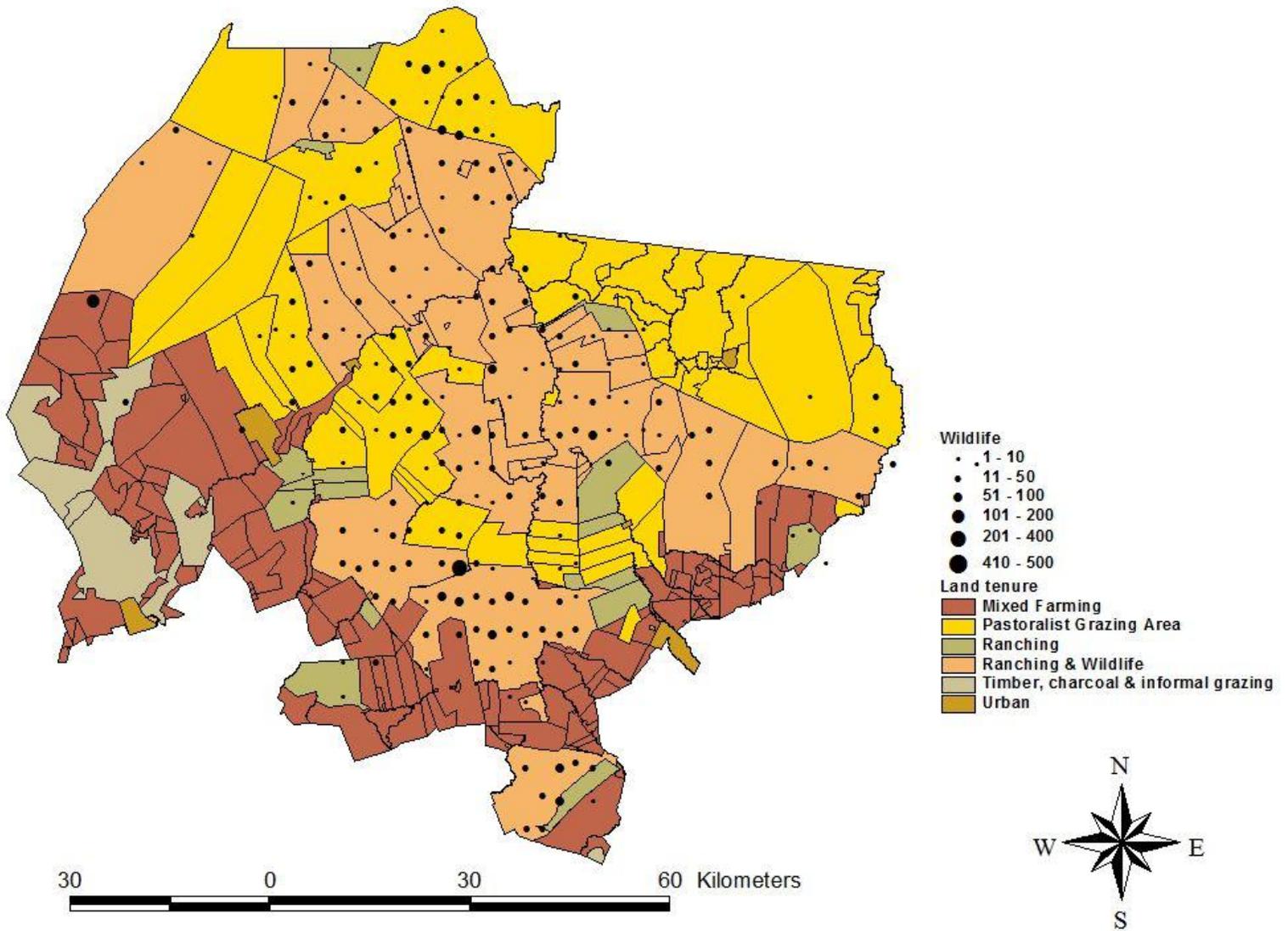


Figure 3. Distribution of wildlife across Laikipia County 2012.

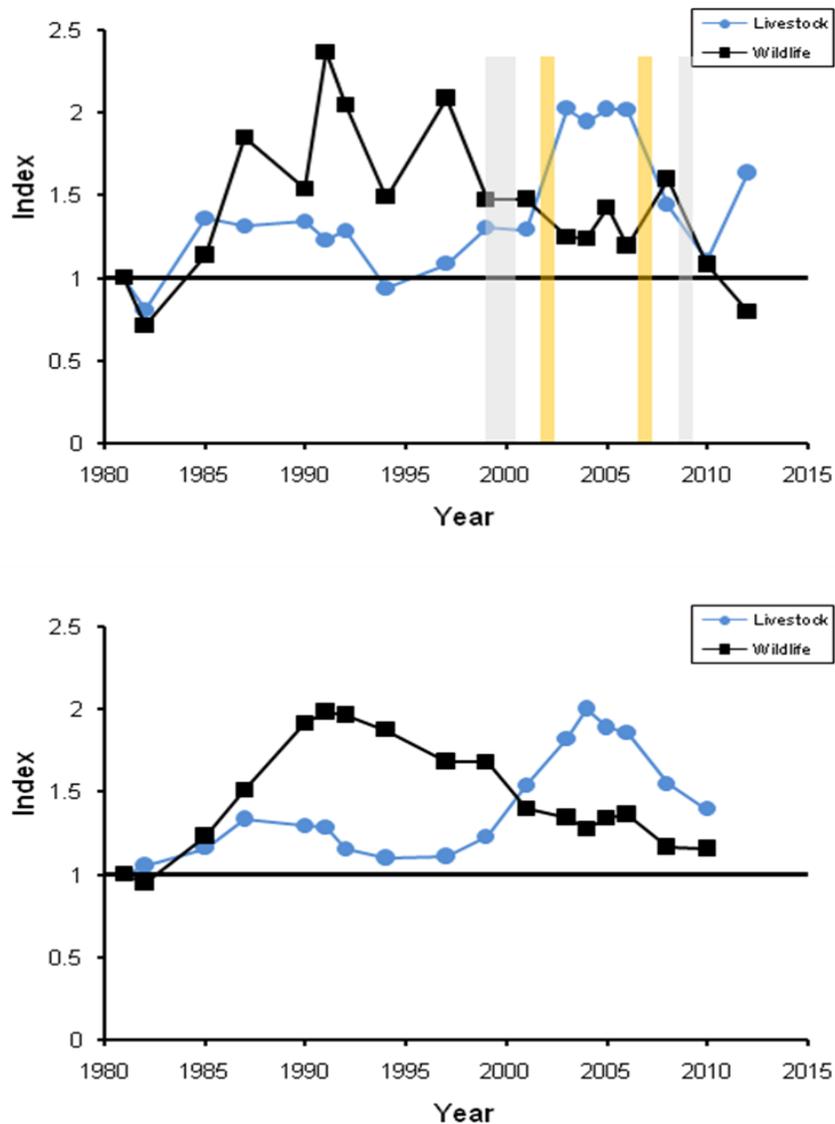


central portion of the district, in a swath from the south-east to the north-west, where land use is primarily commercial ranching and tolerance of wildlife is high. Sixty-one percent of all observation cells (12.5 km²) contained no wildlife.

Long-term trends

Since the 1980s, livestock in Laikipia Country have increased in abundance, except during times of drought (Figure 4). During the 1990s, livestock numbers were on average 17% higher than in the 1980s while in the first decade of the 21st century, livestock numbers increased, on average, by almost 70% in comparison to the 1980s.

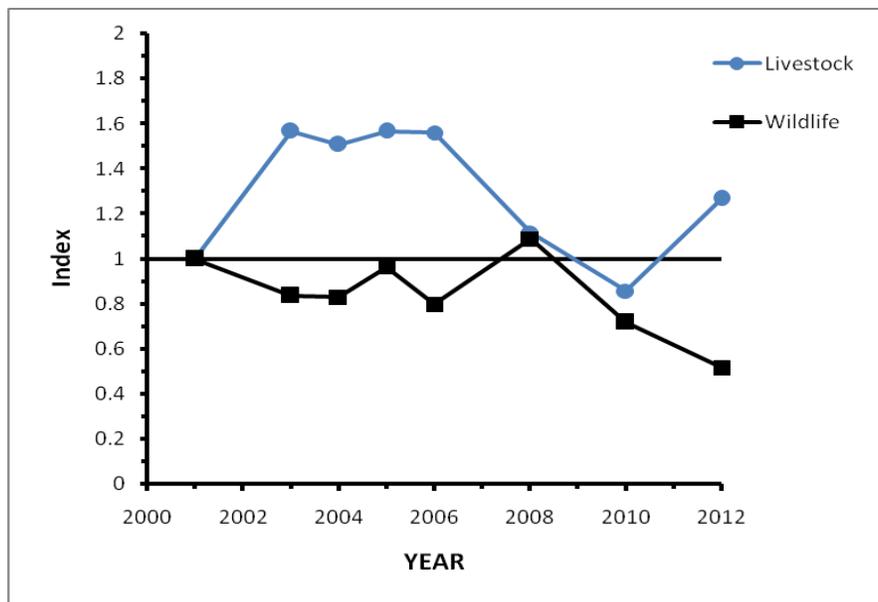
Figure 4. Top: Aerial surveys of 5 livestock and 15 wildlife species by year. The livestock index is the ratio of change in numbers from 1981 forward (N_t/N_{1981}). The wildlife index is the geometric mean of rate of change for wildlife species. Grey bars show recent droughts and orange bars show below average rainfall for past decade. Lower chart is 5-year running average of indices.



During the same time period, wildlife numbers increased steadily from 1983 to 1992 and then began to slowly decline. In 2012, wildlife numbers fell below the 1981 benchmark for the first time since 1982. The 5-year running average however, remains at 16% above 1981 (Fig 4).

If we consider the trends for the 21st century only (2001 to 2012; Fig. 5) the data are much more detailed because Mpala and LWF regularly commissioned surveys (2001, 2003, 2004, 2005, 2006, 2008, 2010 and 2012). There was an increase in livestock from 2001 to 2003, followed by several years of stability before declining again between 2006 and 2010 with the final 2012 estimates showing an increase. These trends have been driven predominately by changes in numbers of sheep and goats, which have increased by more than 57% during the past decade (Table 1).

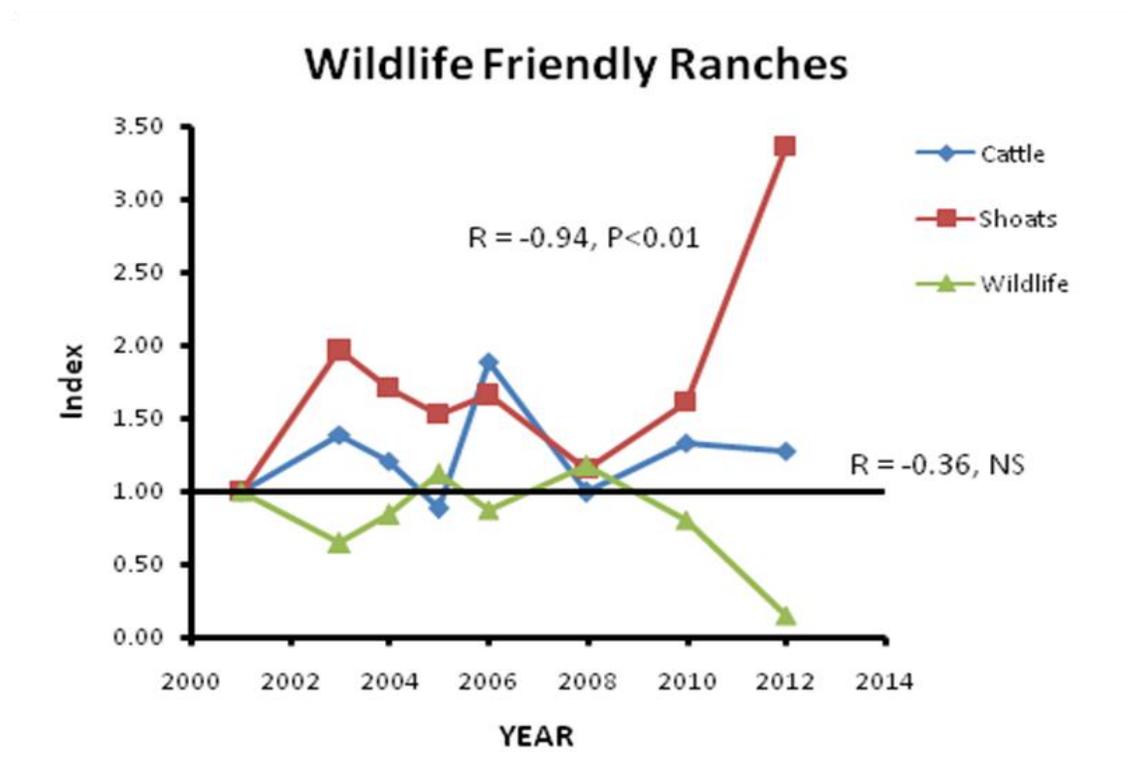
Figure 5. Trend in livestock and wildlife using 2001 as the baseline for the 21st century.



Wildlife trends for the 21st century show declining overall numbers, especially between 2008 and 2012. Currently, wildlife numbers are at 52% of 2001 figures. The decline has been broad-based (Table 1); 10 wildlife species show population declines of more than 30% since 2001. The most worrying declines (>75% downward change) are in Grant's and Thompson's gazelles. Only Burchell's zebra, Elephants, Cape buffalo and Beisa oryx appear to be stable or increasing.

Changes in wildlife and livestock populations over the past decade vary across the different land uses (Fig 1) but the most dramatic changes have occurred in areas classified as 'Wildlife Zone'. Surprisingly, wildlife numbers in the 'Wildlife Zone' have declined by 80% across all species since 2001, and most of that decline has occurred since 2008. For this subset of properties, cattle numbers have fluctuated over time but the 10-year trend is relatively flat (Fig 6). Sheep and goats by contrast have increased by 250% since 2001 (Figs. 6 and 7). There is a striking negative relationship between sheep and goats and wildlife. As sheep and goats increase, wildlife declines ($r = -0.95$, $P < 0.01$). Although there is also a negative relationship between cattle numbers and wildlife, the correlation is much smaller and is not significant. Species showing the greatest declines in the 'Wildlife Zone' include Impala, Thompson's and Grant's gazelles (Fig. 8). Other species of concern within this landuse type include Buffalo, Reticulated giraffe and warthogs (Fig. 9).

Figure 6. Trends in cattle, sheep and goats and wildlife in the 'Wildlife Zone' of Laikipia.



Discussion

The 2012 survey data indicate that Laikipia remains rich in wildlife and that wildlife numbers are higher than when counts began in 1981. Within the last decade, however, our surveys indicate an upward trend in livestock numbers accompanied by a downward trend in wildlife numbers. Declining wildlife numbers were most prevalent across lands defined as 'Wildlife Zone', an area comprised of commercial ranches and rhino sanctuaries, which are considered 'wildlife friendly' areas (Georgiadis 2007).

What is driving the Laikipia-wide trend of declining wildlife populations over the past decade? There are a number of possibilities including habitat change, drought, an increase in predation, competition with livestock, and poaching.

There has been substantial habitat change in the past decade. Kinnaird et al. (2012) showed massive forest loss in the Rumuruti and Marmanet forest complex due to conversion of land for agriculture and other uses. Such habitat loss undoubtedly has had a negative effect on forest dependent species such as buffalo. Changes in the abundance and distribution of grassland, bare land, whistling-thorn acacia woodland and bushland will negatively affect species such as Thompson's and Grant gazelles, hartebeest. Thompson's gazelles are at the northern limit of their range in Laikipia and therefore, may be sensitive to changes in short grasslands. Historically, Thompson's gazelles were most abundant in the agricultural and pastoral grazing areas in the south, preferring wetter climates and doing well on degraded pastures. The Laikipia hartebeest also prefers grasslands and is sensitive to livestock competition (Kingdon 1997). We are currently examining levels of bush encroachment and grassland loss across Laikipia over time in hopes of providing further insight into this hypothesis.

The period between 2000 and 2012 was characterized by 2 major droughts and 2 years with below average rainfall. Although cattle numbers were relatively stable during this period, sheep and goats declined in number during drought years, followed by a rapid post-drought increase. In 2012, combined livestock numbers increased following 18 months of high rainfall and restocking. Wildlife show mixed responses to drought. Drought prone species such as Burchell's zebra and warthog continued to decline or remain with depressed population numbers post-drought while Cape buffalo increased in

number. Species such as Oryx, which are considered drought resilient, have shown cyclical trends in population increases and declines unrelated to climate conditions.

Georigadis and colleagues (2007) speculated that increasing predator populations were a significant factor in declining prey populations. He assumed that as ranch owners and managers became engaged in tourism, they tolerated lions and allowed their numbers to increase. As lion populations increased, prey species began to decrease. Although this hypothesis is attractive in explaining the loss of wildlife on among properties classified as 'wildlife zone', we have no data to indicate that large predators have in fact increased on wildlife friendly ranches. This is an important issue to carefully examine in the near future.

Our surveys indicate a shift in pastoralist practices in Laikipia over the past 30 years from cattle to sheep and goat husbandry. Sheep and goats at high densities can result in degradation of habitat and displacement of wildlife. The distribution data acquired during the current and prior years show a strong negative relationship between sheep and goat abundance and wildlife abundance. Kinnaird and O'Brien (in press), using camera trapping approaches have shown that the negative effect of sheep and goats is pervasive across most wildlife species.

Our surveys also demonstrate an increase in human population in the 'Wildlife Zone' of northern Laikipia in the past 6 years (detected by increasing numbers of houses and manyattas). This coincides with the occupation of disputed lands such as Eland Downs, and other abandoned properties. It is possible that movement between wildlife friendly properties and other surrounding properties exposes wildlife to harassment, displacement, or death. If wildlife friendly properties can no longer sustain losses on surrounding properties that act as 'wildlife sinks', then population declines, such as we have documented over the past decade, can occur.

Finally, we cannot rule out the possibility that poaching has increased in the past decade. The bushmeat trade in Kenya is generally regarded as an increasingly serious problem for wildlife conservation. However, data on the bushmeat trade in Laikipia are non-existent but critically important to gather. A careful examination of security guard records on ranches that conduct patrols might be enlightening.

The Mpala/DRSRS bi-annual livestock and wildlife surveys are a critical monitoring tool for assessing trends in wildlife and livestock

populations across Laikipia. However, we believe it is essential to broaden our surveys to include an examination of drivers of population change in order to understand where best to make interventions for halting wildlife losses.

Future Activities

We will be submitting a companion document to this report, expanding on collaborative work with statisticians at the Wildlife Conservation Society which focuses on how and if we can improve on the interpretation of the aerial surveys using more sophisticated statistical approaches. We will consider the trade-offs between model improvements and the skills needed to use these models.

Acknowledgements

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Figure 7. Density estimates of cattle, sheep & goats (shoats), and camels in Laikipia County by year and landuse.

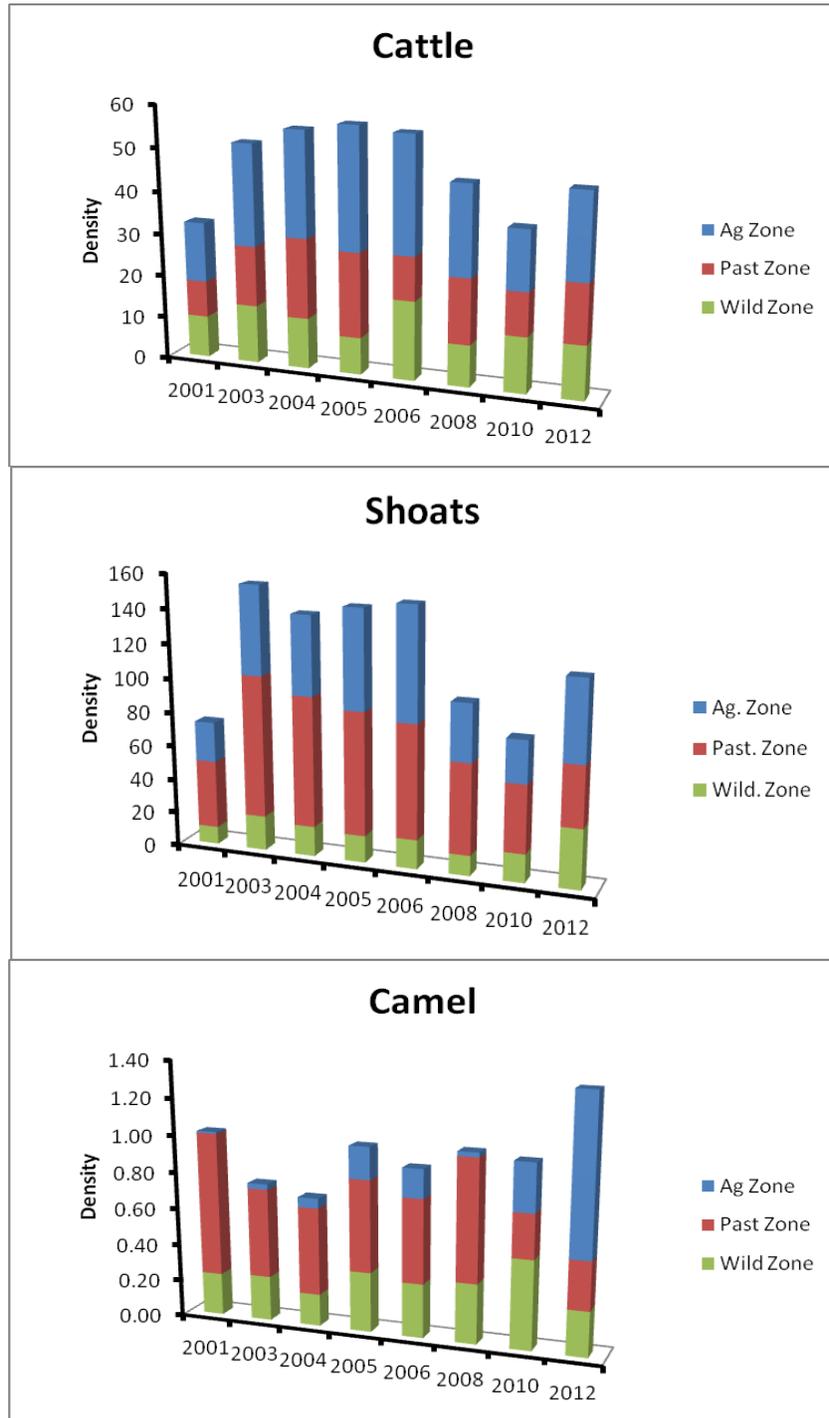


Figure 8. Density estimates for Impala, Thompson's and Grant's gazelles in Laikipia County by year and landuse.

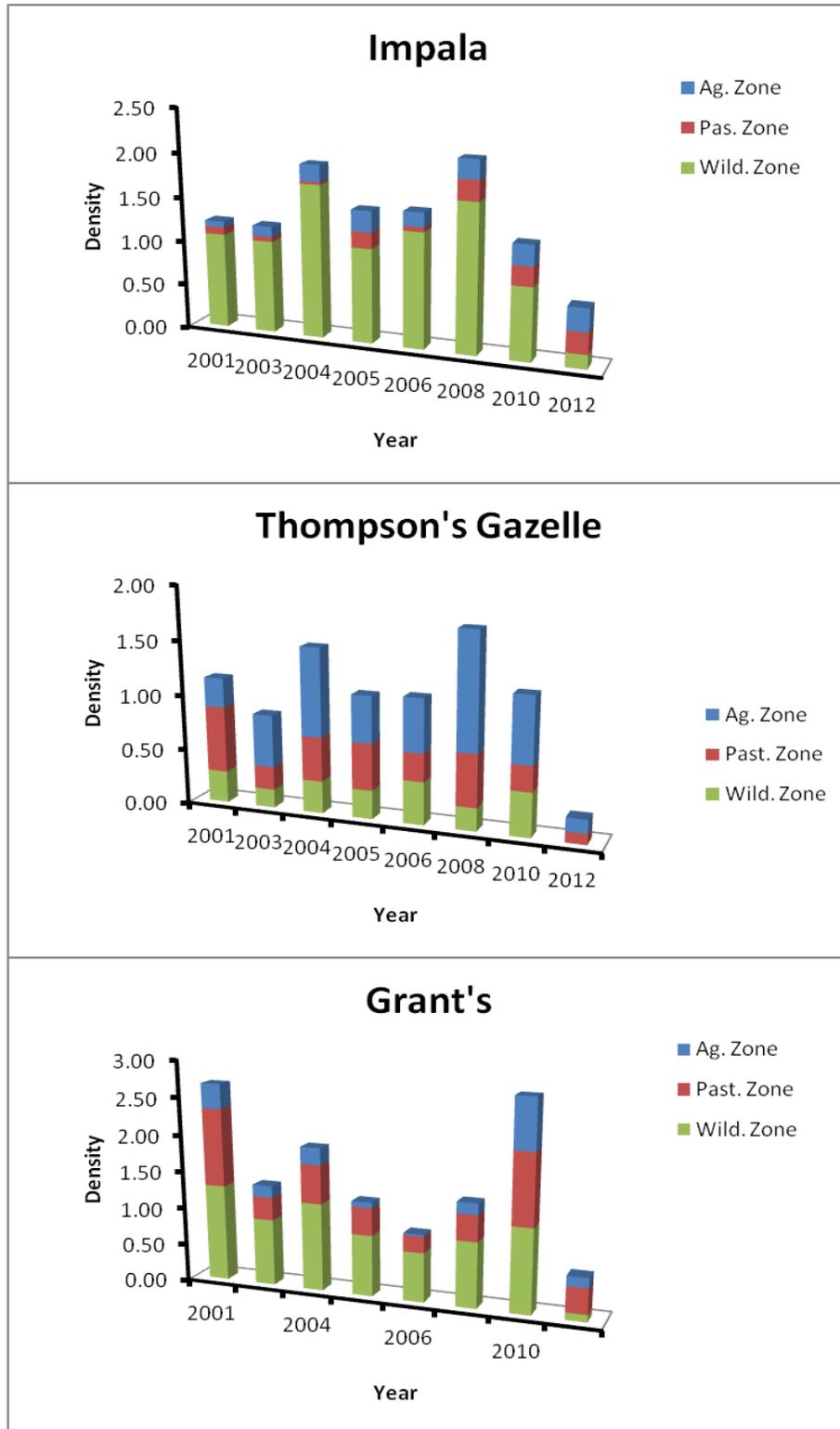


Figure 9. Density estimates for Buffalo, Reticulated giraffe, and warthogs in Laikipia County by year and landuse.

