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Seasonal interactions of pastoralists and wildlife in relation to pasture in an African savanna ecosystem

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ABSTRACT

Wildlife and livestock have coexisted across East African rangelands for millennia, tracking seasonal forage availability across large landscapes. More recently however, free-ranging movements have been increasingly restricted by land use changes, reducing the ability of livestock and wildlife to access necessary grazing resources, leading to both homogenization and degradation of the rangeland. This in turn has led to losses in productivity of both livestock and wildlife. This study describes wildlife and livestock interactions in response to pasture in one of the few remaining areas of mixed wildlife-livestock use with unrestricted movements. We ask if pastoral management systems can create and maintain spatial and temporal heterogeneity of pasture, through the seasonal movement of livestock. Furthermore, does this heterogeneity create a diverse, productive and resilient assemblage of both domestic and wild ungulates? Our results provide evidence to support the notion that traditional pastoral systems which continue to manage for heterogeneity of pasture can still support not only livestock but also substantial numbers of wildlife. The results highlight the need for wildlife and livestock to retain both mobility and access to both wet and dry season areas to maintain ecosystem resilience and promote coexistence in mixed livestock-wildlife landscapes.

1. Introduction

Sub-arable rangelands lands cover 60% of East Africa (Bourn and Blench, 1999) and have been dominated by subsistence pastoralists for the past three to four millennia (Williamson, 2000). Although best known for the abundance of wildlife, livestock make up 60–90% of the large mammal biomass in the African savannas (Ogutu et al., 2016; du Toit and Cumming, 1999).

Until the last two to three decades, wildlife and livestock coexisted over most of the rangelands and moved freely with the seasons, driven largely by rainfall, pasture availability and water (Coughenour et al., 1990; Western, 1982, 1975). Two thirds of Kenya's wildlife is still spread across the rangelands in community lands, group and private ranches (Western et al., 2009b). A rising human population, land pressure and subdivision of land has resulted in a 40%–70% percent loss of wildlife in the past forty years (Ogutu et al., 2016). Wildlife losses in parks match the country-wide losses (Western et al., 2009b). Large wildlife losses have also occurred in Tanzania (Estes et al., 2006) and in other Eastern and Southern African protected areas (Craigie et al., 2010).

Evidence also points to a steady loss of pastoral productivity in much of the rangelands, resulting from subdivision, range compression, loss of seasonal resources, mobility to access these resources, collapse of traditional grazing management systems and pasture degradation (Bhola et al., 2012; Boone, 2005; Groom and Western, 2013; Hobbs et al., 2008). The importance of the pastoral lands in maintaining wildlife has been highlighted in Kenya by the success of community and private wildlife conservation initiatives since the 1990s. More wildlife is now supported in the community and private conservation lands (conservancies) than within nationally protected areas, and the populations are holding steadier (Western et al., 2006). The conservancies are also proving important in restoring and sustaining pasture and livestock health (Glew, 2012).

The growing importance of conservancies underscores the need to understand the factors governing the productivity, diversity and resilience of savannas in order to sustain free-ranging populations of wildlife and livestock in the rangelands. The focus on wildlife studies in protected areas and lack of research into interacting livestock and wildlife populations within traditional pastoral systems has hampered the application of research to conservation planning in the rangelands areas (Butt and Turner, 2012).

Research studies into African savanna ecosystems point to the

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importance of rainfall and seasonality as the main drivers of the pasture quality, quantity and spatial heterogeneity governing wildlife and livestock abundance and movements (Coughenour et al., 1990; Illius and O'Connor, 2000; Mose et al., 2013). Water availability (Western, 1975), topography (Coughenour et al., 1990), geology (Cole, 1982), disturbance (McNaughton, 1983) and human activity (Turner and Hiernaux, 2002) modify the influence of rainfall and seasonality. In Eastern Africa the biannual rainfall supports a higher livestock biomass and a more milk-dependent pastoral system than the single season rainfall of Southern Africa (Western and Finch, 1986).

Subsistence pastoralists around the world have developed ecological and social strategies to maximize production, lower risk and take advantage of the spatial and temporal variation of pasture (McAllister et al., 2006; Müller et al., 2007; Western, 1982). Mobility in pastoral and wildlife herds is important in reducing the effect of seasonality, avoiding droughts and taking advantage of landscape heterogeneity (Niamir-Fuller, 1999). Free-ranging herds are able to track seasonal pastures and maximize digestible intake by optimizing trade-offs between pasture quantity and quality (Illius and Gordon, 1992; Mose et al., 2013) within range of permanent water (Western, 1975).

Typically, wildlife and livestock in the savannas migrate seasonally between higher quality wet season ranges unconstrained by water and dry season lower quality higher biomass areas near permanent water (Fryxell et al., 2005; Müller et al., 2007; Western, 1975).

Since the beginning of the 20th Century there have been negative perceptions towards pastoral grazing practices, including seasonal movements of livestock in Kenya, with pastoralists blamed for both rangeland degradation and for loss of wildlife (Mwangi and Ostrom, 2009). Here we follow on previous work that has shown that there is coexistence between livestock and wildlife in the Shompole and Olkiramatian ecosystem (Schuette et al., 2013), and provide evidence that pastoral governed rangelands can indeed promote sustainable coexistence of wildlife and livestock.

Important as it is to understand the ecological dynamics of free-ranging wildlife and pastoral livestock systems in light of its growing significance for rangelands productivity, sustainability and wildlife conservation, few areas remain where traditional seasonally governed movements remain. Exceptions include the Shompole and Olkiramatian group ranches in southern Kenya. Here, the Maasai still sustain seasonal movements and traditional grazing practices alongside a large population of wildlife, with a full complement of herbivore and carnivore species, except for black and white rhinoceros (Schuette et al., 2013). The two group ranches remain as intact land parcels held under communal title, with none of sub-division or fragmentation into smaller parcels which is occurring across much of the East African rangelands (Homewood et al., 2009). Here we draw on long-term ecological data to describe the seasonal dynamics of this South Rift ecosystem, focusing on trends in pasture availability and the densities and distributions of wildlife and livestock.

Using this case study, we ask if pastoral management systems can maintain and create spatial and temporal heterogeneity of pasture through the seasonal movement of livestock. Does this heterogeneity in turn create a diverse, productive and resilient assemblage of both domestic and wild ungulates? We hypothesize that this community management system will help create and maintain a temporally and spatially heterogenous pasture resource base (quantified as grass biomass, grass height, percentage grazed and percentage green). In addition, we expect that productive populations of wildlife and livestock are distributed across this landscape in relation to this pasture resource base, which is dictated by the underlying management regime and the metabolic requirements of each specific species.

2. Materials and methods

2.1. Study area

Located at the western edge of Great Rift Valley on the international border between Kenya and Tanzania, the study area borders the Nguruman Escarpment and Loita Hills to the West, the alkaline Lake Magadi to the East, and the alkaline Lake Natron to the South. The area has an altitude of 600–700m and high temperatures ranging from 18 °C at night to 45 °C during the day (SORALO, unpublished data). This area is classified as Agroclimatic Zones V (Bekure and International Livestock Centre for Africa, 1991), which is semi-arid land, with erratic rainfall that is scattered across the area, averaging 400–600 mm yr^{-1} (SORALO, unpublished data; Agnew et al., 2000), and with percentage variation of annual rainfall over 33% (Agnew et al., 2000). High evapotranspiration rates and low rainfall ensures there is little standing water outside the rainy season. A perennial river, the Ewaso Ngiro, runs through the study area, along with some small streams from the Nguruman Escarpment, these representing the only permanent water sources available in the area. The Ewaso Ngiro river flows through the Shompole swamp before ending up in Lake Natron.

Historical Rift Valley down-faulting and up-thrusting has created steep elevation gradients, a range of habitats from arid soda flats to montane forest, and one of the richest vertebrate assemblages in Africa (MEWNR, 2015). Despite the semi-arid climate, combinations of topography, river and spring discharge through the area creates a mosaic of habitats and seasonal pasture fluxes which in turn support a high density of migratory grazing herds of wildlife and livestock and resident browsing species. The ecology and seasonal dynamics mirrors other pastoral and livestock systems in East Africa that have now largely been fragmented and ecologically uncoupled by land use changes (Hobbs et al., 2008).

The area is covered by two group ranches which are, however, used as a single management area. A group ranch is a jointly owned freehold land title given to the customary occupants of communal lands (Kimani and Pickard, 1998). The occupants of Olkiramatian and Shompole number roughly 20,000 people (Agnew et al., 2000) in an area of approximately 1000 km^2 (Fig. 1).

In Shompole and Olkiramatian the traditional seasonal livestock movements and herding practices are formalized by group ranch grazing plans governed by local committees. The wet season grazing areas in both group ranches are termed 'livestock zones.' The dry season grazing areas have been retained as a 'grass banks' for livestock and since 2000 have been established as wildlife conservancies used for ecotourism. In both group ranches livestock rearing occurs to the East of the Ewaso Ngiro river, grass banks and the wildlife conservancy to the West of the Ewaso Ngiro river, and the area North West of the group ranch in Olkiramatian and the South West in Shompole for crop farming. Seasonally the communities of both group ranches move their livestock between the livestock rearing zone in the wet season and the grass bank in the dry season when regional grass biomass and quality decline. See Fig. 1 below for a map of these land use zones.

In 2007 a long-term ecological monitoring programme was established on Shompole and Olkiramatian group ranches, modeled on the Amboseli ecological monitoring program (Western et al., 2015). The Shompole-Olkiramatian monitoring program is run by the South Rift Association of Landowners (SORALO), which has also set up the Lale'enok Resource Centre and trained local resource assessors to conduct the regular monitoring activities.

2.2. Vegetation characteristics

Pasture characteristics were measured using the pin – intercept methodology (McNaughton, 1983; Mwangi and Western, 1998) which counts the number of plant 'hits' on ten thin metal pins. Twenty-five plots, measuring 314.16 m^2, have been regularly sampled across the