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DEGRADATION DEBATES AND DATA DEFICIENCIES: THE MKOMAZI GAME RESERVE, TANZANIA

Dan Brockington and Katherine Homewood

INTRODUCTION

The challenge of environmental history is to explain how and why environments have changed. But it is a demanding task. It is often easier to explain how particular interpretations of the environment formed, why they persisted and how they have been contested and reproduced by administrators, politicians and residents. Accounts of this type cannot always determine whether the interpretation in question was right or wrong. Ultimately, asking how a view came to be, and how it varied or stuck, does not tell us how correct it was. Sometimes no light is shed on whether or not statements made about forests, deserts, lakes, pasture or soil were true or false.

In one sense it is not a useful exercise to discern whether a particular theory portrays the truth about the environment. Groups construct images of the environment and environmental change that work for them which are not really within the realm of Popperian refutation. They exist and persist for a number of reasons in which 'hard evidence' or 'data' will not necessarily figure (Leach and Mearns, 1996). But discussing perceptions of nature only in terms of their social construction is unsatisfactory—it risks replacing natural reductionism with social reductionism (Entrikin, 1996; Proctor, 1998). Social constructions of nature say things about the environment that can be tested.

We hold that it is possible to test statements about the environment with data if one sets proper caveats to their use and the conclusions drawn. Our difficulties are more practical than theoretical. Sometimes it is not possible to reach firm conclusions from the data available. A major difficulty facing African environmental histories in general is how to cope with a paucity of good data. Speculation is always possible, but rejecting hypotheses may not be.

In this article we confront these dilemmas in the Mkomazi Game Reserve of northern Tanzania. There has been official and local concern over the environmental effects of pastoralism here for over 60 years. The government's concerns, local responses to them and pastoral resistance to central control ensure a wealth of records, claims and opinions about Mkomazi's environment. We have argued that

TABLE 1. *Contrasting perceptions of Mkomazi*

<i>Received wisdom</i>	<i>Alternative view</i>
<i>Environmental change</i>	
Pastoralists damage the eco-system by overstocking	Pastoralists do not damage the environment by overstocking
Soil erosion increases; rangeland vegetation becomes less palatable; bush invades pasture	Soil erosion does not increase to dangerous levels; vegetation dynamics are not driven by stocking rates
<i>Wildlife</i>	
Pastoralists compete for resources with wildlife to the exclusion of the latter	Pastoralists and wildlife do not compete to the exclusion of the latter
Pastoralists physically exclude wildlife from water sources and use up water, not leaving enough for wildlife; pastoralists exclude wildlife from good pastures and use up grazing	Competition over water and grazing is not sufficient to threaten the viability of the reserve's wildlife populations; pastoralists are excluded from some sites by the threat of diseases held or transmitted by wildlife
<i>Resource management</i>	
Local communities' resource use is not well organised	Local communities do organise their resource use
<i>Either</i> they are unable to act collectively of their own accord to prevent degradation resulting from their use of resources <i>or</i> attempts which they do organise are ineffective	Levels and extent of use are agreed and negotiated; sanctions are available to punish those who ignore these agreements

SOURCES: Brockington and Homewood, 1996

competing claims about Mkomazi's environment should be taken as alternative hypotheses (Brockington and Homewood, 1996). We now wish to examine some of the claims that have been made about Mkomazi's environment. Our goal is to test and if possible refute some of the hypotheses concerning vegetation change, overgrazing, livestock-wildlife interactions and resource management (Table 1).

We first outline the nature of the disputes and the complexity of the different world views brought to bear on Mkomazi. Then we consider the data cited to support ideas about Mkomazi's environment relevant to these hypotheses. Where data have not been cited we assess what evidence exists to support or refute the ideas.

DISPUTES OVER MKOMAZI

Mkomazi's environment has long been contested, and the last fifty years have seen disputes about Mkomazi grow from local to national and ultimately international concerns (Rogers *et al.*, 1999; Brockington, forthcoming). When it was set up in 1951, residence was allowed to some Parakuyo pastoralists who lived in the east of the reserve with a few thousand cattle. But the reserve held excellent pasture and was also used by hunters and honey gatherers, and for wild food and fuel wood. Legal and illegal use of its resources mounted over the next 35 years. By 1984 there were nearly 100,000 cattle living in and around its borders (Homewood *et al.*, 1997). The Department of Wildlife reasserted control over the reserve in 1988, evicting all who lived inside it and prohibiting any resource use. The principal reason given for the eviction of people was that they were destroying the reserve's environment (Mangubuli 1991).

Since it was cleared, Mkomazi has come to international attention both as a conservation triumph and as the focus of human rights concerns. It is the site of an ambitious programme to rehabilitate a wilderness and reintroduce black rhinoceros by UK and US conservation organisations.¹ It has been the focus of an international research effort, under the aegis of the Royal Geographical Society, which explores and documents the biodiversity of the reserve. But it was also the centre of an acrimonious (and unsuccessful) legal action by former residents of the reserve who contested the legality of their eviction and demanded rights to return to the reserve and compensation for losses suffered. Their case was supported by the Dar es Salaam University Legal Aid Committee and by UK-based charities (Rogers *et al.*, 1999).

Interwoven in the dispute are two competing views of the nature of pastoralism's impact on the environment. The most powerful view is that pastoralism causes overgrazing, soil erosion, deforestation, burning and depletes biodiversity. This view follows from the perception that herders do not regulate livestock numbers to meet the feed available. The assumed overstocking is thought to damage the vegetation cover, exposing the soil to erosion. The large livestock herds are seen as excluding wildlife, and the damage to vegetation as depleting avifaunal and insect life. The fires that herders set to regenerate the grasses are perceived as killing many forms of biodiversity and preventing forest regeneration. At Mkomazi this view underpinned the decision to evict herders:

Habitat destruction, as a result of overgrazing, led to choking of dams with silt, and change in vegetation composition and structure. No dams, except Dindira, could now hold water for the entire dry season period. Settlements

¹ The George Adamson Wildlife Preservation Trust (GAWPT), a British charity, and the US-based Tony Fitzjohn/George Adamson African Wildlife Preservation Trust (TW/GAAWPT).

increased around waterholes denying access by wildlife. These circumstances forced most of the wild animals to move out of Mkomazi into Tsavo National Park. Wildfires, often started by pastoralists, became an annual phenomenon, destroying and opening woodlands and montane forests. [Mangubuli, 1991: 12]

The ecological principle behind this view is that stocking rates are crucial to plant dynamics. Interaction between grazers and vegetation determines vegetation cover and composition.² Wildlife numbers are naturally regulated, but livestock are not; they are protected by people, and may thus exceed the natural limits and induce unnatural change. The sociological assumptions are that communally owned pastures will inevitably be degraded and that herders' stocking rates are irrationally high. People's greed and preoccupation with cattle result in too many animals (Hardin, 1968; Sinclair and Fryxell, 1985; Coe, 1990; Prins, 1992).

The idea that pastoralism is not destructive is less powerful. This view holds that pastoral stocking rates are rational responses to the environmental constraints (Dyson-Hudson and Dyson-Hudson, 1969; Dyson-Hudson, 1980). Effects of livestock use are seen as complex but do not correspond to the common concept of environmental degradation. They are rarely thought to cause environmental degradation. In a semi arid savanna environment the disturbance caused by grazing and burning is believed not necessarily to cause damage, but to result in a level of disturbance that fosters biodiversity (Homewood and Brockington, 1999). Livestock are seen as not excluding wildlife, rather the greatest concentrations of wildlife in East Africa depend on using grazing together with livestock (Western, 1982; Homewood and Rodgers, 1991).

The ecological basis for this challenge is the theory which holds that vegetation dynamics in drylands are not driven primarily by grazing pressure. Vegetation change is stochastic, non-linear and primarily dependent upon precipitation and the physical environment, rather than simply multiple biophysical interactions.³ The stress of a prolonged dry season and frequent droughts mean that herd numbers are continually checked, they rarely approach the concentrations

² Variation in livestock numbers on a given range would drive vegetation communities up or down known seres in predictable ways. A sere describes the development of vegetation communities towards a steady state. The concept comes from Clements' succession theory which holds that in a given eco-system bare ground will be colonised by successive assemblages of plants, each altering the environment in preparation for its successor until the most suitable vegetation for this climate, the climatic climax, is reached (Clements, 1916). The principal mechanisms at work are interactions between biotic elements of the eco-system. See A. Illius and T. O'Connor (1999) for a recent review advocating this.

³ There are two principal differences between these ideas and succession theory. First, the long-term importance of changes to the environment wrought by fauna is doubted. Second, vegetation assemblages do not change in predictable ways as the sere concept suggests.

necessary for herbivory to affect vegetation (Ellis and Swift, 1988; Westoby *et al.*, 1989; Behnke and Scoones, 1993; Sullivan, 1996).⁴

Economists' theories of communal property management suggest that communal use will not inevitably lead to abuse of the resource (Berkes, 1989; Bromley and Cernea, 1989; Ostrom, 1990, Ostrom *et al.*, 1999). The general conditions for successful and sustainable long-term communal resource management are becoming increasingly clear (Ostrom *et al.*, 1999). Anthropologists and economists have shown that herd sizes enhance long-term survival of household production systems through drought, and optimise long-term offtake in variable environments (Sandford, 1983; Western and Finch, 1986; Mace and Houston, 1989).

Two different conceptions of nature are implied by these competing ideas. One suggests a delicate balance between vegetation, soil and animals. Dryland eco-systems are seen as 'fragile', easily destroyed and threatened by clumsy, careless and shortsighted human action upsetting the equilibrium between the number of stock and the eco-system's long-term ability to sustain them. The second conceives of dryland eco-systems not as fragile but resilient, shifting between multiple alternative states depending on circumstances and thus able to recover from disturbance and stress. Equilibrium is neither a goal nor an indication of eco-system health. Change is stochastic, uncontrollable. Nature is independent of people, ungoverned by their actions.

But the disputes are about more than the impact of cattle on the environment or how nature should be conceived: they have a strong political dimension (Sullivan, 2000). The proposition that pastoralists degrade or do not degrade the environment is integral to beliefs about what East African landscapes should look like and what people's proper place in nature is. They have different political and social agendas for use of the reserve's resources.

Conservationists active in the reserve celebrate Mkomazi as a reclaimed wilderness, a landscape restored to what it should look like, saved from becoming a barren desert (Watson, 1991).⁵ They believe that the reserve should be consumed by photographic tourist safaris (Neumann, 1998). The main users now will be foreign tourists whose entry fees will assist local development projects. In the future, it is envisaged more and more Tanzanians will enjoy the reserve's recreational amenities and natural beauty.

⁴ The relative importance of infrequent and weak but nonetheless occasionally density dependent interactions is the focus of ongoing debate (Illius and O'Connor, 1999; Sullivan and Rohde, forthcoming). Empirical evidence for the relatively minor role of grazing pressure on long-term environmental change in arid and semi-arid areas is mounting (e.g. Sahel: Turner, 1998a b; Turner, 1999; Namibia: Sullivan, 1999; 30-year analysis of Serengeti-Mara eco-system: Homewood *et al.*, forthcoming).

⁵ The views of conservationists are divergent. By labeling this viewpoint 'the conservationist position' we do not imply that all conservationists think like this.

In contrast some Maasai and Parakuyo herders claim it as their home. They say herds flourished within the reserve, that they did not damage the environment and that pastoralists' presence deterred poachers (Mustaffa, 1997). They want to use the reserve's resources now for cattle herds supporting local livelihoods. The pastures will contribute directly to local livelihoods and the local economy.

Subtler confrontations are at work, too. The conservation organisations active at Mkomazi exist in order to save the reserve, but also need threatened reserves to exist. If the reserve were not endangered, and its environment not fragile, it would not need saving, and would not justify sponsors' money. The fund-raising literature about Mkomazi attempts to make the name and a particular image of the reserve popular and normal. The conservation activities undertaken are pursued with that end in mind. The reintroduction of rhinoceros, for example, was partly a political, image building project, deliberately encouraged to enhance the reserve's prestige, as well as an ecological restoration scheme (Igoe and Brockington, 1999).

The same political, image building dimension is true of pastoralists' campaigns. Although almost all pastoralists farm and pursue other livelihoods, transfers of cattle still mediate social relations and bind families together in ties of marriage and exchange. Controlling cattle enhances participation in pastoral social networks. Claims on the pastures of the reserve are as much in pursuit of a way of life as of a livelihood. Furthermore the proliferation of indigenous peoples' non-governmental organisations adds another dimension to the contest. Rival NGOs have competed to represent the evicted from Mkomazi, and to gain access to lucrative Western funds available for activism and lobbying. The power of funders' money means that funders not herders become the NGOs' real constituents (Igoe, 2000).

The polarised dispute reported above is more representative of international opinion about the reserve than national and local opinion. Nationally and locally, the spectrum of opinion about the reserve is broad and these views are from the spectrum's edges. There are many in government and conservation who would be happy with less draconian exclusion policies. Equally, there are many locals who are wary of admitting notorious cattle rustlers so close to their doorstep. The majority of the reserve-adjacent population are not Maa-speakers. Their ethnic identity does not depend on cattle (Homewood *et al.*, 1997). They would be probably be content with limited use of resources close to the reserve's borders.⁶

The administrators have had to adjudicate between the competing claims of ardent conservationists, wronged herders and irate local farmers. The state is partly responsible for the current disputes. Their

⁶ Note that allowing tourists in favours one elite, but allowing herding in the reserve favours another. Cattle owners are by definition wealthy in Tanzania, and pastoralists with large herds are probably the richest element of modern Tanzanian rural society.

origin lies in colonial concerns about which ethnic groups should live where and how rangelands should be best used, and in local resistance and adaptation to these plans. But the state is not entirely to blame. In other ways the state has just become embroiled in local contests between residents and immigrants over access to resources on the plains. The history of Mkomazi is as much a history of pastoral expansion and local resistance to new arrivals, by residents and earlier pastoral immigrants, as of conservation.

Throughout these disputes there are two strong continuities in official thinking. First, that the plains and the reserve within them should generate revenue and enhance development and, second, that in the process the environment should not be degraded by herders. In the 1950s this almost led to the abolition of Mkomazi Game reserve for fear that it removed too much land from useful production (Brockington, 1998). Environmental concerns ensured its survival. In the 1990s the central government has more strongly supported the use of the reserve to generate tourist income, which comes in US dollars and is more easily accessible to central government than are the locally circulating shillings the cattle economy creates. Environmental concerns are congruent with their endeavour. At all times farmers and herders have sought to manipulate official thinking to their own ends.

All in all there are a plethora of opinions (including our own, Rogers *et al.*, 1999) about what to do with the reserve, and what to do about all the other ideas for it. The debate is shrill. Reasoned opinion about what was actually happening to the environment, rather than what should be happening to it, is rarer. To attempt this appraisal we consider two bodies of evidence. The first is a series of statements about the environment made by various people about changes to, and the state of, Mkomazi's environment. This we call the 'social record'. The second are data about the physical environment—rainfall, cattle numbers, vegetation change and biodiversity. These we call 'physical data'.⁷

⁷ The labels do not indicate an epistemological distinction between observations and data. The labels may be unhelpful but we do not want the connotations of words like 'data', 'social' and 'biophysical' to limit our use of them. All 'facts' are collected in a social context, all involve some analysis and interpretation in their collection and presentation. All are part of a social record of observations about the reserve. Some were collected with political purposes in mind. Cattle numbers are collected (and offered by herders) with a view to forthcoming cattle taxes or possible removals. Vegetation data were collected because authorities were concerned that there were too many cattle and it might be necessary to advocate their removal. The biodiversity surveys conducted by the RGS were instituted and reported with a view to raising the profile of the reserve (Homewood and Brockington, 1999). Rather, the distinction is simply one of focus; we draw it for convenience. The physical data are specific statements about the environment, the social record is more general. The physical data refer to particular elements of the environment about which it may be possible to draw precise conclusions. The social record consists of more general statements, conflating changes to soil, vegetation, wildlife and cattle numbers.

THE SOCIAL RECORD

What have people said about the environment, and what light does that throw on how it has changed? There are three sets of opinions to consider—administrators', cattle keepers'—both pastoralists and agro-pastoralists—and conservationists'. The first are concerned with the environmental, economic, social and political problems of the location of herders and their stock. Pastoralists wrote to their local government officers and each other in response to overstocking and mismanagement of herds and pastures. Conservationists have left us with a valuable record of what happened to the environment in the absence of people.

The administrators

The internationalisation of disputes around Mkomazi is the latest stage of more than sixty years of contests over the use of the plains on the eastern borderlands of Kenya and Tanzania (Rogers *et al.*, 1999).⁸ A collection of environmental statements about Mkomazi and its environs recorded in the course of these disputes is shown in Table 2. It is derived from archival records of disputes surrounding the location of cattle and herders first at Toloha and subsequently inside and around Mkomazi.⁹

The complex train of events provides a rich source of statements about environmental change spanning years, but it is a record which mixes 'simple' environmental concern (about what is happening to soil and grass) with more overtly political goals (about where particular groups should be located, and how they should be contributing to development). Nevertheless there is remarkable consistency about the negative environmental impact of pastoralism in official circles before and after independence. The significant exception was the pro-Maasai view of a prominent sociologist (Henry Fosbrooke) who was keen that the Toloha Maasai should not be moved and maintained that they were better stock keepers than the Pare.

⁸ Contests over the use of the plains extend into the nineteenth century (Brockington, forthcoming).

⁹ The 'Toloha Maasai' problem was part of the general movement of Maa-speaking pastoralists east of the Ruvu valley after the 1920s. One of the places they moved to was Toloha, an area of plains between the middle and north Pare mountains close to Lake Jipe. Local Pare leaders, neighbouring Kenyan officials and the Tanganyikan authorities objected to their presence variously because they were beyond the area designated for the Maasai, they stole cattle and caused overgrazing. In 1951 the Toloha pastoralists migrated eastwards to the Katamboi waterholes, just inside the south eastern corner of Tsavo National Park, and to Mnazi, north of the Usambara mountains. Their arrival coincided with the creation of the Mkomazi Game Reserve. The authorities decided that the Maa-speaking Parakuyo pastoralists (also called Kwavi), who already lived around Mnazi, should be allowed to stay, but that the Maasai should be evicted. With time the continued residence in the reserve by the Parakuyo was perceived to cause damage to the environment and a number of government officials began agitating for their removal. At the same time Parakuyo, Maasai, Sambaa, Kamba and Pare pastoralists who had been excluded from the reserve actively set about using it, and lobbying for their use to be legalised. This continues to the present day.

Both pro-pastoral, and anti-pastoral views are based on flimsy data. Before 1966 there were no studies of the impact of livestock on vegetation and all remarks seem to be based on observation alone, often relatively brief. We have no idea about how well qualified these observers were, or how well they made their observations, and what norms, or previous conditions they were comparing them to. In a sense then, it is difficult to know what these observers were seeing, and what therefore the environment was doing. Although two studies were completed in 1966 and 1967 (see Vegetation change section below) it is hard to tell to what extent these studies were known as the findings were cited only once.

Anderson (1984) has shown that fears of erosion in Kenya reflected fears of erosion driven by events abroad (the Dust Bowl), that the resulting concern was exploited for political ends. It is easy to see parallels between this situation and the convenient coincidence of the government desire to move pastoralists out of the Mkomazi or Toloha area and their excitement about soil erosion there. Degradation proved a convenient platform on which to lobby for other agendas. However that would not *per se* refute the notion that livestock were causing soil erosion. The political utility of an argument does not necessarily invalidate its conclusions.

In some other situations, a long record of perceived degradation has been used to discredit the existence of degradation. In particular, if doom-laden predictions have been made, it is possible to compare them to the subsequent state of the environment. If the predictions have proved false then so may have been the understandings and depictions of the environment upon which they were based. Thus if people have always been scared that the environment is about to 'end', and it has not done so over 50 years, then does that mean that the fears were groundless? This has been effectively employed at Machakos where experts were predicting irrevocable loss of soil in the 1930s, but where the environment subsequently sustained a five-fold increase in the population alongside improving environmental indices (Tiffen *et al.*, 1994). It has also repeatedly been observed that the geomorphologically unstable parts of Baringo area were suffering severe erosion, but that the region has continually and repeatedly shown rapid recovery of livestock populations after drought and die-off to support large numbers of cattle (Homewood, 1994).

We appear to have a similar situation here. Dire prophecies have been made about the consequences of pastoralism in and around Mkomazi. Does their reiteration over 60 years alongside the persistence of increasing livestock numbers invalidate them? Not in this case. The claims cited in the table refer to a variety of different situations, ranging from whole districts to specific places. The repeated statements about Toloha are only for a six-year period. Concern in the 1960s is restricted to the environs of the reserve in the east. In the 1970s and 1980s statements are much more general and refer to the reserve as a whole. We do not have a sufficiently constant record of concern about one place to say that the predictions are invalidated because their persistent

TABLE 2. *Administrators' views about the plains.*

<i>Date</i>	<i>Context</i>	<i>Statement</i>	<i>Source</i>
December 1938	Annual report of the Pare District Commissioner	'Upare covers about 3,000 square miles. One half is mountainous, fertile and thickly populated: in the other half conditions prevail that are little different from desert conditions. Extensive denudation has taken place as the result of extensive grazing and uncontrolled and unskilful [<i>sic</i>] methods of agriculture' 'The area is grossly overgrazed and, aggravated by the lack of rain this year, appears likely to become semi-desert fit only for goats and camels within a few years. It is essential to find alternative grazing for a large proportion of the Stock to allow the area to recover'	TNA File 6/1
August 1946	Assistant District Officer, Pare to District Commissioner, Pare, about the stock situation at Toloha	District Commissioner Voi to the Provincial Commissioner Coast, over Tanganyikan requests to use Kenyan grazing	TNA File 723/II
February 1949	Henry Fosbrooke, Senior Sociologist, arguing that the Toloha Maasai were useful residents and should be allowed to stay in Pare District	'In general I feel that the policy of pandering to the Maasai and of allowing them to roam at will ruining the country and spreading East Coast Fever and other diseases is an outworn creed. They alone of African tribes appear to be able to "get away with" the dislike of hard work which is common also to other less fortunate mortals'	KNA File DO/Tav/1/26/13
April 1953		'[The Pare] do not practice [<i>sic</i>] the seasonal movement of the Maasai, with a result that 1,000 head of Pare cattle do more damage to the grazing than do 10,000 head of Masai cattle'	TNA File 11/5 vol III
December 1955	Member for Agriculture and Natural Resources to the Provincial Commissioner, Tanga, explaining why the Mkomazi Game Reserve should not be degazetted to meet resource needs of the local population	'The present position appears to have arisen through failure to effect any control of the number of livestock grazing on the plains in this area, with the result that the grazing over a large area has seriously deteriorated and the carrying capacity of the land has declined in a comparatively short period of time. The great difficulty in exercising such control is fully appreciated but until some progress is made in this direction, it would not be wise nor in the interests of the people themselves to open up the land to be devastated in the same manner'	TNA File G1/7

9 January 1961	Provincial Commissioner, Tanga, to Permanent Secretary, Ministry of Agriculture and Co-operative Development, concerning a Parakuyo complaint of lack of access to Mkomazi	'The short answer is that an increasing infiltration by Maasai and Kwavi cattle, coupled with the complete lack of any grazing control, has led to a deterioration in grazing in the areas concerned. . . . To abandon the Mkomazi Game Reserve, with resultant disastrous effect both on game control and preservation, would also be no more than a temporary palliative quickly made valueless by over-grazing in such areas where there are water supplies'	TNA File G1/7
5 April 1966	Appraisal of the range condition of the Kalimawe Game Controlled Area by the College of African Wildlife Management	'The "poor" or "very poor" vegetative condition classifications for Kalimawe was corroborated [exacerbated?] by . . . the gradient . . . such that with destruction of the perennial grass cover erosion starts immediately. Sheet and gully erosion was widespread in this type [sic]. Tons of the silt are being added to the Kalimawe Reservoir [sic] annually Even more serious is the loss of topsoil and permanent reduction of the range's capacity for either livestock [sic] or big game'	TRA TA4. Box 12 G1
3 August 1966	Game Warden, Lushoto to MP, Lushoto North concerning a complaint of the citizens of the area to have more access to the reserve	'In a short time this area [Eastern Mkomazi and especially its southern border] will become like the desert of Engaruka in Masai District because the residents there keep a quantity of cows which exceeds the capacity of the grazing, soil and water. We will shortly face the prospect of the River Uмба drying up because the trees around the river have been finished off and pushed over by cows'	TNA File G1/7
June 1976	J. S. Ibeun, dissertation for Diploma in Wildlife Management at the College of African Wildlife Management	'In most of the Eastern sector of the game reserve soil degradation due to overgrazing and trampling by cattle (leading to soil erosion) is quite evident. Other major results of human pressure are manifest in the occurrences of unplanned fires set by cattle herders and poachers. In view of the "precarious" nature of the semi-arid eco-system of the Mkomazi Game Reserve, unplanned fire may have far reaching consequences on the game reserve's primary productivity'	Ibeun 1976
13 April 1988	Principal Secretary, Ministry of Lands, Natural Resources and Tourism to all residents of the reserve announcing their eviction	'By this letter I would like to tell you that all those who were permitted to live inside Mkomazi/Umba Game Reserve . . . are now required to leave . . . This decision was arrived at with the intention of saving this wilderness . . . '	URT GD18/R/8/ 226

pessimism is not fulfilled. Indeed the predictions of environmental misfortune are not really precise enough to be tested. All we can say is that a consistently gloomy view of the environmental consequences of pastoralism has been taken in the absence of any cited evidence to support it and despite the presence of thriving cattle populations.

The pastoralists

Some of the more interesting records of environmental change and degradation are afforded by livestock keepers themselves. These records consist of a number of letters written by local herders to their village governments. All, bar the second, are complaints about the consequences of excessive grazing on pastures that they had set aside for their herds. There are two types. The first is that visitors to the area have 'finished up' the grazing leaving little for the residents' herds, the second that visitors have used particular reserved pastures out of season. The relevant sections of the letters are translated in Table 3.

The complaints about untimely use of reserved pasture refer to the illegal use of 'calf pastures'. These are set aside near watering points for use in the dry season by young and weak animals when pastures are often available only far from water. Calves and weak stock would die without them. These pastures could be communally or privately owned.

The records indicate that communal management of calf pasture was attempted. Indeed there are still a variety of practices current in the area of Mkomazi, including the setting aside of fodder trees, particularly certain acacia species whose seed pods provide a valuable source of nutrition during the dry season, especially for small stock. However, one cannot conclude that, because the schemes were in place, they worked. The letters are in fact indications that they failed on some occasions, and there is little evidence to say that the arrangements which followed them were any more successful. All these records show is that people tried to manage their environment through regulation, sanctions and negotiation, and that in some cases the management was contested. This makes them less anarchic than some of the hypotheses of Table 1 suggested but not necessarily effective at stopping environmental problems.

Was degradation the consequence of this failure? It would appear that if people were talking about the 'finishing' of their grazing and the destruction of their pastures that there were problems with the environment. There is some resonance between the official accounts of degradation around the borders of the reserve, or at Toloha, and these local complaints. However, they may yet be talking about different things. The pastoralists may be talking about the loss of one year's biomass, not of long-term damage to the productive capacity of the eco-system. Only the latter is degradation. There is no indication from these letters that the environment was degrading (Homewood, 1999).

There is also a further problem in that residents of an area might say that their grazing is being destroyed in order to encourage official sanctions against immigration. This was particularly the case at Toloha

TABLE 3. *Problems with pastures*

'I have received news . . . that Maasai from Arusha Chini/Moshi have brought their herds to graze . . . and that they are finishing all the grass and [our] cows . . . are lacking grass and when [the Maasai] herds finish all the grass they go back whence they came and the Pare beasts are not able to go to Arusha Chini. Please intervene to resolve this problem.'

President of the Native Court, Usangi to the District Commissioner (DC), Pare, 3 July 1946, TNA file 11/5 vol. II

'Now (the Maasai) are going beyond (the Jipe watering point) where they see much grazing, because on this side of Vilima Viwili there is not even one blade of grass, which is why they try and steal grazing.'

Veterinary Guard of Toloha to the DC, Pare, requesting watering points on Tanganyikan land, 1 September 1946, TNA file 11/5 vol. II

'I received a complaint from these comrades who herd their animals in the Game Reserve of Mkomazi . . . that there are Maasai who have entered this Reserve and . . . Pare from . . . many . . . places . . . these citizens have asked me to give help to expel these herders.'

Ward Secretary of Kisiwani to the District Commissioner, Same, after complaints from Parakuyo resident in Mkomazi, 6 January 1976, Kisiwani Livestock File

' . . . our herds do not have grazing because thousands of other animals are brought . . . from outside this village. And if they finish the grazing they leave and go back to their place; they await the monsoon and other rains that bring grass, they return and thus they have their benefits and our herds are very sick.'

The Pare people of Igoma sub-village to the Ward Secretary of Gonja Ward, 8 June 1977, Kisiwani Livestock File

'Since this reserve was gazetted by the government, Kwavi have lived (here) . . . In 1963 here in this Reserve there began serious problems between the Kwavi and employees of the Game department. People were arrested night and day. This dispute carried on until 1967 when the government decided to return these people and to write a new list of names . . . But in the years 1968-9 herds . . . began to come [from] . . . outside the borders and, after a few months, we saw these cows had entered that Reserve which had been forbidden . . . Straight away the Reserve began to be damaged/disturbed and to fill up with people from outside with permits from cash.'

Local leader of Parakuyo and Maasai pastoralists to the Ward Secretary of Kisiwani following proposals to change the procedure for getting permission to use the Reserve, 18 July 1977, Kisiwani Livestock File

'Troubles have resulted in this time of the short dry season which were caused by various cows from outside the Reserve. I have therefore called a meeting to debate this question from which we reached the conclusion that all the section west of the Korongo la Msara should be a reserved grazing area. All this area which we are setting aside is a store area for the future need of dry season grasses or all people with difficulties. Respected comrades, in the meeting we agreed that from the beginning of 1 January 1981 the reserved grazing area will be closed until 25 August 1981 each year until another law is enacted.'

Local leader of the Maasai and Parakuyo pastoralists setting aside a dry season grazing area, 20 December 1980, Kisiwani Livestock File

in the 1950s when Pare herders were anxious that Maa-speaking herders should not obtain too strong a foothold near their own grazing grounds. This is not to say that there was not 'overgrazing', or that there was no degradation. Just that an ulterior motive exists that could have swayed, and possibly exaggerated, reporting of the problem. Yet again the evidence from these accounts is inconclusive.

The conservationists

A wealth of confident assessments about the state and destruction of Mkomazi's environment under pastoralism that have been made by conservationists associated with the reserve. Mangubuli's claim, quoted above (pp. 451–2), exemplifies the case and there is no need to list further examples. All the statements are flawed in that they do not cite any data, nor do they deal with the theoretical objections to overgrazing discussed above. This does not mean that they are necessarily wrong.

Much more interesting, however, are the observations and comments made after the reserve was cleared. These speak of an environment that is healthy and well, that has recovered from the previous ravages and that is whole again. For example, Watson, writing in *Swara* in 1991, said that Mkomazi had been 'brought from the brink of collapse and restored to its former glory' (1991: 14). The curious thing about these assessments is that they are made such a short time after the original predictions of doom and assessments of disaster. One has to ask whether the situation was really that bad if things have recovered so quickly. The degradation of the reserve must have been remarkably ephemeral. A similar picture is gleaned from the diaries of those working inside Mkomazi (Table 4).

Ironically these accounts suggest the resilient environment that non-equilibrial ecology envisages, rather than the fragility the writers thought they had saved. This is an environment that can recover rapidly from grazing pressure because its vegetation dynamics are driven primarily by rainfall, and only to a lesser extent by grazing pressure. The accounts are doubtless coloured by enthusiasts' eagerness to think positively about an environment which is now free of people. Nonetheless, these statements are possibly the strongest indication there is in the social record that the environment at Mkomazi is resilient, and that its dynamics may be best explained by non-equilibrial ecological theories. They further suggest that the impact of grazing and livestock was short-lived and that therefore, by definition, the environment was not degraded in any significant sense. However they give little clue as to what the nature of the impact of grazing had been, or where that impact had been most pronounced. The excessively rapid transformation of Mkomazi into an environment that conservationists like is not sufficient evidence to refute the hypothesis that livestock changed vegetation dynamics, or that soil erosion rates have decreased since eviction. Just as these social constructions of the environment can persist with little reference to 'hard evidence', so it is difficult to use them to refute specific propositions about environmental change. They

TABLE 4. *Ephemeral degradation*

'I first visited Mkomazi in 1989. The only resources in plentiful supply were hope and expectation. Years of uncontrolled poaching, burning and illegal overgrazing had left most species of game scattered and scarce. . . . The progress that has been made in three years is, literally, spectacular. As we visited in the dry season game was not abundant but it was all there.'

Robert Marshall-Andrews, QC, MP, Trustee of the George Adamson Wildlife Preservation Trust, report on the first Friends' visit to Mkomazi, August 1992

'In the beginning of November [1992] the waterholes were all dried out and cracked and their surfaces a maze of cracked, hard impenetrable mud. The roads were washed with several inches of dust. . . . It was impossible to imagine there was anything nutritious left at all for the animals to eat or the vegetation to soak up in the Reserve. Any grass that had been left to dry out had by mid November burned due to natural fires or deliberately set ones. Then during the second week of November the clouds began to build and on the 11th, rain kissed the frog and the bush transformed.

The fairytale began. Magic permeated every drop of rain that sprinkled the Reserve. . . . The animals weakened from the drought were now faced with not enough strength to stand up in the downpour nor ability to cope with the outrageous extravaganza. Many perished by the side of the road. . . . Literally, within 2–3 days new grass shoots sprouted throughout the Reserve, and every bush and tree peeled back their surfaces to reveal their buds. Like Mardi Gras, the insects and birds took to the streets. I have never seen such wild ecstasy—the insects were multiplying on the wing and coming from EVERYWHERE and birds all the way from Europe were enjoying the moveable feast. . . . Not only are all the waterholes and korongos (river beds) full, but also standing water is prominent throughout the Reserve. And the bush—wow!—it is so green and thick with vegetation. The grass stands over 6 feet tall in places where you could never have thought a seed of grass could have lodged let alone grow.'

Kim Ellis, then partner of Tony Fitzjohn, Field Director of the George Adamson Wildlife Preservation Trust, newsletter, early 1993

'Mkomazi was gazetted in 1950 and maintained as a Game Reserve until around 1970 when extensive human encroachment was not combated. By 1988 Maasai bomas covered much of the Reserve. . . . Mkomazi was verging on a wasteland. . . . by the beginning of last year [1993] we could honestly say that a spectacular environmental recovery had taken place, the elephant population had gone from 11 to 300 and even 900 at certain wet season times of the year, and everything else was on the increase.'

Tony Fitzjohn, Field Director of the George Adamson Wildlife Preservation Trust, speech to the Royal Geographical Society, 1994

'In all some 78 species of mammals have been recorded [in Mkomazi]. . . . That so much wildlife remains is a miracle. By the late 1980's Mkomazi was in steep decline. Heavy poaching had wiped out its black rhino and elephant populations. Overgrazing, deliberate burning and illegal hunting had also taken their toll. . . . in 1989 the Mkomazi Project was born. . . . The result has been a spectacular success. One of the most fragile, threatened and beautiful parts of Africa has been reborn. Already the years of hard work have had a profound effect on the animals living in the Reserve.'

George Adamson Wildlife Preservation Trust fundraising literature, c. 1994.

make an order of statement about the environment other than do specific hypotheses.

PHYSICAL DATA

Where allegations of environmental degradation conflate changes in soil, vegetation composition, vegetation structure, fire regime, biodiversity and large mammal populations, then specific data are needed to test the claims made. Can, for example, the warnings of desertification be corroborated with data about vegetation change, soil loss or declining cattle health and numbers? Here we consider data on rainfall, livestock numbers, vegetation and wildlife separately to see if any conclusions can be drawn about the nature and causes of change at Mkomazi.

Rainfall

Mean rainfall at Same town and Voi is less than 600 mm. Close to the eastern (windward) side of the Pare mountains more than 700 mm is recorded (Table 5). Totals further out on the plains are thought to be nearer to those of Same and Voi (McWilliam and Packer, 1999: 17). This makes the reserve, with the exception of its mountains, a semi-arid area. The co-efficients of variability at all sites underlines how unpredictable rainfall is here. These are above the 30 per cent level suggested by Caughley *et al.* (1987) to indicate eco-systems likely to be explained best by non-equilibrial dynamics (Ellis *et al.*, 1993: 33).

Figure 1 makes the same point. Rainfall totals are commonly far from the mean. These are data best described by their variability rather than their averages. The graph also shows that there have been no long-term trends in the amount of rainfall that has fallen in and around the reserve area between 1935 and 1990. Data are patchy, but no overall trends are evident from Same and Voi (McWilliam and Packer, 1999: 17). If there has been environmental change, it is unlikely to have occurred because of climatic change.

Livestock Numbers

The plains in which Mkomazi was gazetted were occasionally grazed in

TABLE 5. *Rainfall at sites around Mkomazi*

<i>Station</i>	<i>Mean (mm)</i>	<i>Coefficient of Variability (%)</i>	<i>Years of data</i>
Same	566	32.9	60
Kiswani	734	49.4	18
Gonja	894	31.0	44
Mnazi	782	32.5	28
Voi	556	36.4	87

SOURCES: East Anglia Climate Research Group; Dar es Salaam Meteorological Office; Same Town Meteorological Station; Harris (1972).

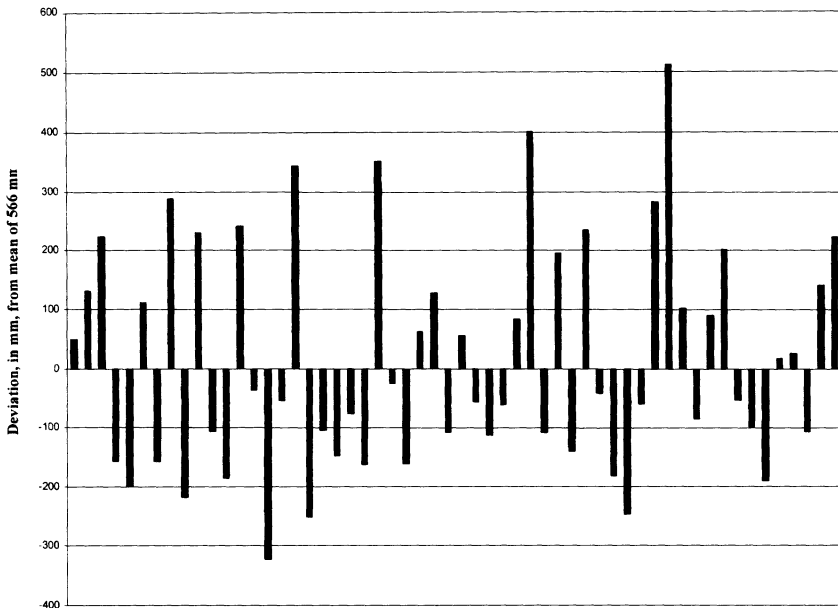


FIGURE 1 Rainfall at Same town 1935–90. *From district records*

the nineteenth century but often emptied by war and disease (Brockington, forthcoming). In the twentieth century livestock numbers steadily increased and herders increasingly looked to the reserve for pastures (Brockington, 1998). The presence of livestock has always concerned authorities; increase in stock alarmed them. However, inconsistencies and weaknesses in the reports about the effect of cattle make it hard to determine what impact domestic animals actually had on the eco-system.

In 1967 a report was written evaluating the current use of the reserve and discussing future plans (Anderson, 1967). Anderson refers to their being 3,000–5,000 cattle ‘grazing within the reserve’ (which at the time meant only the eastern portion, *ibid.*: 15). Anderson states that:

Because of the restricted range and more selective grazing habits of cattle, they exert a very destructive force on the eco-system. Neither the habitat nor the cattle will be able to withstand this grazing pressure for long. The habitat will continue to deteriorate until herders will be forced either to move into denuded areas or localities outside of the reserve. [*ibid.*]

But by Anderson’s own criteria the reserve was understocked. If the cattle are assumed to be using one quarter of the reserve, then 5,000 cattle would give a stocking rate of one animal per 29.8 acres. Anderson states that suitable stocking rates vary from half an acre per beast in a few choice areas to over 8 acres per beast over the majority of the

TABLE 6. *Cattle resident in Umba Division 1951-68*

<i>Year</i>	<i>Location</i>	<i>District Records</i>	<i>Game Ranger reports</i>	<i>Aerial Count</i>
1951 ^a	In the reserve	—	b	—
1952 ^c	Umba Division	15,000-33,000	—	—
1953 ^d	Umba Division	16,503-28,291	—	—
1960 ^e	Umba Division	21,984	—	—
1960 ^f	Mnazi, Kivingo and Lelwa	16,000	—	—
1963 ^g	In the Reserve	—	4,300	—
1964 ^h	In the Reserve	—	—	3,235
1964 ⁱ	Plains north of the Usambara mountains	14,000	—	—
1964 ^j	Reserve-adjacent villages	32,721	—	—
1965 ^k	Mnazi and Kivingo	30,000	—	—
1965 ^l	Outside the reserve	38,561	—	—
1966-67 ^m	In the reserve	—	—	1,350-3,000
1967 ^c	Umba Division	45,245	—	—
1968 ⁿ	In the reserve	—	21,080	—

NOTES The Umba Division comprises the plains in Lushoto District north of the Usamabara mountains.

a Reported by David Anstey to Director of Game. TNA file G1/7, 24 January 1967.

b 'A few thousand Wakwavi cattle and a small number of herdsmen lived in the Reserve and on the south bank of the Umba outside the Reserve near Mnazi and Lelwa. There were a small number of Sambaa and Kamba etc., cattle owners at Kivingo, Mnazi, Kamba and Lelwa.'

c Correspondence between Tanganyikan and Kenyan officials over Tanganyikan requests for grazing, TNA file 723/III.

d TNA file 6/1, Lushoto District Annual Report. The figures are estimates derived from the total livestock population given for the district. Later livestock censuses found between 28% and 48% of the district's cattle population in Umba Division and 98% of that figure on the plains below the mountains. We applied these proportions to the district data, providing the estimates shown.

e District census, Lushoto District Livestock Office wall-chart.

f District Commissioner, Lushoto to a lawyer hired by Pare and Sambaa herders. TNA file G1/7, 15 February 1960.

g Reported by the Game Ranger. TNA file G1/7, 14 April 1968.

h Counted by the Game Warden. TNA file G1/7, 17 January 1964.

i Estimated by the Regional Veterinary Officer. TNA file G1/7, 11 May 1964.

j A count reported by the Regional Agricultural Officer. TNA file G1/7, 11 July 1964.

k Estimated by the Regional Veterinary Officer. TNA file G1/7, 9 September 1965.

l Reported by the District Agricultural Officer. TNA file G1/7, 2 January 1968.

m Harris (1972: 113)

n Reported by the Game Ranger. TNA file G1/7, 17 April 1968. Referred to in other publications as TA/GD/D10/16/22/193.

reserve. Where the grazing has been destroyed he said that a mature animal would require twenty to twenty-five acres' grazing. Anderson's claim that cattle were damaging the environment is not supported by the number of cattle that he said were present and his estimated ideal

TABLE 7. *Cattle numbers around Mkomazi*

Year	Lushoto District (East)	Same District (West)	Total
1960	21,984	No data, probably not more than 15,000 ^a	21,984 + ? ^a
1967	45,245	No data, probably not more than 15,000 ^a	45,245 + ? ^a
1978	28,219	39,539	67,758
1984	48,233	39,977	88,210

NOTES Data are taken from District level livestock census data which were compiled from ground counts. These are total counts, not samples and therefore there are no confidence limits that can be set around them.

a Harris 1972: intensive ground observations show negligible numbers in western part of Mkomazi. Parker and Archer's 1970 map shows absence of stock from most of the west of the reserve and its environs. There was no official record of concern over pastoralism in the western part of Mkomazi and environs at this time while cattle herding is an active issue in and around the east in this decade (Brockington, 1998). We therefore conclude that stock numbers were negligible.

stocking rate. More puzzling still, Anderson got the size of the reserve wrong, underestimating it by 200,000 acres. This meant that the 5,000 cattle, if they used a quarter of the reserve, had 40 acres each.¹⁰

Why did he think that so few cattle were causing so much damage? The most obvious answer is that Anderson underestimated the number of cattle that were using the reserve. Although he described overcrowding around the reserve's boundaries, Anderson appears not to have thought that these animals were also using the reserve (1967: 29–30). If cattle outside the reserve are included, much larger numbers of potential reserve-using animals become apparent (Table 6). It may be that the effects Anderson saw and was reacting to were the consequence of much higher stocking rates than he realised.

But if stocking rates were higher than feared what were their long-term consequences? How did they affect the long-term ability of the eco-system to support livestock? For a twenty-five year period before the evictions, cattle in and around the reserve increased (Table 7). Smallstock populations remained relatively stable (Figure 2). Cattle censuses offer only a snapshot of a fluid situation, but with an increase of this magnitude the census data are likely to reflect a reality on the ground. The magnitude of the rise in the reserve cattle population is a little misleading. It is composed of a fluctuating population in Lushoto combined with 14 years of growth in Same District (1970–84) after the

¹⁰ Anstey (1958: 68) said that the reserve was about 1,100 square miles (285,000 ha) in area. Anderson (1967: 18) gave a figure of 597,770 acres (241,918 ha). Harris (1972: 3) gave the size as 3,276 km² (327,600 ha, 809,488 acres) which Coe (1999: 7) reports is almost the same as the area calculated from current maps.

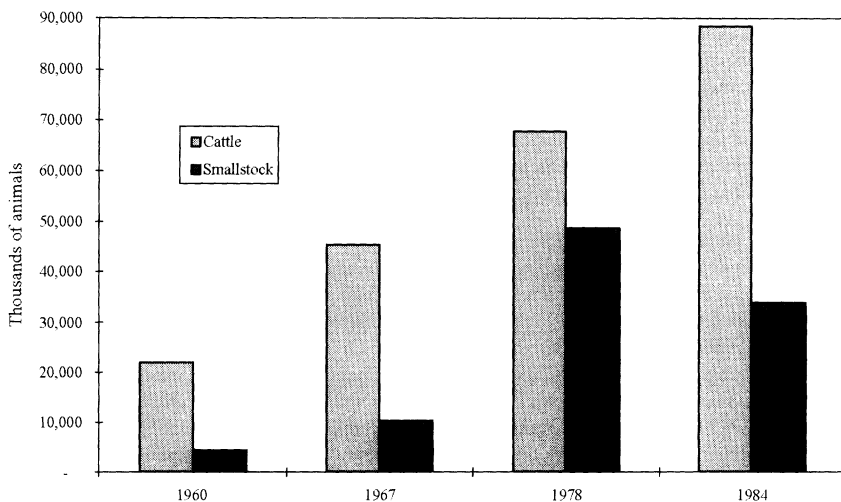


FIGURE 2 Livestock census results. No data are available for Same District in 1960 or 1967. Numbers were low at the time and would be unlikely to alter the trend. *From district records*

western half of the Game reserve was opened up. The increase is not the result of one area sustaining greater herds, but of more places supporting more cattle.

The implications for the environment of such a growth in the cattle population are equivocal. Such an increase must have affected the environment in some way. Yet it is hard to see how it could have been causing the damage Anderson feared. The eastern half of the reserve sustained a population of 15,000–40,000 cattle, far higher than he thought possible, for over thirty years. Whatever changes were occurring were not damaging the ability of the eco-system to support cattle at this time (cf. Bell, 1987). The environment was able to sustain the growth.

The problem of interpreting the environmental impact of cattle is essentially one of scale. A system which is supporting increasing livestock numbers is unlikely to be losing its productivity potential at the same time. However this large-scale impression of the whole of the reserve and its environs tells us little about the exact nature of cattle-vegetation dynamics in particular places. It may well be the case that herds were grazing, overgrazing and moving on within the area censused but that the effects were sufficiently localised so that the cumulative effect was not extensive enough, or permanent enough, to impede the growth of livestock populations. More detailed studies of how livestock affect vegetation in this environment are needed to refute the hypothesis that cattle graze, overgraze and move on.

Vegetation change

A central weakness of Anderson's report is that it offers no data which describe what cattle actually did to the vegetation. There were two studies which attempted a small-scale analysis of the impact of livestock on vegetation. They date from March 1966 and August 1967 and were undertaken outside and along the borders of the game reserve, in the Kalimawe Game Controlled Area and around the Uмба river respectively. Five points were surveyed in Kalimawe on three different types of soil. Nine sites were sampled along the Uмба river, with no indication of how the soil type varied between sites (Hemmingway *et al.*, 1966; Robinette and Gilbert, 1968).

The researchers recorded the vegetation cover of a 0.75 m diameter wire loop (attached to the end of their shoe) at two-step intervals along a 200 step transect (Parker, 1951; Anderson, 1959). When a live plant falls within the base of the loop a 'hit' is recorded. These are divided into forage (perennial grasses) and 'plants' (other live vegetation). Dead vegetation litter is recorded as 'ground cover'. Bare soil is termed 'bare ground'. The results of the two studies and four (undated) surveys in Tsavo are shown in Table 8.

The authors compared these records of vegetation cover with range condition data from the Sandhill prairie rangeland in the Western United States (Table 9). As most of the range examined by these researchers was, according to these criteria, in poor or very poor

TABLE 8. *Range Condition for Acacia-Commiphora areas*

<i>Site</i>	<i>Number of transects</i>	<i>Forage density</i>	<i>Plant density</i>	<i>Ground cover</i>	<i>Bare ground</i>
Uмба river (six)	7	3	9	51	49
Uмба river (five)	7	3	7	51	49
Uмба river (seven)	7	4	10	57	43
Tsavo, north of Loosioto Hill	2	4	11	22	78
Kalimawe—red soil	8	5	7	23	77
Uмба river (two)	11	5	16	58	42
Uмба river (nine)	7	6	19	77	23
Uмба river (three)	6	6	18	54	46
Uмба river (one)	9	7	20	67	33
Kalimawe—red soil	8	8	16	40	60
Kalimawe—mbuga	8	9	21	41	59
Uмба river (four)	7	9	17	57	43
Uмба river (eight)	7	9	16	67	33
Lake Jipe, east side (Tsavo)	10	10	12	43	57
Kalimawe—mbuga	8	10	16	35	65
Kalimawe—grey clay	8	13	16	38	62
Tsavo—Murka	13	18	22	63	37
Tsavo—Pump Station	9	27	28	68	32

SOURCE Robinette and Gilbert (1968)

TABLE 9. *Range condition on the Sandhill prairies*

<i>Range condition</i>	<i>Forage hits per 100</i>
Excellent	25
Good	22–24
Fair	15–21
Poor	8–14
Very Poor	0–7

SOURCE Robinette and Gilbert (1968)

condition they concluded that it was overgrazed. Appropriate stocking densities were also derived from the Sandhill prairies. They suggested that one cow on Sandhill prairie requires 192 acres of grazing a year and that, on the basis of the 1965 census, the Uмба River area was fourteen to nineteen times overstocked. Other stocking densities from Kenya were also cited which still left the area ten times overstocked. They therefore suggested that the range should be destocked.

But there are a number of problems with these methods and conclusions. First, only perennial grasses were counted as fodder, not annuals, when annuals can make a useful contribution to livestock's diet (Mace, 1991). Second, browse was not included. Third, there is no indication of what recent rainfall there had been, nor any discussion of the problems of comparing data collected in March with those collected in August, nor any information about the timing or previous rainfall when the Tsavo surveys were conducted. Fourth, these surveys are snapshots of what could be a highly variable system and there is no mention of how range cover varies through the year. Fifth, there are no data on the actual herding patterns followed by the livestock of the area; it is not certain how many animals were using the areas sampled, and how often. Sixth, there is no sense of what local herders make of the situation. Seventh, it is impossible to say how representative these data are as there is no indication of how the sites of the transects were selected.

The advised stocking rates are also questionable.¹¹ Stocking rates are intimately related to the goals of production and these were not made explicit. We do know that they came from the western United States, where stock farming was geared towards beef production. This maximises productivity per animal, minimises losses during droughts and attempts to produce a high-quality product (Sandford, 1983; Behnke, 1985). Subsistence dairy herding is altogether different. Here productivity is maximised per hectare by keeping a higher stocking rate which lowers productivity per cow, but raises it per unit area. A high

¹¹ For a start they are quite diverse; compare Anderson's rates above.

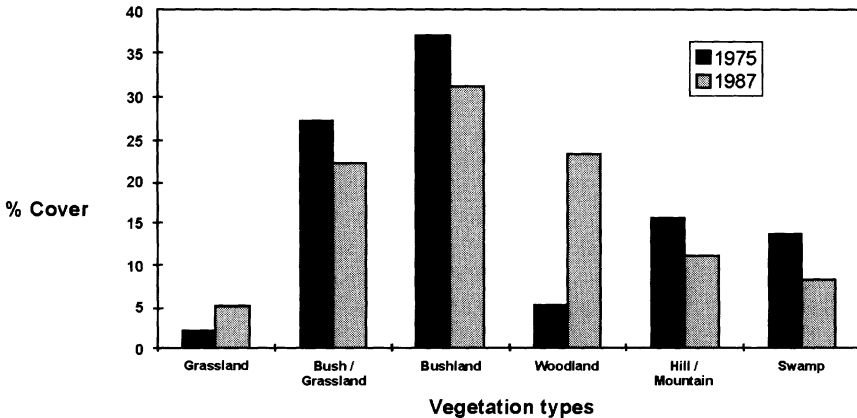


FIGURE 3 Changes in land cover in the western half of Mkomazi Game Reserve 1975–87. (From Brockington and Homewood, 1999)

stocking rate also allows the herder to take advantage of the highly variable primary productivity of these climates. Low stocking rates fail to capture all the resources that can become available in the wet season. Moreover, a large number of animals minimises risk for they are more useful when facing a drought, as more are likely to survive to provide for the families' needs and produce more offspring in the following years. Subsistence dairy herders therefore operate stocking rates which are higher than beef ranching. The comparisons offered were not appropriate.¹²

More recent data on a larger scale are available in Cox's preliminary study of vegetation change in the western half of Mkomazi between 1975 and 1988 using two Landsat images. We have previously discussed the problems and implications of this research (Brockington and Homewood, 1999). The data are not reliable enough to offer any explanations of vegetation change in the reserve, but can be used to generate hypotheses. These are that during 1975–88 the extent of grassland remains unchanged, that thinly wooded grassland (2–40 per cent canopy cover) decreases, and that this is compensated by a growth of woodland cover (over 40 per cent canopy cover; see Figure 3). The thickening of bushland to become woodland suggests that one of the driving forces behind vegetation change at Mkomazi could be the decline of the elephant populations of the Tsavo eco-system, with a resultant decline in the pressure on tree numbers. An increase in the extent of bushland is also consistent with overgrazing theories which suggest that pressure on grass populations will result in an increase in

¹² In this regard it is instructive to note that the researchers suggested that the 'Tsavo pump station site' was a model of ideal range condition whilst at the same time noting that it has 'escaped livestock use during the past few years'. It was almost as if range at Mkomazi could be 'good' only if it was untouched.

bushland. However the lack of change of the 'grassland' vegetation (0–2 per cent woody canopy cover) does not fit those data.

Biodiversity

We have previously examined the impact of human residence of Mkomazi on biodiversity (Homewood and Brockington, 1999). Mkomazi manifests high levels of insect, bird and plant diversity that reflects its high habitat diversity, and its position on an ecotone. It has been suggested that Mkomazi could be 'one of the richest savannas in Africa, and possibly the world' for birds, plants and insects. This is not supported by the data. Either other Protected Areas are richer, or they have not been studied as intensively (Coe, 1995; MNRT, 1997). More importantly, it is impossible to say that there has been any decline or improvement in these levels of biodiversity since eviction because there is no baseline against which to make comparisons.

The implications are numerous. The high levels of diversity were monitored soon after the people were excluded. If people did reduce the biodiversity, then levels appear to have recovered sufficiently to be exciting to scientists within a relatively short time; the degradation people caused may have been short-lived. On the other hand, the current high levels may be but a remnant of much higher numbers of species that existed within the reserve before people lived there in large numbers. It is also possible that some forms of human disturbance may foster biodiversity, and human exclusion would be deleterious to that. However, current research simply does not allow us to offer an informed account of how human residence of Mkomazi may have affected its insect, bird and plant life.

Assessing the impact of people on Mkomazi's large mammals is difficult given the lack of data. The best records are available for changes to elephant populations (Table 10). Though not frequent, they do indicate that elephant populations were higher when the reserve was less occupied (before 1968), that it plummeted after twenty years of pastoral dominance in the reserve, and that it has recovered since the reserve was cleared. One conclusion could be that elephants declined because of the impact of pastoral occupation after 1970 (Coe and Ndolanga, 1994).

Once again, however, that is not the only possible reading of the data. It is not obvious why an elephant population which had thrived with

TABLE 10. *Elephant populations in and around Mkomazi Game Reserve*

<i>Year</i>	<i>Month</i>	<i>Season</i>	<i>Count</i>	<i>Std. error</i>	<i>Source</i>
1968	June	End of long wet	2,760	Unknown	Watson <i>et al.</i> (1969), Huish <i>et al.</i> (1993)
1988	February	Short dry	93	Unknown	WCMD (1988)
1991	June	Start of long dry	273	198	Huish <i>et al.</i> (1993)
1991	October	End of long dry	1,719	1,568	Huish <i>et al.</i> (1993)
1994	April	Long wet	477	304	Inamdar (1995)

herders present up to 1968 should no longer be compatible with pastoralism after that time (Watson *et al.*, 1969). To understand variations in the elephant population it is important to understand what is going on in the broader Tsavo eco-system. The decline in the elephant population there following drought and extensive poaching in the 1970s is well-documented (Inamdar, 1996). The collapse of the Mkomazi population could reflect these larger-scale changes. There are also other disturbances to consider. In 1968 and 1969, 598 elephants were rounded up by helicopter and light aircraft and shot in the reserve as part of research into the dynamics of herd growth (Parker and Archer, 1970). This may have had the effect of encouraging elephants to leave the reserve, at least in the short term.

Data about changes in the other fauna of the reserve are not available except for rhinoceros which was once commonly sighted and which became locally extinct during the poaching crisis of the 1970s and 1980s. There are two general impressions about what has happened to wildlife numbers since eviction. The first is that, in the absence of people and livestock, they have recovered. Elsewhere in East Africa, livestock are excluded from pasture by the presence of wildebeest whose calves carry malignant catarrhal fever which is fatal to cattle (Home-wood and Rodgers, 1991: 183-4). At Mkomazi there are no wildebeest and interactions between livestock and wildlife may accordingly have favoured livestock. It is quite possible that wildlife numbers may have increased since the evictions.

A less popular view among wildlife conservationists, voiced by researchers who have studied the general populations of the broader Tsavo eco-system, is that for reasons of soil type, water availability and habitat diversity wildlife densities in Tsavo are generally low anyway compared to other protected areas like Maasai Mara, the Serengeti, Tarangire and others (Cobb, 1976; Inamdar, personal communication, 1996). The reserve does not support large concentrations of wildlife, and the presence/absence of cattle has made little difference to a place like Mkomazi, which is on the borders of the wet season dispersal range of generally small populations.

CONCLUSION

Problems of precision and scale hinder clear interpretations of the impact of livestock on the environment. Claims that the environment was degraded by overstocking are often general, vague, or made for ill-defined areas. They are difficult to refute or support. Data about environmental change are poor for Mkomazi. They do not show what was going on at the micro-level. Although we do not feel able to dispose of any of the hypotheses with which we began some tendencies are clear, suggesting more profitable lines of enquiry for the future.

Our review of the social record gave the general impression that things were not as bad as claimed. Herders did try to manage their environment, administrators' pessimism about the impact of cattle was misplaced. The rapidity of the reserve's recovery, which occasioned

such exuberance from conservationists, suggests that it may not have been so badly harmed in the first place. But these are only hints, counter-interpretations that the imprecision of the data permit, but which, for that very reason, they cannot further clarify.

The biophysical data are sparse. There are no repeated surveys of wildlife/insect/bird diversity which would make it possible to assess their interaction with cattle over time. In the case of large animals, the mechanism that provides for compatibility between wildlife and livestock elsewhere is absent at Mkomazi. Here, however, dynamics must be considered at a larger scale still. Wildlife migrations extend into Tsavo West National Park and the impact of people on wildlife in Mkomazi needs to be considered in conjunction with events in Tsavo.

We can be sure that cattle numbers increased throughout the period of anxiety over their impact. This poses a challenge to degradation thinking, because a deteriorating environment could not have supported such an increase. It suggests that the pessimism surrounding livestock's impact on soil and vegetation was misplaced. But it tells us what was going on only at the regional scale, over thousands of square kilometres. There are no good data on the small-scale impact of livestock on vegetation at Mkomazi. Herders may still have been grazing, overgrazing and moving on, but the impact on soil, vegetation and also on cattle numbers has not been visible at the current temporal and spatial scale of analysis. The large-scale health of the eco-system may have entailed local and temporary degradation and recovery. We have no data to refute or support that hypothesis. The overall indication of health does not elucidate the nuts and bolts of eco-system dynamics.

If that was the case, then at what level do cattle populations become too dense to allow sufficient time for degraded patches to recover? We have argued that all along the 'limits' suggested for livestock were too low. But does that mean there are no limits? There must be some limits to resilience. The concept risks being used without sufficient definition, parameters or support; it risks being abused as 'degradation' has been. What limits should be set on cattle populations?

Long-term records of livestock populations in Baringo and Ngorongoro suggest that livestock populations do not continually increase but fluctuate up to a certain level (Homewood and Rodgers, 1991; Homewood, 1994). They are repeatedly depressed by drought and disease and frequently constrained by poor rainfall. Cattle populations only rarely and briefly attain levels where they are sufficiently dense to have a sustained and widespread impact on soil and vegetation. Our hypothesis therefore is that no limits need be set because populations are already restrained by aridity.¹³ Before the cattle can damage the environment, the droughts kill the cattle.

¹³ If any management of livestock populations is attempted we would follow Scoones, Behnke and others and suggest that marketing facilities are developed the better to enable pastoralists to sell stock during drought years and so more closely to 'track' rainfall and associated primary productivity (Behnke and Scoones, 1993; Scoones, 1995).

We believe that this line of enquiry would be most likely to generate insights into the reserve's environment, but we are pessimistic as to the fate of this hypothesis. We believe that our ignorance of people and livestock's role in the environmental dynamics of Mkomazi before 1988 will persist for some time. A more apposite prediction for its environment, therefore, is this: 'There will never be any clear understanding of human agency in environmental change at Mkomazi prior to 1988.' This might occur for two reasons. First, because no clear data will be available. We may never have sufficiently precise data about the environment, or an accurate enough history of herding patterns or of pressure on particular places to be able to distinguish between different explanations of environmental change. Or sufficient funding will not be available to make those data accessible. In part the data problem is one of scale. It may be possible to make accurate statements about particular parts of the reserve, but sufficiently accurate and long-lasting data sets are infrequent and unlikely to be widespread.

Second, because clear discussion of good data is unlikely. At Mkomazi the social construction of the environment, and the determination of its use, are an acrimonious process. Conflicting views are based on different values and have different goals and complicated links with diverse local, national and international political agendas. Even relatively disinterested observations are unlikely to be discussed in a way which generates more light than heat.

Mkomazi could be a case of regional obscurity. Just as degradation, or regeneration will be place specific and contingent, so will be our ability to know about them. Clarity and resolution are patchy. Some places are more contested and complicated, or historically more obscure, than others. We suggest Mkomazi will always be one of them.

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11/5, vol. II, Movements of Masai and Kwavi. Accession No. 19.

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 723, vol. III. Movements of the Maasai and Kwavi. Accession No. 4.
 6/1, Pare District annual reports. Requisition No. 19/6/1.

Files consulted at the Tanga Regional Archives
 TA4 Box 12 G1, untitled.

The Kisiwani Ward Livestock File

This is held at Kisiwani village, Same District at the village office. Brockington has copies of relevant papers.

URT GD18/R/8/226. Letter of eviction from Principal Secretary, Ministry of Lands, Natural Resources and Tourism to residents of the Mkomazi Game Reserve.

ABSTRACT

The Mkomazi Game Reserve is contested by people who wish to use its resources and by conservationists who have argued that the reserve should be set aside for wildlife. Underpinning the conservationist case is the argument that people are harmful to the reserve's environment. Former residents of the reserve, notably pastoralists, argue that human use of the reserve did not cause its degradation. The debate is characterised by a lack of data extraordinary in view of the assertions made. An earlier paper set out the contrasting views and defined the data that would be needed to test them. This paper assesses what data there are, and whether it is possible to evaluate the extent to which people caused environmental change at Mkomazi. Using physical data and comments about the environment made by observers it is argued that no firm conclusions can be drawn about small-scale change but that there are indications of large-scale resilience. As a result of this uncertainty the article goes on to consider the extent to which there can ever be clarity about environmental change at Mkomazi as a philosophical contention or as a researchable issue.

RÉSUMÉ

La réserve naturelle de Mkomazi est contestée par ceux qui souhaitent exploiter ses ressources et par les écologistes qui veulent la voir consacrée exclusivement à la faune et à la flore. L'argument sous-jacent des écologistes est que l'homme nuit à l'environnement de la réserve. Des anciens résidents de la réserve, notamment des pasteurs, affirment que l'utilisation de la réserve par l'homme n'a pas entraîné sa dégradation. Le débat se caractérise par un manque de données, ce qui est extraordinaire compte tenu des affirmations présentées. Un article antérieur exposait les avis divergents et définissait les données nécessaires pour déterminer leur validité. Cet article évalue les données existantes et détermine s'il est possible d'évaluer l'impact de l'homme sur l'environnement à Mkomazi. Se servant des données physiques et des commentaires formulés par des observateurs concernant l'environnement, les auteurs affirment qu'il est impossible de tirer des conclusions fermes quant à un changement à petite échelle, mais observent des signes de résilience à grande échelle. Compte tenu de cette incertitude, ils se demandent s'il pourra un jour se dégager une clarté quant à l'évolution de l'environnement à Mkomazi en tant que différend philosophique ou objet d'étude.