

A REVIEW OF CHANGES IN RANGELAND
VEGETATION AND LIVESTOCK POPULATIONS FOR
NORTHERN KENYA

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PREPARED BY

MICHAEL JACOBS AND D. LAYNE COPPOCK

UTAH STATE UNIVERSITY

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SUMMARY

This is a preliminary review of information pertaining to environmental change in northern and north-central Kenya, roughly covering three decades from the 1960s to the 1990s. Districts covered included Marsabit, Mandera, Isiolo, Samburu and Baringo. Source materials were dominated by government reports generated from bilaterally funded research projects. We wanted to answer three questions: (1) Has vegetation change occurred in these districts?; (2) if vegetation change has occurred, why and how has this happened?; and (3) what are the trends for livestock populations? Despite considerable ecological variability of this arid and semi-arid region, there was a remarkable degree of consistency in conclusions regarding environmental changes, namely, that many rangeland sites have been fundamentally altered by woody encroachment over the past 40 years. This has resulted from concentration of grazing pressure that has occurred due to declines in the mobility of pastoral people and their herds. Human population growth, insecurity, inadequate distribution of key resources, and the lure of markets and public services are all implicated in this pattern. Where sacrifice zones have been created around human settlements, extreme degradation has occurred. In some cases, however, it has been noted that herbaceous vegetation recovers to a marked degree following high rainfall and protection from herbivory. Given the specter of pervasive change in the composition of range vegetation, it may be anticipated that livestock populations had changed in numbers or species composition, but this was generally not evident from aerial survey data collected by the Kenya DRSRS from 1977-94. The lack of trend detection may be complicated by imprecision of aerial survey data, the possibility that major changes in livestock populations occurred before the period of aerial survey, and/or the presence of non-forage factors such as epidemic disease and livestock raiding that can exert marked influences on population dynamics. Investigators often conclude that restoring pastoral mobility is a key intervention to protect the environment. Whether or not this is a realistic concept, however, is another matter.

INTRODUCTION

Unfavorable and long-term changes in the composition and productivity of rangeland vegetation have far-reaching implications for pastoral economies in East Africa. Chronic overgrazing, drought, and inappropriate cultivation have been most commonly cited as causes of deterioration in range condition in East Africa (Coppock, 1994; Mäkel, 1994; Herlocker et al. 1995a ; Herlocker, 1999). It is difficult to generalize about causes of change in range condition because of site-specific interactions among ecological features and human use (IPAL 1984, Sinclair and Fryxell, 1985; Homewood and Rogers, 1987). Recent controversy has focused on whether climate or consumers are primarily responsible for vegetation dynamics observed in arid and semi-arid Africa (Ellis and Swift, 1988; Behnke and Scoones, 1993).

Synthesis of ecological work for southern Ethiopia was presented in Coppock (1994), who concluded that ecological degradation attributable to heavy stocking rates had occurred in some parts of this semi-arid environment. Grazing-induced bush encroachment was evident in the upper semi-arid and lower sub-humid zones, especially near places where pastoralists had settled in the past 20 years. A regional pattern of bush encroachment was probably associated with restricted mobility of pastoralists over the past 100 years due to a slowly growing population that encouraged sedentarization [Billé (1983) cited in Coppock (1994)]. In some cases, competition from woody plants here decreases productivity of the herbaceous layer, thus rendering an environment less suitable for grazers such as cattle and possibly more suitable for browsers such as goats or camels (Coppock, 1994). Other forms of soil surface erosion have been observed in the more arid, western portions of the Borana Plateau (Coppock, 1994). The regional cattle herd in the central Borana Plateau exhibited a boom and bust pattern of dynamics between 1980 and 1997 (Desta, 1999). Massive levels of cattle mortality occurred in 1984-5, 1991 and 1997. Although long-term trends for cattle, sheep and goat numbers have not been evident, social

survey data indicate that camels may have substantially increased in number over the past 15 years (Desta, 1999). This may reflect the greater suitability of camels for browse vegetation that has emerged throughout much of the Borana Plateau, and the high utility of camels for milk production and portage during drought. Overall, this paints a picture of a generally semi-arid system (440 to 1100 mm p.a. in a bimodal pattern) where livestock periodically reach densities that affect vegetation composition (Coppock, 1994). Increase in the cover of woody plants at higher elevations has probably also been exacerbated by a policy banning range fires, first enacted in the mid-1970s (Coppock, 1994).

In contrast to southern Ethiopia, ecological studies and systematic assessment of livestock populations in Kenya have been conducted more often in a wider array of environments, over a longer length of time, and by a more diverse group of investigators. Such work in Kenya was less familiar to us and merited a preliminary review. Our objective therefore was to review literature pertaining to northern and north-central Kenya to try to answer three questions: (1) Has rangeland vegetation changed over the past few decades?; (2) if vegetation has changed, what is the nature of change and what forces have been implicated?; and (3) have livestock populations changed over the same time frame, and has this been linked to changes in rangeland vegetation? Our interest in livestock populations relates to the idea that livestock are the dominant consumer of range vegetation in our area of interest. If vegetation has been altered (degraded) from overgrazing, it follows that livestock populations should be in decline. It has been hypothesized in recent years that livestock populations are dropping in the East African rangelands, variously due to natural resource degradation, excessive raiding, disease epidemics, etc (Coppock, personal communications).

METHODS

Our work primarily involved sifting through an extensive gray literature for Kenya, namely

numerous reports produced in bilaterally funded projects. This main source was supplemented by graduate studies and information from the open literature. Various series of reports were obtained during field tours of Kenya in 1997-8. We organized information according to two broad locations, namely: (1) the more arid Marsabit and Mandera Districts to the north and northeast; and (2) the more semi-arid Samburu, Isiolo, and Baringo Districts in the north-central region. For the remainder of this review these will be referred to as the northern and north-central regions, respectively.

RESULTS

Climate

Like the southern Ethiopian rangelands, the Mandera and Marsabit Districts of Kenya have a bimodal rainfall regime, but are much more arid, with less than 2% of this region receiving >500 mm of annual rainfall on average (Herlocker et al., 1995a,b). Annual rainfall varies from <300 mm (North Horr) to >700 mm on the slopes of Marsabit. Precipitation in the north-central region is also bimodal and varies widely depending on altitude and aspect (Herlocker et al., 1995c,d,e). The driest areas in the north-central region are northern portions of Samburu and Isiolo Districts which receive about 400 mm of annual precipitation. The southern portions of Samburu and Isiolo Districts and most of Baringo District tend to be semi-arid and receive from 700 to 1100 mm per year, respectively, in a bimodal pattern.

Vegetation Change

Northern region

Research was conducted on rangeland vegetation on sites west of Marsabit across to Lake Turkana, and from the Huri Hills near Ethiopia south to the Korante Plains by IPAL (1984). For Marsabit District overall, the current fair or poor range condition in the mid-1980s was

considered to be a result of two factors (IPAL, 1984; Herlocker and Walther, 1991). First, the area had been severely over-grazed in the past, and this resulted in suppression of desirable grass and woody species. As an adaptation to this condition, the authors surmised that pastoralists changed livestock composition from dominance by cattle to dominance by camels. Second, it was noted that the vegetation condition was also a product of climate, specifically, the sporadic and low rainfall. The poor range condition was primarily associated with over-grazing near settlements and water points, although sites without surface water were commonly under-utilized. Overall, the arid lands of northern Kenya were thus viewed to be in an accelerated state of degradation largely due to implementation of uncoordinated development that served to concentrate impacts of livestock and people (IPAL, 1984).

Keya (1998) conducted research 8-9 years later in the same area where IPAL worked. Keya reported that vegetation was further reduced compared to baselines provided by IPAL, but that vegetation could exhibit considerable recovery following heavy rainfall. Keya concluded that the area was overstocked with respect to pressure on the grasses, and this favored production of forbs and dwarf shrubs. Keya observed that use of woody plants by people was the most significant cause of decline in larger shrub and tree species.

Mäckel (1994) conducted research southwest of Marsabit mountain and used permanent plots to monitor 13 years of vegetation change. He found that periods of heavier rainfall increased plant regeneration, numbers of plant species, and cover and production of forage. However, heavy grazing appeared to cancel out the positive effects of higher rainfall. Mäckel (1994) speculated this was due to a weakened state of the “preferred” forage species from heavy utilization. Mäckel (1994) concluded that an apparent increase in abundance of undesirable plant species was primarily a result of decreases in the abundance of preferred species.

In the Mandera District vegetation changes have been documented over the past 20 to 40 years (Herlocker and Walther, 1992). Some changes were noted to be drought-related, but most

were noted to be due to effects of use by humans and their livestock. Overall, shrubs were observed to be in decline and perennial grass cover had shifted to dominance by annual species. The authors hypothesized that these changes were livestock related and were probably exacerbated by restricted movements of animals caused by widespread insecurity during the 1960s.

North-central region

Rangelands in Samburu District have been assessed as being in poor condition (Herlocker, 1992). Historically, however, this was not always the case for Samburu. Until 30 to 40 years ago, Samburu District supported low to moderate levels of livestock use. Stock watering points were limited and grasslands produced sufficient fuel to support frequent fires. The primary changes in range vegetation have included an increase in tree and shrub vegetation and decrease in grass cover (Herlocker, 1992). Overstocking was considered to be the primary cause of vegetation change. Overstocking was the consequence of several factors, including an increase in the human population, a reduction of available grazing lands, and sedentarization processes (Herlocker, 1992). Two reasons were cited for the reduction of available grazing lands. First, there has been a chronic risk of cattle raiding in the eastern lowlands of Samburu. Second, portions of the district have been divided into individual or group ranches. Some of the ranches have been leased to wheat farmers (as in the Leroghi-Karrisa Hills) and this has eliminated important dry-season grazing for the pastoralists. Sedentarization has also occurred as a result of increased numbers of water points, schools, and clinics. Vegetation changes have probably benefited browsers (camels and goats) at the expense of grazers, according to Herlocker (1992).

While the central portions of Samburu District have deteriorated in condition, the eastern portion has improved due to restricted use resulting from insecurity. Insecurity and escape from

colonial grazing schemes elsewhere were responsible for the concentration of livestock in the central plateau (Herlocker, 1992).

Vegetation changes in Isiolo District, as reported by pastoral elders, were primarily an increase in woody cover with a concomitant decrease in grass cover—this began in the 1960s (Herlocker, 1993). The start of woody encroachment is thought to have begun when livestock increased their access to the district as a result of improved security. The Isiolo rangelands received additional rest from grazing as a consequence of two droughts during the 1970s that depleted livestock populations. Woody encroachment in Isiolo has not always been due to overgrazing, however. In some instances woody encroachment is speculated to be due to a lack of foraging by livestock and lack of fire. Thus both overuse and underuse have been implicated in affecting vegetation dynamics in Isiolo District (Herlocker, 1993).

During the last 30 years (from 1964 to 1994), the rangelands of Baringo District are thought to have undergone major changes (Herlocker, 1994). Overgrazing and cultivation over much of Baringo District have been considered responsible for serious environmental degradation and reduction in rangeland productivity. In the eastern and southern portions of Baringo District a decline in fire frequency has led to woody encroachment on grasslands. Ecological restoration schemes in Baringo during the 1930s and 1950s aimed to control grazing, reduce shrub cover, and promote grass reseeding, but these failed (Herlocker, 1994). The 1960s and 1970s brought more development projects including increases in livestock watering points and more failed attempts to control grazing. In the late 1970s and 1980s projects concerned with conservation and rehabilitation of rangelands were initiated. A major change in the 1980s was that communal land in the southern portion of the district was switched to private small-holder ownership and group ranches. Consequently, pastoralists in this area have become increasingly sedentary (Herlocker, 1994). The northern portion of Baringo District has retained a semi-transhumance pastoral system for the Pokot. Cattle are moved to lowlands during the wet season

and highlands for the dry season. Construction of schools and clinics, however, has discouraged stock owners to maintain optimal livestock and range management practices. Furthermore, cattle raids from the north have also restricted movements resulting in biased grazing distributions (Herlocker, 1994).

Livestock Population Dynamics

The Rinderpest epidemic in East Africa, ca. 1885, caused 80-90% mortality in cattle and sheep. Therefore, data on livestock numbers at the turn of the century, when counting systems were first implemented, probably reflect unusually low population baselines. Sandford (1983) considered it difficult to prove that livestock numbers have reached unprecedented levels in the 20th Century since pre-Rinderpest population estimates are unavailable. Sandford (1983) further commented that livestock population statistics produced from aerial surveys should be viewed with caution because of inherent problems related to data collection and extrapolation using aerial survey methods. With this in mind, available population trend data from aerial surveys (DRSRS, 1995) for livestock are summarized in Table 1 that cover the period 1977-94. A mix of results was obtained; the dominant pattern was no apparent trend in population sizes over 17 years.

Table 1. Trend¹ in livestock numbers from aerial surveys for selected areas of Kenya, 1977-94. Source: DRSRS, 1995).

| Region ² | District | Cattle | Sheep/Goats | Camels | Donkeys |
|---------------------|----------|----------|-------------|----------|-----------------|
| | | | | | |
| N | Marsabit | No trend | Increase | No trend | Increase |
| N | Mandera | Increase | No trend | No trend | NA ³ |
| N-Central | Samburu | Decrease | No trend | No trend | No trend |
| N-Central | Isiolo | Decrease | No trend | Increase | NA |
| N-Central | Baringo | No trend | No trend | No trend | NA |

¹Trends assessed by Jacobs and Coppock by examining graphs of aerial survey data.

²Where N stands for North and N-Central stands for North-central.

³Where NA stands for not applicable (insufficient data).

DISCUSSION

From our review it appears that the consensus is that change in rangeland vegetation is pervasive throughout the Kenyan districts surveyed. A common theme is the encroachment of woody vegetation to the detriment of perennial grass communities. This benefits browsers over grazers. Site-specific loss of woody vegetation has also occurred, however, and this is most typically associated with bore-holes and high impact zones around villages. In these “sacrifice” zones increases in the extent of bare soil and erosion have prompted some investigators to view the impact as an example of human-induced desertification. Despite the prevalence of weakened vegetation due to heavy grazing, some investigators have noted that the productivity of herbaceous vegetation is resilient and recovery can occur with adequate rainfall and rest from grazing.

In general, most investigators concluded that overgrazing was the most likely agent of vegetation change, both through unsustainable harvest levels and reduction in fuel loads that reduce the natural frequency of fires. Fires are known to keep woody seedlings in check, while grasses can survive by virtue of having sensitive tissues safe below ground (see review in Coppock, 1994). That chronic overgrazing has primarily resulted from reduced mobility and sedentarization of livestock owners is another common hypothesis. Factors responsible for reducing mobility include growth in human populations, land annexation, insecurity, provision of public services, and poor distribution of watering facilities. This chain of events is elaborated upon further by Skovlin (1984). He also recommends that rotational grazing systems and forms of bush control are needed to restore grazing systems in light of increased demands on rangeland resources.

In light of the general support for biotic interactions driving change on these rangelands, it is important to note that factors such as drought were only occasionally mentioned as a

contributing factor to change. We did not encounter detailed analyses of long-term rainfall dynamics that could offer convincing alternative explanations of sources of change. In other words, it is unclear if a pervasive shift in precipitation over the past 40 or so years has also contributed to the replacement of grasses by woody plants in many of these range sites. Ellis and Swift (1988) contended that rainfall variability, not herbivory, was the defining factor influencing herbaceous dynamics in arid Turkana District, Kenya.

The aerial survey data we reviewed did not support the idea that livestock populations were in decline during recent times. The data also did not confirm a hypothesized increase in browsing animals (i.e., goats and camels) relative to grazing animals (i.e., cattle). For example, in Marsabit District vegetation change was observed to benefit browsers over grazers. Although aerial surveys showed no trend in cattle numbers from 1977-94, increases in sheep and goats were found. In Mandera District, there has reportedly been a shift from perennial to annual grasses, while woody species have declined due to human activities. Despite these changes cattle numbers have reportedly increased while numbers of sheep, goats, and camels numbers have not changed. In Samburu District, vegetation change was also said to benefit browsers. Although the aerial survey data indicated that cattle appeared to be in decline in Samburu, there was no evidence that browsers were on the increase. Pervasive environmental change in Baringo District has apparently not been accompanied by commensurate changes in either livestock numbers or livestock species composition. These apparent inconsistencies could be due to several factors. For example: (1) aerial survey techniques may lack the precision to detect most changes in livestock populations (Sandford, 1983); (2) major changes in livestock populations may have preceded the period of analysis by DRSRS (1999); and (3) other limiting factors besides forage (i.e., disease epidemics, drought, or livestock raiding) can complicate livestock population response.

Investigators have made various suggestions as to how negative trends in range

vegetation could be mitigated or reversed. For Marsabit and Mandera, for example, redistribution of livestock is noted as the most appropriate management solution (IPAL, 1984). This could be accomplished by grazing some areas during the rainy season when surface water is available and by placing bore holes to improved livestock access to the Hedad (Korante) plains. Keya (n.d.) suggested that forage short-falls in the arid zone could be addressed by improving the efficiency of the livestock marketing system to spur off-take, or by encouraging mobility and creation of fodder reserves. Whether or not any of these plans are realistic, however, is open to debate.

CONCLUSIONS

The issue of livestock numbers and vegetation change on the rangelands of northern and north-central Kenya is complex. In general, the conventional wisdom appears to be that vegetation change is pervasive, and occurs largely in the form of encroachment of woody vegetation as a result of heavy, localized grazing. Heavy grazing, in turn, largely results from a reduced mobility of livestock. There is little evidence from aerial survey data, however, that reduced livestock mobility has altered livestock population sizes or species composition over the long term.

REFERENCES

- Behnke, R.H., and I. Scoones. 1993. Rethinking range ecology: Implications for range management in Africa. Pages 1-30, In: Range ecology at dis-equilibrium: New models of natural variability and pastoral adaptation in African savannas (eds. R. Behnke, I. Scoones, and C. Kerven). Overseas Development Institute, London.
- Coppock, D.L. 1994. The Borana plateau of southern Ethiopia: Synthesis of pastoral research, development and change, 1980-91. Systems study no. 5. International Livestock Center for Africa, Addis Ababa. Ethiopia. 374 pp.
- Desta, S. 1999. Diversification of livestock assets for risk management in the Borana pastoral system of southern Ethiopia. Ph.D. Dissertation. Department of Rangeland Resources, Utah State University, Logan. 189 pp.
- DRSRS (Department of Resource Surveys and Remote Sensing). 1995. Data summary report, Kenya rangelands: Livestock mean, standard error, trend and regression analysis, 1977-1994. DRSRS, Nairobi, Kenya.

- Ellis, J.E., and D.M. Swift. 1988. Stability of African pastoral ecosystems: Alternate paradigms and implications for development. *Journal of Range Management* 41:450-459.
- Herlocker, D.J. 1992. Vegetation Types. Pages 19-26, In: Samburu District, Range Management Handbook of Kenya Vol. II, 2, (eds. S. Shaabani, M. Walsh, D.J. Herlocker, and D. Walther). Republic of Kenya, Ministry of Livestock Development, Nairobi.
- Herlocker, D.J. 1993. Vegetation Types. Pages 21-29, In: Isiolo District, Range Management Handbook of Kenya Vol. II, 5, (eds. D.J. Herlocker, S. Shaabani, and S. Wilkes). Republic of Kenya, Ministry of Agriculture, Livestock Development and Marketing, Nairobi.
- Herlocker, D.J. 1994. Vegetation Types. Pages 14-26, In: Baringo District, Range Management Handbook of Kenya Vol. II, 6, (eds. D.J. Herlocker, S. Shaabani, and S. Wilkes). Republic of Kenya, Ministry of Agriculture, Livestock Development and Marketing, Nairobi.
- Herlocker, D.J. (ed). 1999. Rangeland ecology and resource development in Eastern Africa. GTZ, Nairobi. 393 pp.
- Herlocker, D.J. and D. Walther. 1991. Vegetation Types. Pages 51-52, In: Marsabit District, Range Management Handbook of Kenya Vol. II, 1, (eds. H.J. Schwartz, S. Shaabani and D. Walther). Republic of Kenya, Ministry of Livestock Development, Nairobi.
- Herlocker, D.J. and D. Walther. 1992. Vegetation Types. Pages 18-22, In: Madera District, Range Management Handbook of Kenya Vol. II, 4, (eds. S. Shaabani, M Walsh, D.J. Herlocker, and D. Walther). Republic of Kenya, Ministry of Livestock Development, Nairobi.
- Herlocker, D.J., M. Nicholson, and S.Allanson. 1995a. Marsabit District. Pages 18-20, In: The climatology of northern and north-eastern Kenya, Vol. II, 10. Republic of Kenya, Ministry of Agriculture, Livestock Development and Marketing, Nairobi.
- Herlocker, D.J., M. Nicholson, and S.Allanson. 1995b. Samburu District. Pages 35-42, In: The climatology of north and north-eastern Kenya, Vol. II, 10. Republic of Kenya, Ministry of Agriculture, Livestock Development and Marketing, Nairobi.
- Herlocker, D. J., M. Nicholson, and S.Allanson. 1995c. Wajir and Mandera Districts. Pages 43-63, In: The climatology of northern and north-eastern Kenya, Vol. II, 10. Republic of Kenya, Ministry of Agriculture, Livestock Development and Marketing, Nairobi.
- Herlocker, D.J., M. Nicholson, and S.Allanson. 1995d. Isiolo District. Pages 64-72, In: The climatology of northern and north-eastern Kenya, Vol. II, 10. Republic of Kenya, Ministry of Agriculture, Livestock Development and Marketing, Nairobi.

- Herlocker, D.J., M. Nicholson, and S.Allanson. 1995e. Baringo,Elgeyo Marakwet and West Pokot Districts. Pages 92-96, In: The climatology of north-western Kenya, Vol. II, 11. Republic of Kenya, Ministry of Agriculture, Livestock Development and Marketing, Nairobi.
- Homewood, K. and W. A. Rogers. 1987. Ecology of pastoralism in Ngorongoro Conservation Area. *Tanzanian Journal of Agricultural Science*102: 47-72.
- IPAL (Integrated Project in Arid Lands). 1984. Final summary report. IPAL/UNESCO. Nairobi, Kenya.
- Keya, G. (1998). Impact of land use patterns and climate on the vegetation ecology of arid and semi-arid nomadic pastoral ecosystems of northern Kenya. *Materialien zur Ostafrika-forschung Heft 17*. Trier, Germany: Alle Rechte bei der Geographischen Gesellschaft Trier.
- Mäckel, R. 1994. Assessment and demonstration of causes for range condition changes in southwestern Marsabit district, Kenya.
- Sandford, S. 1983. Management of pastoral development in the third world. Overseas Development Institute, London.
- Sinclair, A.R.E. and J.M. Fryxell. 1985. The Sahel of Africa: ecology of a disaster. *Canadian Journal of Zoology*. Vol. 63, 987-994.
- Skovlin, J.J. 1984. Long-term trends from selected range sites throughout Kenya. Pages 537-8, In: *Proceedings, Second International Rangeland Congress, Adelaide, Australia.*