Environmental Change and the Vulnerability of Pastoralists to Drought: A Case Study of the Maasai in Amboseli, Kenya

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Introduction:

Chapter Three of the Africa Environment Outlook Report is concerned with the impact of environmental change on human vulnerability. The Report considers vulnerability in the context of exposure to environmental hazards (contingencies, shocks and stresses) and the coping capabilities of people. In this case study, we will show that the Maasai of Kajiado district in Kenya (as well as other pastoralists) face two distinct types of environmental hazards. The first includes climatic uncertainty and drought. The second hazard consists of the environmental changes driven by shifts in land use patterns. Whereas the Maasai have well developed and intricate strategies for coping with the first type of environmental hazard, the impact of the second set of hazards has seriously diminished their ability to cope using traditional strategies. As a result, they have become increasingly vulnerable to droughts. They have responded with a set of alternative strategies, which have cushioned a portion of the community from environmental shocks, while leaving the rest more vulnerable than ever.

I. Methods

This case study summarizes a long-term research project undertaken by David Western on the ecology of wildlife and Maasai livestock in the Amboseli region of eastern Kajiado District in southern Kenya. The project, initiated in 1967, is still ongoing. It includes long term monitoring of livestock and wildlife numbers, distributions and herd sizes seasonally, as well as pastoral and agricultural settlements patterns, vegetation composition and pasture production (Western, 1975, 1976). Methods include sample aerial counts over an area of 8,500 km^2 of eastern Kajiado District encompassing the Amboseli ecosystem, total aerial counts, fixed-plot vegetation and animal counts of the dry season range and vegetation exclosures (Western and Grimsdell, 1979). The project also spans a number of specific research projects pertinent to this study, such as wildlife and livestock grazing strategies, herding and settlement decision-making, human-wildlife and human-environment interactions, pastoral drought responses gleaned from ecological monitoring, interviews, livestock physiology and experimental manipulation studies (Finch and Western, 1977; Western, 1982; Western and Finch, 1986; Western and Gichohi, 1993).

II: The Maasai

East African pastoralists move their livestock, including cattle, sheep, goats, donkeys and, in the more arid areas, camels, in response to erratic rainfall conditions of the savannas in order to maximize herd size, milk yields and meat production for human consumption (Western and Finch, 1986). Traditional subsistence pastoralism revolved around optimizing livestock forage intake by selecting the best grazing pastures in any season and minimizing stock losses to drought, disease and predation, including raiding (Waller 1976, 1990; Homewood & Rodgers 1991; Behnke 1995; Ole Lengisugi & Mziray 1996; Scoones 1996; Hendrickson, *et al.*, 1998). The extreme dependence of the Maasai and other East African herders on pastoralism is explained by the twin rains that allow them to schedule milk-production year-round with less dependence on alternative forms of production (Western 1991, Herlocker 2000, Scoones 1996, Behnke 1995). Milk production is more efficient than meat for converting forage to human food (Western, 1973; Coughenour *et al.*, 1985; Perrier 1996). In contrast, calving is scheduled once a year during the single-season rains of the more northerly agro-pastoral complex. The resulting short-fall of milk during the prolonged dry season compels pastoralists to offset the shortfall with crop production, fishing and hunting.

Pastoral livestock breeds, including the zebu cattle of the Maasai, are extremely efficient at producing milk and meat under highly seasonal and extreme drought conditions (Galukande et al, 1962; Payne, 1970; Coughenour *et al.*, 1985, Western and Finch, 1986; Homewood & Rodgers 1991, Rege et al, 2001). Most pastoral societies have developed breeds adapted for a particular environment or the needs of the society, and the Maasai are no exception. The Maasai have bred their cattle and other livestock for a suite of characters adapted to the arid savannas, including milk production, drought tolerance, long-distance walking ability, color, fertility, disease resistance, and desired behavioral characteristics (Kohler-Rollefson & McCorkle 2000, Rege et al, 2001). Selection operates at a variety of levels. Herders vary the species mix, choosing among cattle, sheep, goats, donkeys and camels. They also selectively breed within individual species, move seasonally, adjust daily foraging regimes and herd size and composition to optimize foraging in response to rainfall and local pasture conditions. Herders also select settlement sites according to the availability of water, forage, fencing and fuelwood, and to minimize climatic extremes, flooding hazards, disease and predation (Western & Dunne 1979; de Leeuw & Wilson, 1987). At the socio-cultural level, complex social stock associateships based on reciprocity and shared husbandry knowledge help to minimize drought, disease and other sources of mortality (Homewood and Rogers 1991, Ole Lengisugi & Mziray 1996). Often overlooked is the extreme competition pastoral livestock in East Africa face from a wide and ecologically efficient spectrum of large ungulates, predators and pathogens. Despite all these challenges, East African pastoralists have developed a highly efficient system of livestock production.

The most adaptive feature of pastoralism is undoubtedly the tracking of seasonal rainstorms and grass production, an adaptation that directly mirrors wildlife migratory strategies in the savannas (Western, 1982). Seasonal migrations and habitat selection locally stretch the availability of highly digestible forage well into the dry season and reduces the impact of dry seasons relative to sedentary livestock production. A

combination of migratory movements to increase digestive efficiency as well as energy sparing mechanisms (such as metabolic downturn during droughts), raise stock carrying capacity to extraordinarily high levels (Western & Finch, 1986). Indeed, the ecological efficiency of Amboseli Maasai cattle compares favorably to indigenous wildlife in terms of energy flow (Western 1982).

Pastoralists use a variety of other mechanisms to increase the survival rate and productivity of their herds, and decrease their own vulnerability to environmental uncertainty. These include herd splitting, range management, herding techniques (including social controls on range use), close monitoring of livestock and environmental conditions, and the use of wildlife as indicators--or for food in times of extreme need. The Maasai traditionally viewed wildlife as "second cattle", to be used in times when livestock had been decimated by drought, disease or predation (Western, 1982; Niamir 1990). By drawing on a variety of strategies, the Maasai and other pastoralists increase the productivity of their rangeland use. Scoones (1996) lists a host of studies showing that the productivity of pastoralist systems reaches or exceeds that of modern ranching systems in arid and semi-arid lands.

III. History

In East Africa, specialized pastoralism may have been perfected as early as the sixteenth century (Galaty 1993). After a period of aggressive expansion throughout the Rift Valley, the Maasai began to suffer a series of setbacks in the second half of the nineteenth century. These began with the *Iloikop* Wars (which ended in the 1870s), between Maasai and other closely related pastoralist groups, which left the Maasai in control of large areas of East Africa and perhaps overextended (Waller, 1976). In about 1883, bovine pleuro-pneumonia arrived from the north, and seriously affected livestock holdings, although the Maasai were able to rebuild their herds through raids on other communities. However, in 1891 the first cases of rinderpest appeared, killing off an estimated 90% of Maasai livestock and a large portion of wild ungulates (Waller 1976, Homewood & Rodgers, 1991). A smallpox epidemic took a heavy toll of the Maasai themselves at the same time.

The Maasai, like other pastoralists, have a history of displacing neighboring groups and raiding their livestock. Such instability has been a feature of pastoral life from early historical times and has in part offset losses from drought, war and disease. However, the combined events of the late nineteenth century left the Maasai unusually vulnerable to the threat of colonial land grabs at the turn of the century. In 1904 and 1911, the Maasai were compelled to sign agreements with the British, resulting in the loss of between 50 to 70 percent of the land they once utilized (Sandford 1919, Leys 1924, Hughes 2002.). Losses by the northern sections of the Maasai included the best grazing and drought refuges in the Rift Valley and the Laikipia area. For the Maasai in southern Kenya, and especially those in the Kajiado area, the loss of Tsavo West, Nairobi National Park and the slopes and forests of Kilimanjaro removed extensive areas and vital drought pastures from Maasai use. During the run up to Kenya's Independence, the Maasai sent a delegation to the Lancaster House talks, in an unsuccessful bid to repossess their lost land (Keen 1962).

In the post-colonial era, even more pastoral areas in the south of the country were lost to farmers in Loitokitok, Ngong and other areas, and to the government for conservation areas (including Amboseli and Chyulus). The lack of permanent settlement and land ownership among pastoralists made them far easier victims of land snatches than the farming peoples of East Africa who traditionally held land by virtue of permanent settlement and priority of access. The wettest parts of the Kajiado have been taken up by agriculturalists, including resident Maasai, further denying livestock herders access to late season reserves. Finally, upstream water offtake for irrigation in newly settled areas of Maasailand such as Kimana has greatly reduced riverine and swamp habitats downstream, depleting grazing lands and drought pastures even further among pastoralists who remain on the rangelands.

All of these factors add up to a major loss of land, a disproportionate loss of drought refuges and therefore an increased vulnerability among the Maasai to ecological change and drought. In addition, well-meaning developments such as water provision, medical services, famine relief and social services contributed to population growth and land shortage. Water development in the Amboseli region during the 1940s, for instance, saw cattle increase from 70,000 to nearly 200,000 by 1960, leaving few areas beyond reach of heavy dry season grazing. The population has not risen since the late 1960s due to pasture shortage. Human numbers increased more slowly, but steadily outran livestock increases. As a result, per capita livestock holdings have fallen steadily from 10 in the 1960s to 4 by the 1980s (Western, 1994), a trend found elsewhere in Kenya (Little *et al*, 2001). These holdings are now under half those needed for subsistence.

The falling subsistence holdings add to the lack of infrastructure and social services among pastoralists arising from the difficulty of servicing remote areas and their weak political constituency. The upshot is that health and educational levels lag far behind national levels. The instability of livestock markets and difficulty of dispersing famine relief relative to their agricultural neighbors has also contributed to the marginalisation of pastoralists (Holtzman & Kulibaba 1996, Blench 2000). Thus, at a time when the emigration rate is building up due to limited options on the land, the Maasai, like other pastoralists, are ill-equipped to compete in other sectors of economy.

Seen in this light, wildlife utilization can provide an alternative source of income that complements livestock production among pastoralists. Instead wildlife, more often than not, has become an additional burden among pastoralists due to inimical policies and the lack of economic incentive and opportunity. Amboseli National Park, gazetted in 1974, was one of the first attempts to make wildlife an asset to indigenous occupants through revenue-sharing and wildlife utilization. As a result of the Amboseli experience, wildlife has since become national policy and contributed significant cash and development income through tourism concessions to group ranches (Western, 1994; Barrow *et al* 2001). The new economic opportunity fits well with pastoral traditions, which saw wildlife as “second cattle” to be used when livestock production faltered during droughts. Despite the significant advance in policy, conflicts remain due to limited rights and inequitable income flowing from wildlife. Conflicts over grazing, disease and destruction of crops remain high in most areas..

IV. The Message

Nomadic pastoralism is a highly specialized production system adapted to the harsh ecological and social conditions of the dry savannas. These conditions call for flexible range practices, herding strategies and social networks. In traditional systems, nomadic pastoralists make decisions based on many environmental, economic and social considerations which researchers and planners have only recently begun to appreciate. Nomadic pastoralists in general and the Maasai in particular have faced enormous changes over the last one hundred years. The pace has accelerated in the last 30 years as subsistence pastoralism has faltered, forcing the Maasai to seek alternative livelihoods on and off the land.

The transition from a relatively closed and socially homogenous subsistence society to an open, diversified economy within a modern nation state is far easier for agriculturalists than pastoralists due to the relative stability of settlements and farm output. Steady progress in the pastoral areas is set back by extreme droughts, causing widespread social and economic disruption. The consequences of land fragmentation, loss of mobility and range degradation on the one hand, and the hardships of entering other sectors of the economy on competitive terms on the other, exaggerate the normal stresses of drought in pastoral areas such as Amboseli. As a result, the increased frequency and intensity of drought (expressed as a shortage of forage relative to livestock herds, rather than absolute shortfall in primary production), has created deeper inequalities among the pastoralists still rooted in pastoralism. The diversification of lifestyles and livelihoods among the more progressive Maasai and competition from more entrepreneurial immigrants creates even greater hardships for those who remain rooted in subsistence pastoralism.

This case study documents the environmental and human changes in the Amboseli region over the last 30 years, points up areas of greatest concern and suggests a number of remedies that apply widely to the pastoral lands affected by aridity and drought.

V. Pressures on the Environment

In this section we draw on data from the Amboseli study to chart the broad trends in range conditions, livestock, human and wildlife numbers, distributions and interactions that apply widely to the pastoral areas of Eastern Africa. We look at the ecosystem consequences for the environment, economy and society. We also consider the interaction among these factors and the significance of national and global factors.

The location and main physical features of the Amboseli ecosystem are given in Fig. 1.

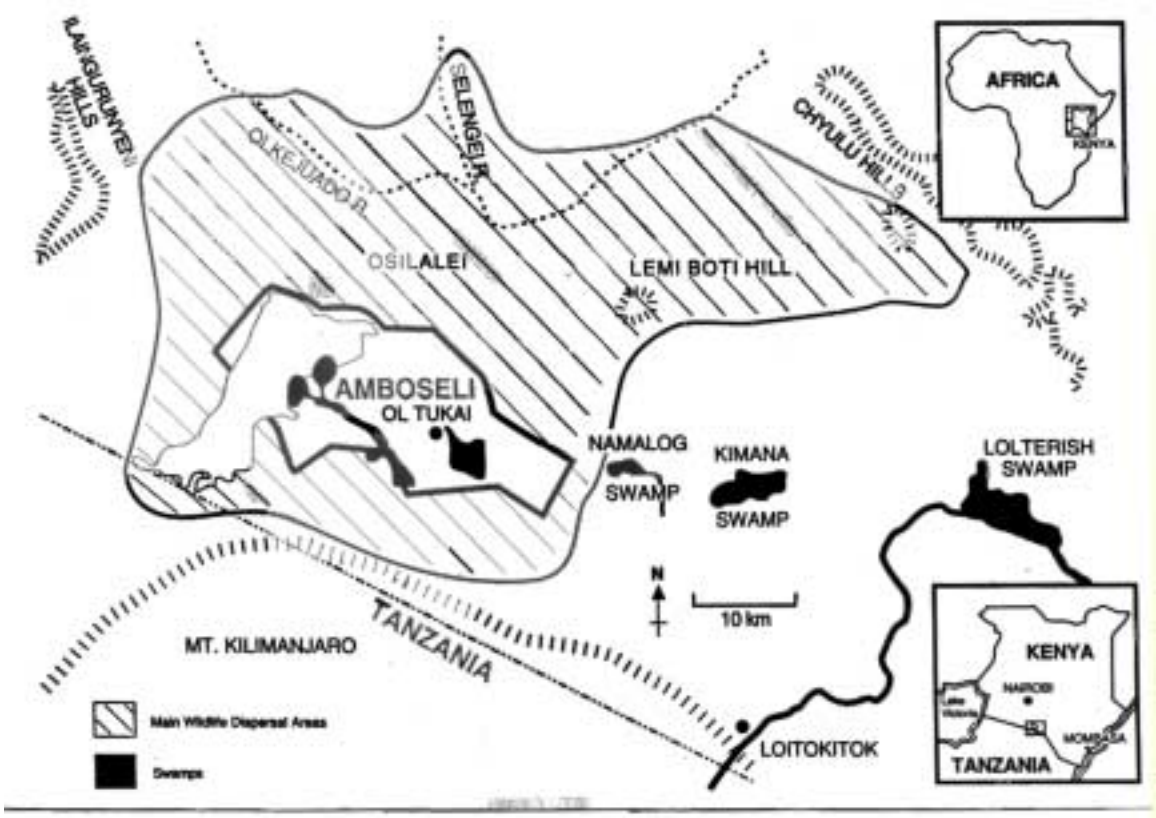


Figure 1. Location of Amboseli National Park in Kenya, and the major characteristics of the ecosystem.

Source: Western 2002

Rangeland productivity

Broadly speaking rainfall governs pasture production in the African savannas (Coe *et al*, 1976). Rainfall is therefore used as a surrogate for pasture dynamics because of the difficulty and time involved in sampling herbage directly. The weakness in using rainfall is that pasture production for a given rainfall varies with many factors, including soil and slope. Furthermore, the severity of a drought depends as much on stocking rates as it does on rainfall. And, rainfall seasonality and storm patterns affect pasture production independently of total rainfall. The best measure of rangeland production is therefore pasture biomass. Fortunately, 20 pasture plots (4 in each habitat type) have been monitored monthly in Amboseli since 1975, giving a direct measure of fluctuating pasture conditions. We therefore use measured plant biomass as a direct measure of rangeland production.

Long-term information collected monthly from vegetation plots typical of the pastoral lands around Amboseli (Bushland and Plains Plots, Fig. 2) show that pasture biomass oscillates sharply over time. Spikes represent seasonal growth, while the downward trends in the figure illustrate senescence and grazing pressure during the dry seasons. The fluctuations are a direct measure of seasonal harshness from point of view of livestock and wildlife. The complete run of data gives a measure of whether range productivity has changed on the last quarter century. The large peak in 1998 was recorded during El Nino.

From these data there are no evidence of long-term grassland degradation, with the possible exception of cover loss around permanent settlements. The same pattern is true of Amboseli National Park with the exception of a significant fall in pasture production in woodland habitats (Fig 2) caused by a highly compressed elephant population.

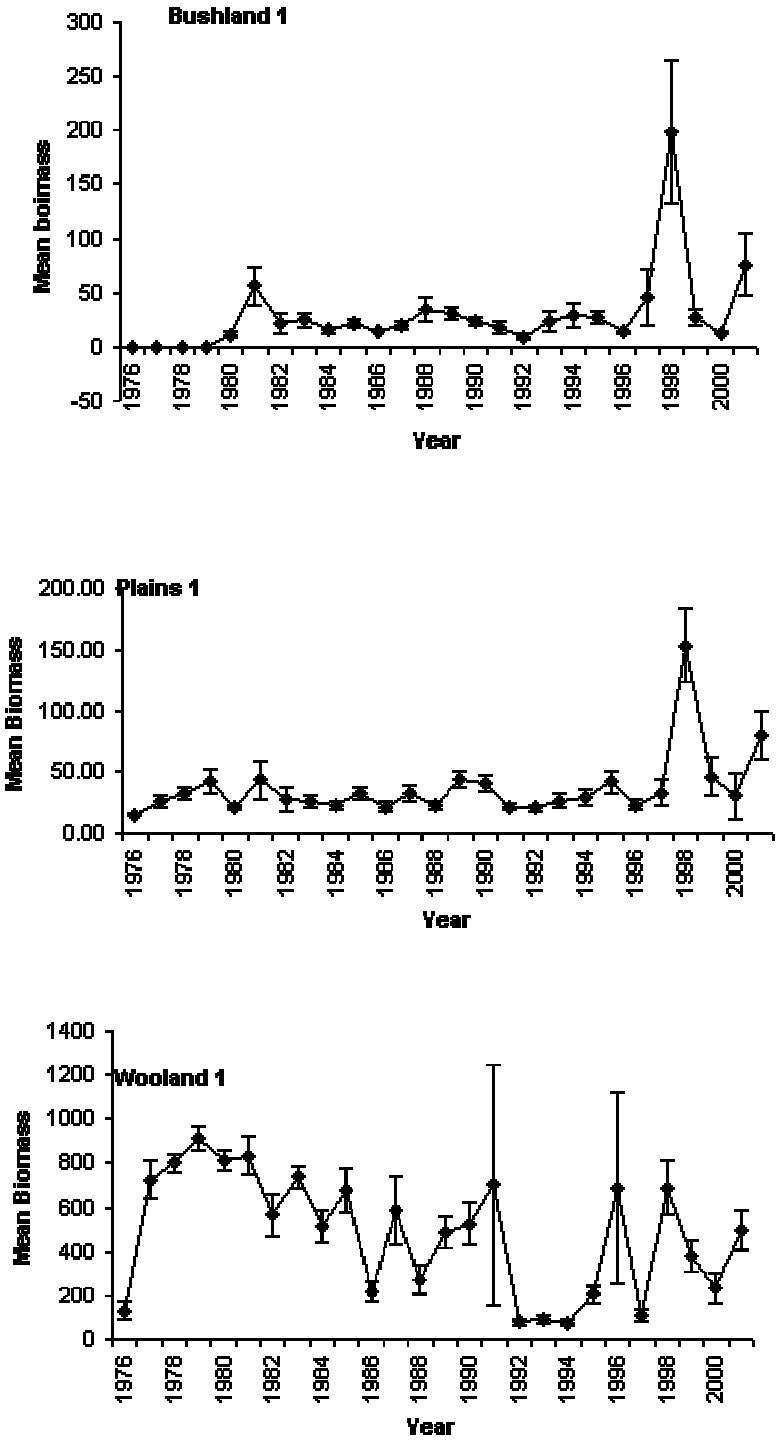


Fig 2. Pasture biomass in Pastoral areas (Bushland) and in Amboseli National Park (Woodland). Annual figures are averaged from monthly measurements

Population trends

Livestock populations rose sharply from the 1940s to the 1960s, due to increased availability of water and veterinary services (Western, 1973). Measured by liveweight (Fig. 3) there has been no further increase since the late 1960s due to a saturation of grazing lands in eastern Kajiado (Grandon, 1991). Rather, livestock populations have fluctuated with rainfall. Taken for the period 1973 to 2000, liveweight correlated with rainfall with a two-year lag, given by the regression equation log liveweight = 5.32 + 0.43 log rainfall ($P<0.05$). Overall, both cattle and combined sheep and goat ("shoats") numbers show a significant increase between 1973 and 2001 (Fig 3). However, the increase in cattle is more reflection of big population losses in the 1970s than actual increase in peak numbers. Numbers fell from a pre-drought level of 200,000 to a little over 50,000 by late 1970 and subsequently reached the 200,000 mark for only two brief periods in the 1980s. Since the mid-1980s there has been a slight decrease. Sheep and goat numbers were less affected by the 1970s drought and climbed steadily and significantly ($P<0.05$) from 100,000 pre-drought to a peak of 170,000 in the 1980s. From the 1980s onwards, numbers have stabilized (Fig. 3). The outcome is a steady decrease in the ratio of cattle to small stock (Fig. 3), a trend consistent with a Kenya-wide pattern (Grunblatt, *et al.,* 1996).

Overall liveweight has increased significantly from the 1970s to 2000 (Fig. 3), but again, the increase has been insignificant since the 1980s ((P.0.05). The strongest pattern overall is the rise and fall of livestock numbers with drought and rains. The drought of the 1970s was particularly severe.

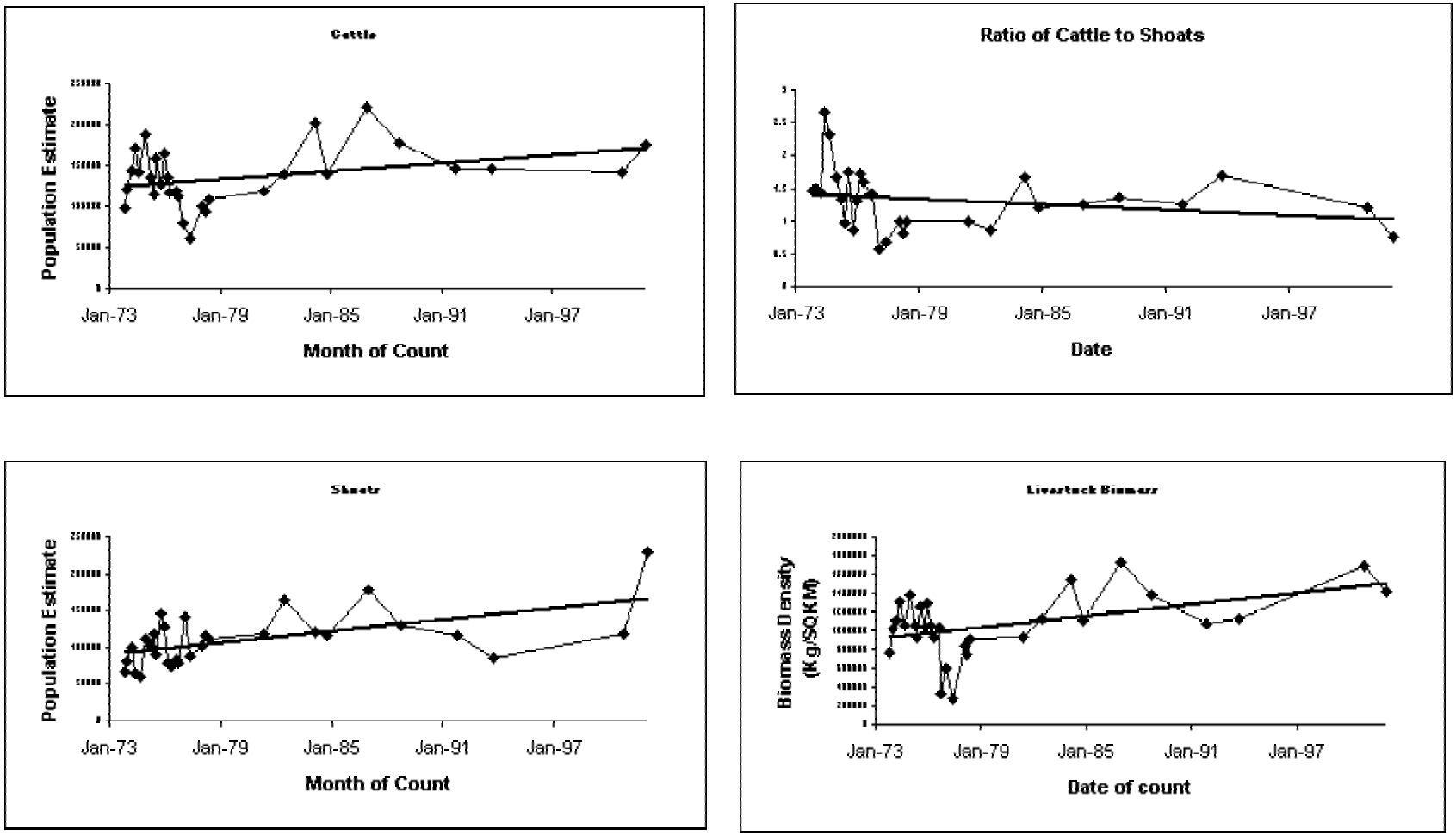
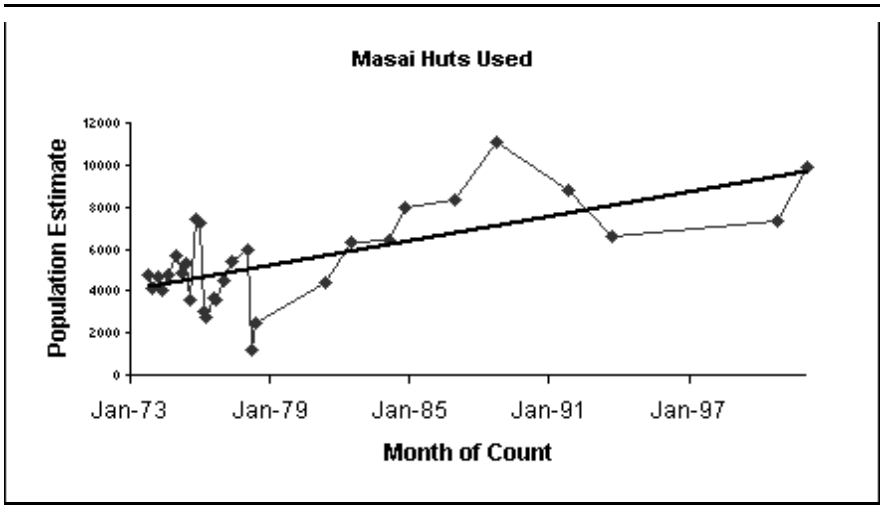
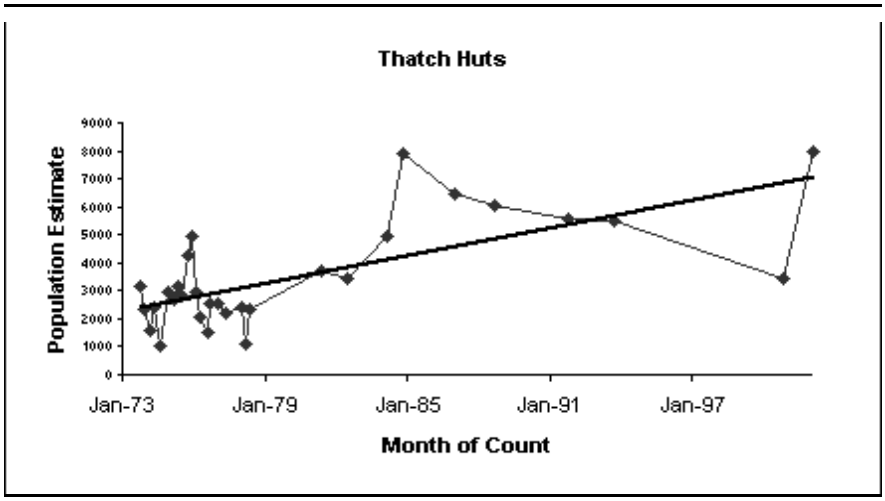


Fig 3. Population Counts of Cattle, Shoats (Sheep & Goats) and ratio of Cattle to Shoats for Eastern Kajiado. The total live weight for all Livestock is also given. The slopes are significant for Cattle, Shoats & Biomass ($p<0.05$)





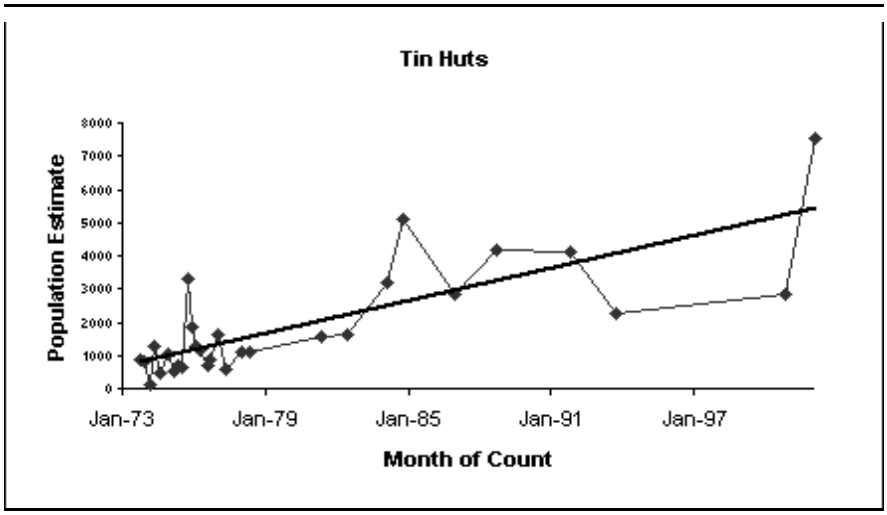
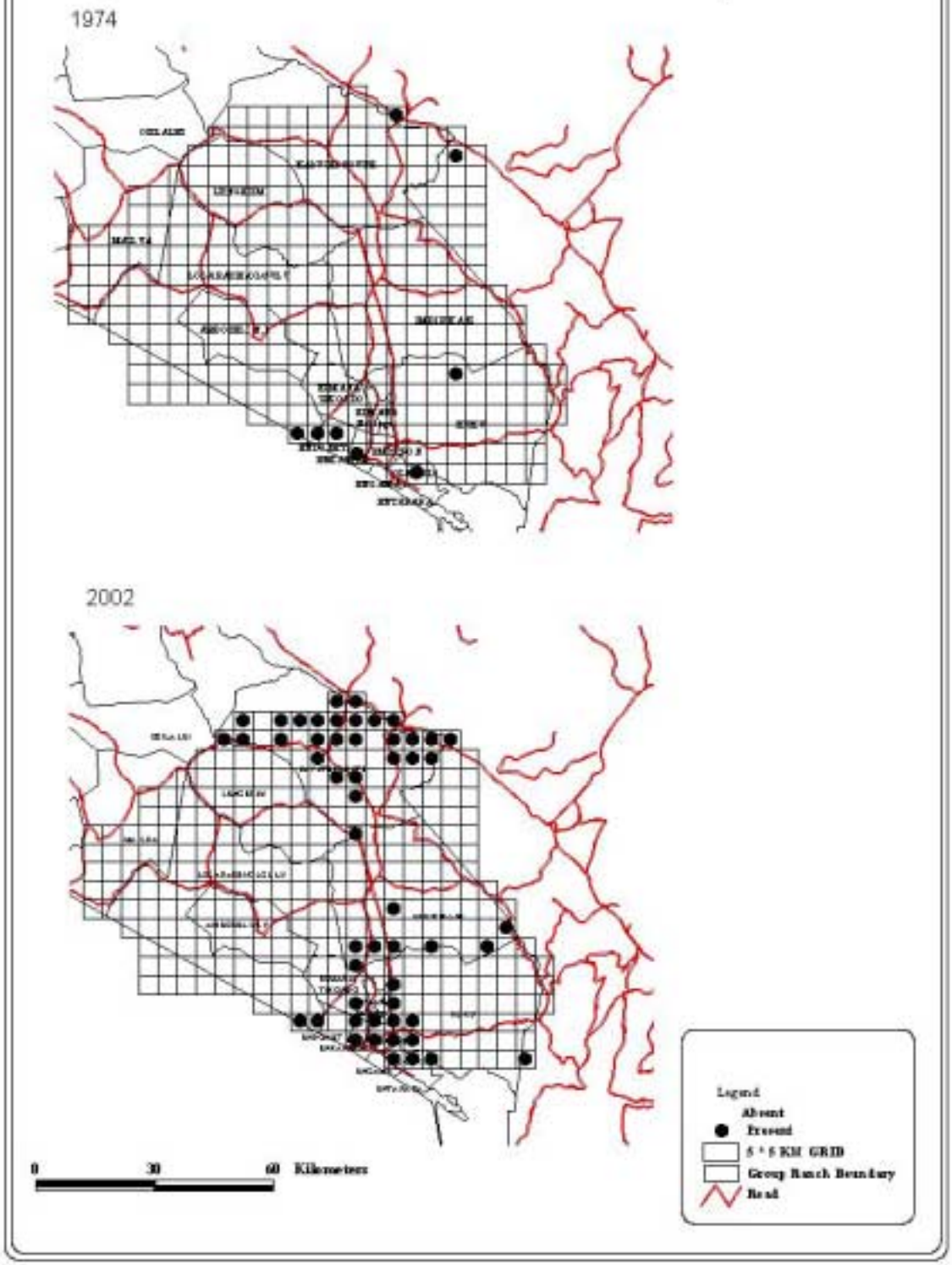


Fig 4.Numbers of traditional Maasai huts,thatch huts & tin huts counted in eastern Kajiado The increases in thatch & tin huts are significant ($p<0.05$), Masai huts is not.

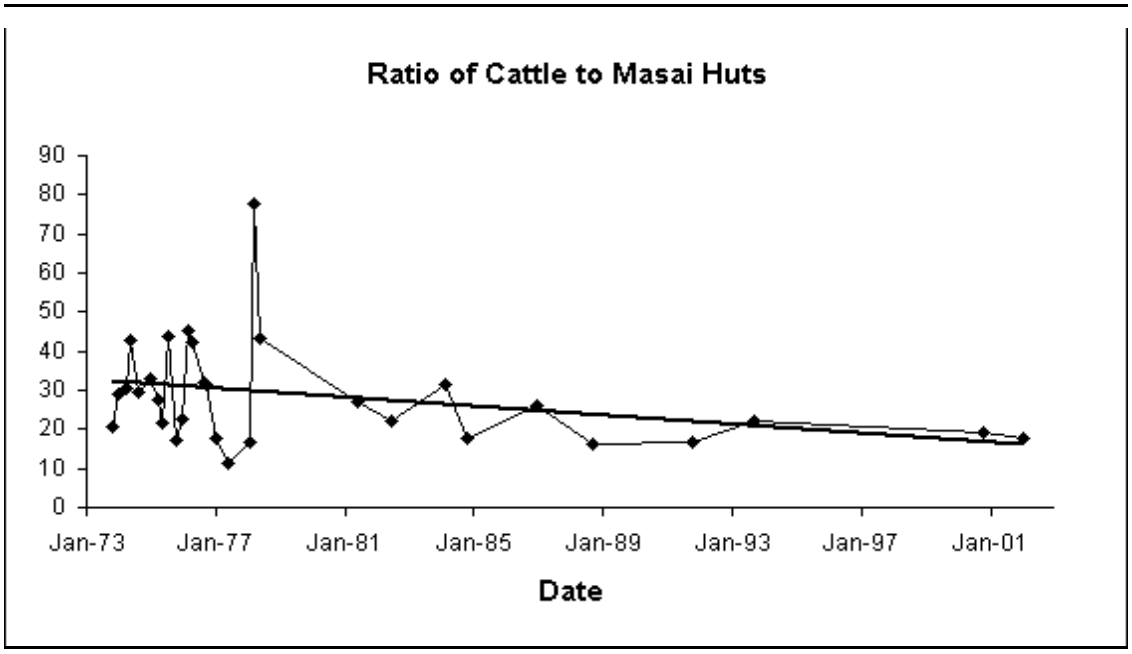
Counts of the number of occupied traditional Maasai huts (Fig. 4) show that pastoral households fell during the 1970s drought then rose steadily to higher levels after the drought. Numbers then stabilized and perhaps fell slightly after the late 1980s. Taking into account the slight fall in the number of occupants per hut due to the emergence of nuclear households among pastoralists and the continued use of traditional huts among many Maasai who have taken up agriculture in the fringing areas, population decrease may be underway in the driest parts of eastern Kajiado. In contrast, the number of thatch and tin-roofed huts has increased steadily since 1973 (Fig. 4). Tin huts have gradually replaced thatch huts over the course of time. But, here again, the rate of growth has slowed after the mid-1980s. There may, in fact, be a decline in thatch huts due to more families switching to tin-roof huts (Fig. 4). We interpret these results to mean that the arable lands within the ecosystem account for most of the population growth over the last quarter century but that growth in general is slowing. The spread of small-scale farms suggests why (Fig. 5). Settlement began in the wetter elevated regions north and south, then spread along the rivers and into the swamps. Marginal farms also spread along the newly constructed Loitokitok-Sultan Hamud pipeline during the late 1980s and early 1990s. Despite the aggressive growth of farms since 1973, most areas with arable potential had been settled by the late 1980s. Non-Maasai immigrants dominated the early phase by buying or leasing farms. The Maasai increasingly took up cultivation of their own farms in the 1980s and 1990s.

Figure 5. The distribution of shambas in 1974 and 2002 in Ilkisongo.



Two other trends point to pressure on pastoral herders. First, the ratio of cattle to households has fallen over the last thiry years (Fig. 6), indicating that per capita stock holdings have also fallen. This confirms the trends established earlier, showing per capita cattle holdings falling from around 10 in 1960 to 4 in 1990 (Grandon, 1991). Second, the ratio of occupied to unoccupied traditional Maasai huts has increased steadily (Fig. 6), indicating that the Maasai are moving less and settling in permanent villages.

For those Maasai who continued to depend largely on livestock, the appropriation of the wetter areas and water sources by farming communities, coupled with the loss drought refuges to national parks (Amboseli and Chyulus), put even more pressure on subsistence herders, increasing their vulnerability to ecological change and drought.



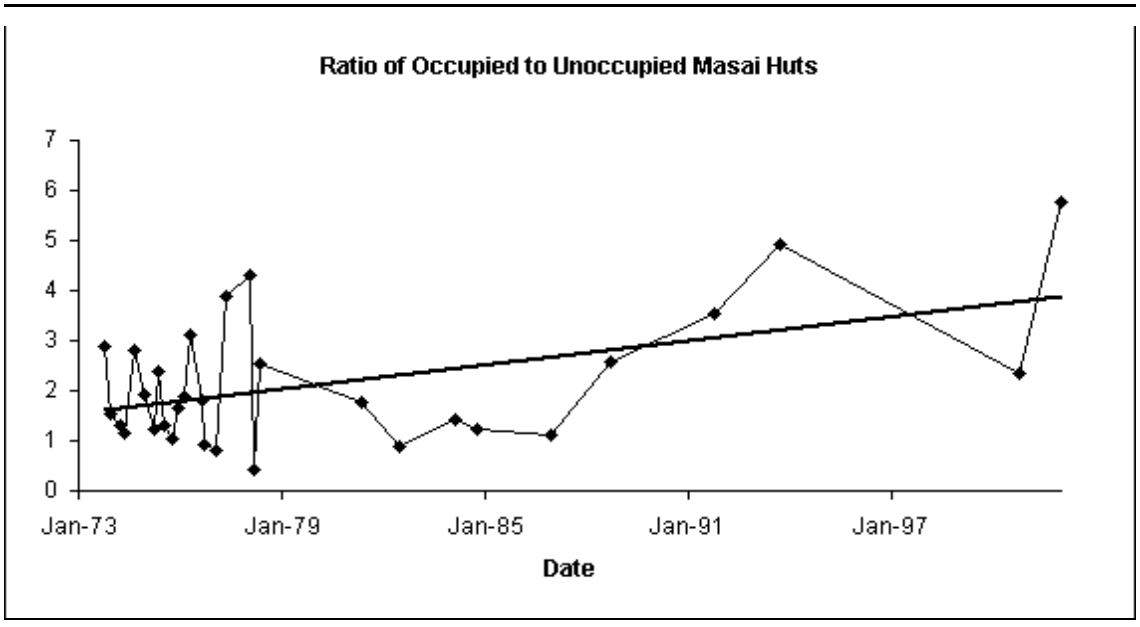


Fig 6 The ratio of Cattle to Maasai huts (a measure of house hold livestock holdings) and Occupied to Unoccupied Maasai huts (a measure of sedentarization for eastern Kajiado) Both slopes are significant ($p<0.05$)

As with livestock, wildlife numbers fluctuate with rainfall. With a lag of five years, total wildlife biomass is predicted by rainfall (log biomass = 2.85 + 0.41 log rainfall). There has, nonetheless been a steady increase in wildlife biomass since the 1970s (Fig. 7), due to the establishment of the national park and community conservation initiatives (see below). Zebra, elephant and buffalo account for a large portion of the increase (Fig. 8 and 9). No overall trend is evident in wildebeest (Fig. 8), though populations rose after the 1970s drought and again after the droughts of the 1980s. The picture for other species is mixed. Grants gazelle have remained steady (Fig. 8). Thomson's gazelle show a great deal of fluctuation (Fig. 10). Most browsing species associated with woodlands lost to farms have, however, fallen. These include impala, eland and giraffe (Fig. 10). Kongoni, a grazing species, also shows a steady decline. Along with eland and giraffe, they have also suffered bushmeat poaching in the vicinity of the Chyulu Hills. The large increase in elephants preceded the international ban on ivory and can be attributed to the success of Amboseli National Park and the participation of Maasai in revenue-sharing schemes and conservation enterprises (Western, 1994).

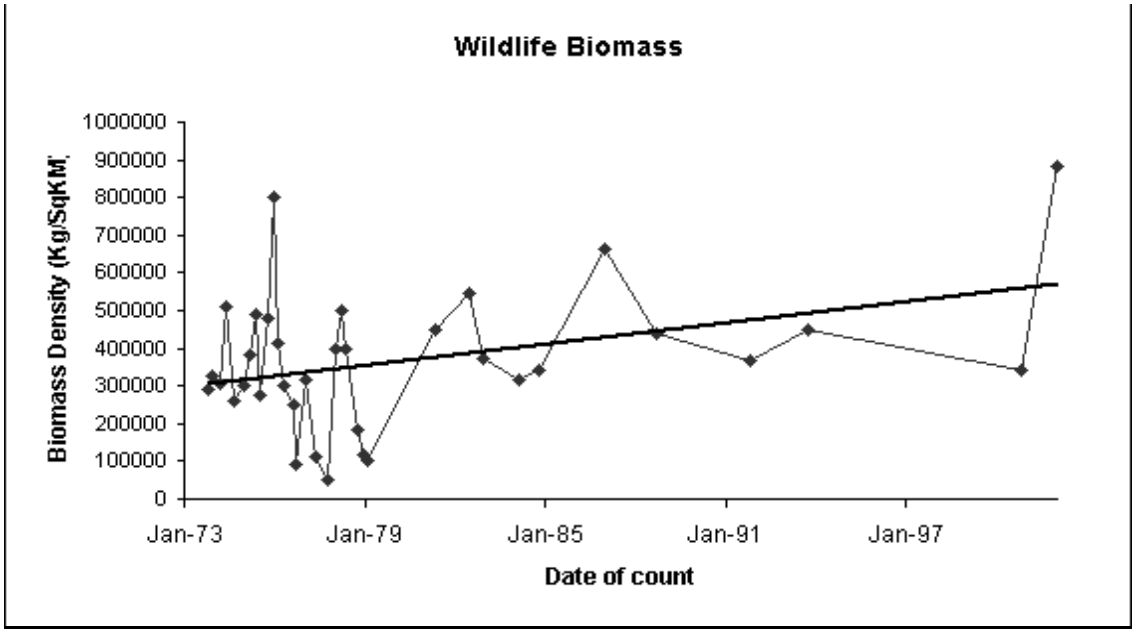


Fig 7. Wildlife Biomass for Eastern Kajiado. The increase is significant ($p<0.05$)

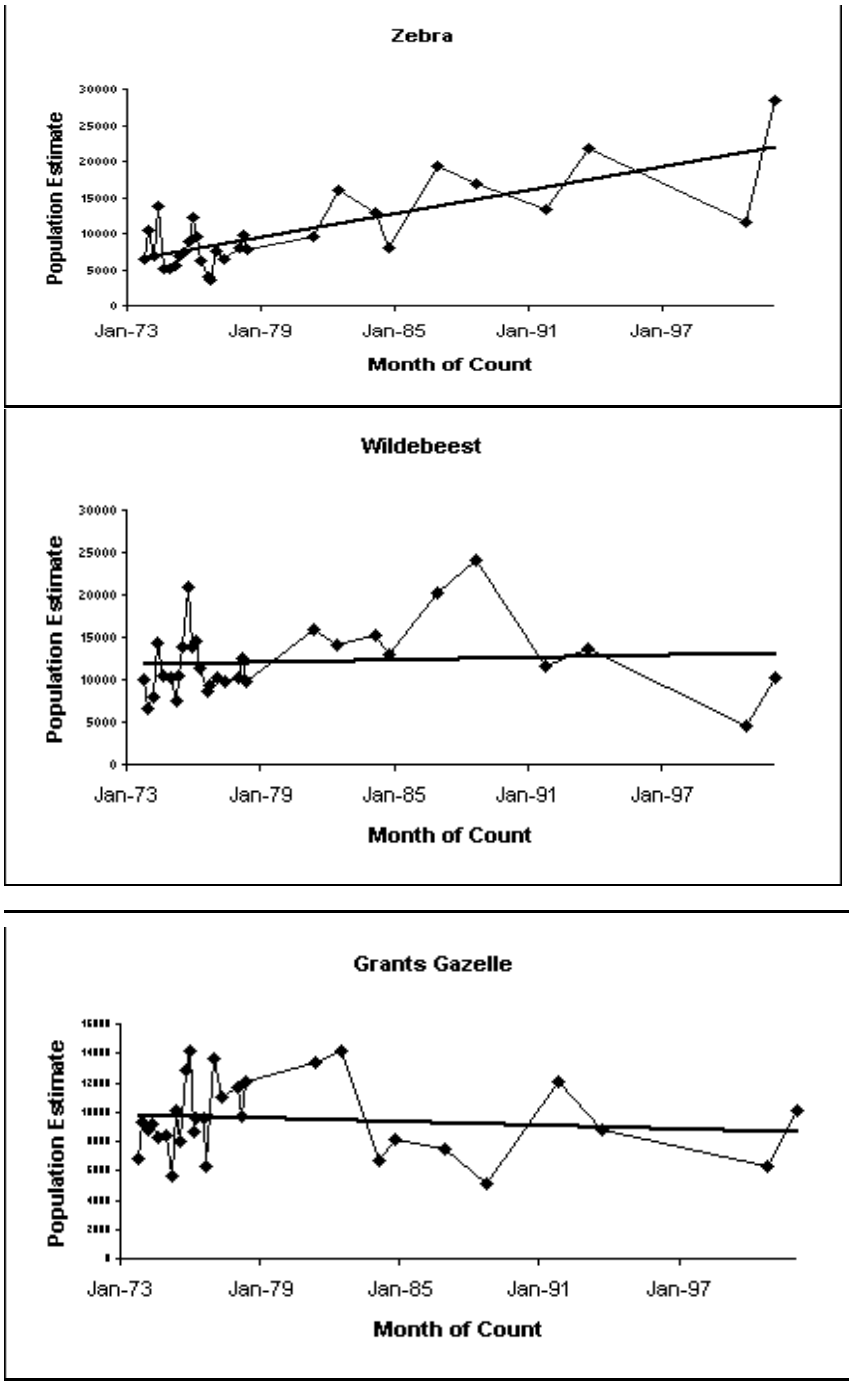
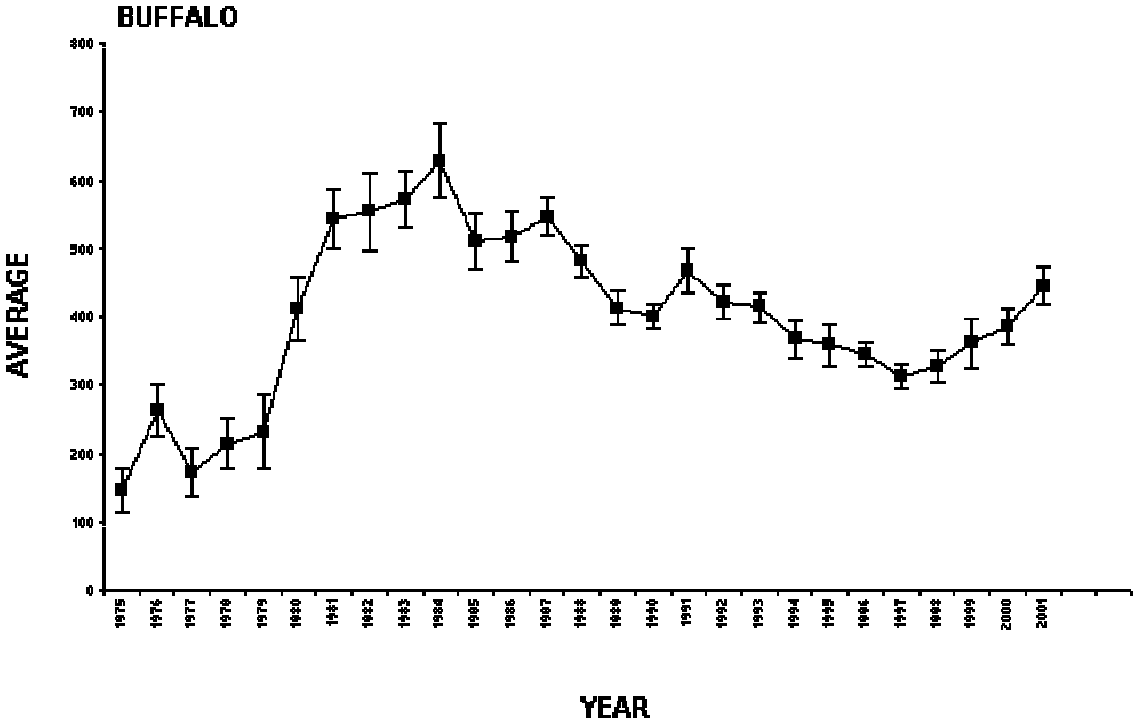


Fig 8 Figures for Zebra, Wildebeest and Grants Gazelle in Eastern Kajiado Zebra show a significant increase ($p<0.05$). The trend for Wildebeest and Gazelle show no significant change



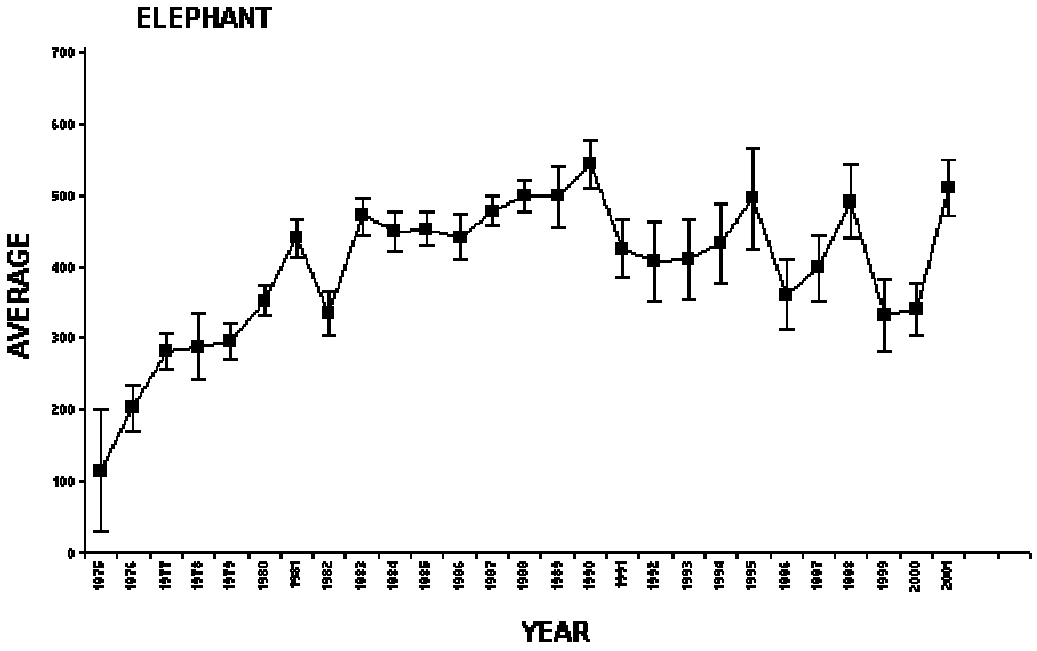
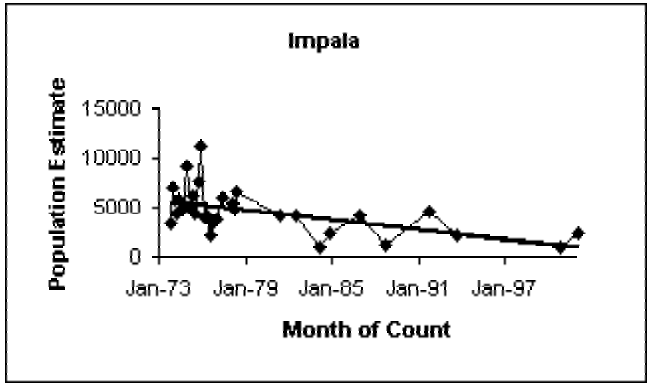
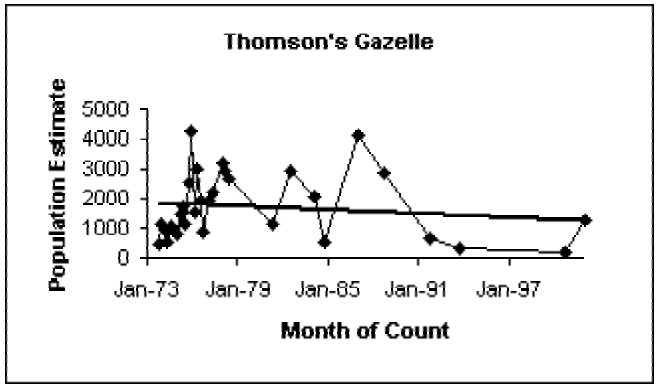
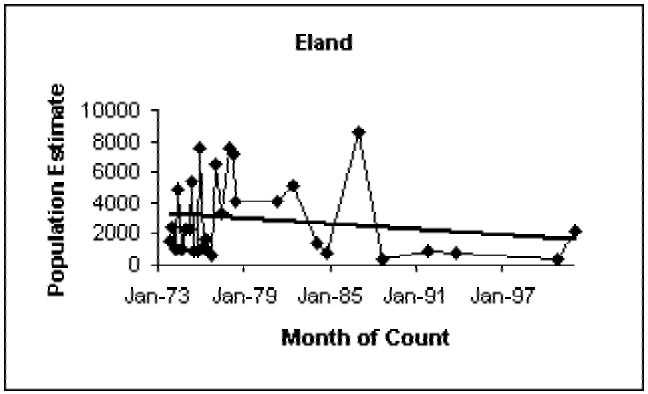
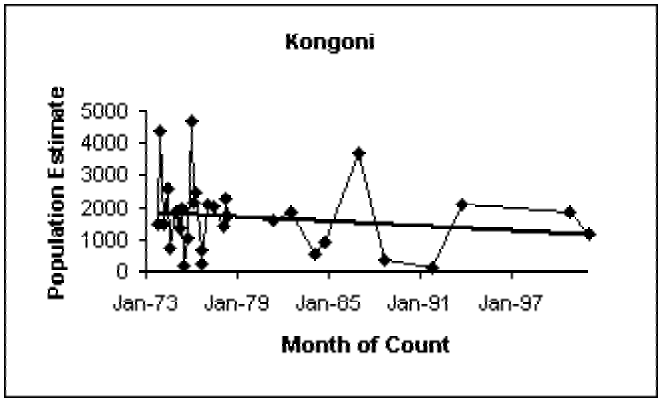


FIG. 9.BUFFALO AND ELEPHANT NUMBERS IN THE AMBOSELI NATIONAL PARK









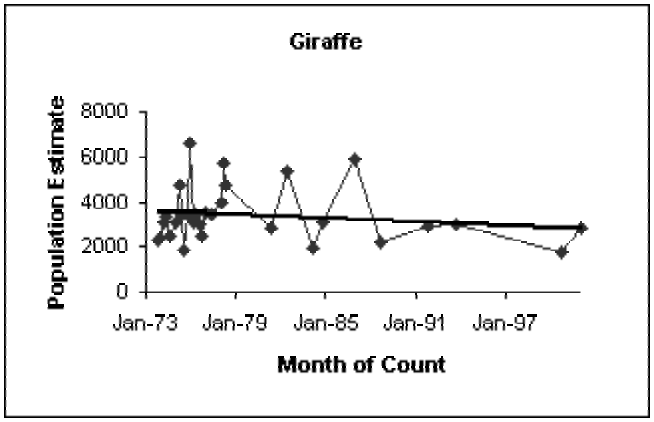


Fig 10. Numbers of Impala, Eland, Giraffe, Thomsons gazelle & Kongoni in eastern Kajiado. While the trend is downward for each species, only impala show a significant decrease ($p < 0.05$)

Biodiversity trends
The results of biodiversity trends in the ecosystem have yet to be fully analyzed, but several results can be tentatively drawn.

There has been a significant drop in the biodiversity of Amboseli National Park due to heavy elephant compression and the ecological separation of pastoral and wildlife ecology across the national park boundary (Western & Gichohi 1993). Prior to the establishment of the national park, the differing impacts and shifting locations of wildlife and livestock activity relative to each other created a shifting patchwork of habitat perturbation and recovery described as an ecological minuet (Western 2002). The shifting patchwork gave the savannas a distinctive habitat mosaic that accounts for its high animal diversity. In recent decades, the permanence of pastoral and elephant distribution either side of the park boundary has created a polarization of ecological forces, leading to a predominance of grasslands inside the park and bushlands outside. Sedentarization and polarization has resulted in a significant loss of biodiversity across the ecosystem (Western 2002). Even within pastoral areas, sedentarization is causing a secondary polarization of habitats, with heavy bush invasion in areas remote from settlements and open heavily utilized herbaceous cover around them.

Conclusions From a pastoralist perspective, the environmental changes in Amboseli over the last quarter century largely echo those for the rangelands of East Africa. Human numbers have risen steadily, though more in the arable than non-arable areas. Livestock numbers have stagnated, leading to falling ratio of livestock to humans (Fig. 6). The upshot is a rapid decline in subsistence pastoralism, accelerated by periodic droughts. The collapse of traditional subsistence livestock economies has in turn created both internal and external changes. Internally, the “push” factor of a declining subsistence economy has led to steady emigration, mostly of young men (who would otherwise become warriors) unable to build up herds. Livestock sales have grown and fueled heavier grain consumption to subsidize the diminishing milk economy. Sales grew strongly after the collapse of the marketing monopoly held by the Kenya Meat Commission until the late 1970s. Externally, a “pull” factor has also drawn people off the land by offering new opportunities in farming and wage employment. The new opportunities have significantly diversified Maasai economy and minimized the risk of drought and environmental change for herders who move off the land. Education is seen as passport to better opportunities.

The shift to a monetary economy and the availability of social services also stimulates sedentarization among those who remain on the land. Sedentarization is reflected in the increase in thatch and tin huts (Fig. 4) and in the sharp increase in occupied to unoccupied traditional Maasai huts (Fig. 6). Sedentarization is further reinforced by land insecurity and the resulting pressure for individual land titles, both of which are an outgrowth of the inadequacy of group ranches to meet the challenges of population growth, land alienation and security of investment (Western 2002). Put simply, sedentarization, however marginal the land and unsustainable in the long run, means priority in the rush to claim land as the group ranches are subdivided.

Sedentarization causes local waterhole-effects, the loss of an energy bonus due to migration, invasion of resilient and less palatable species of plants, greater risk of disease and less flexibility in droughts. Cumulatively, these factors heighten the ecological vulnerability of pastoralists and their livestock. Continued land losses, particularly drought refuges, further adds to vulnerability of herders remaining on the land with no access to *shambas* or alternative sources of income.

On the wildlife front, the introduction of Community Based Conservation initiatives beginning in the 1970s, was seized on by the Maasai as an opportunity to renew the traditional role of wildlife as a drought resource, or "second cattle" and to diversify the use of drylands. Pastoralists began referring to wildlife as their "dryland coffee." The income from conservation enterprises and revenue-sharing from the park has built schools, health centers, provided bursaries and expanded community services. The outcome has been positive for wildlife, with herds growing around Amboseli National Park and across the drier areas of the ecosystem, particularly in the vicinity of ecotourism lodges and community wildlife sanctuaries such as Ol Doinyo Uas, Kimana and Selengei.

Despite notable successes and a positive influence on national wildlife policy, the interaction between wildlife and Maasai in the Amboseli ecosystem also has its downside. For instance, the dislocation of human and wildlife interactions (see above) has led to a loss of woodlands and biodiversity in Amboseli National Park and bush thickening outside on pastoral lands (Western 2002). In addition, new conflicts have arisen as Kenya Wildlife Service has stepped back from its policy of devolving rights and responsibilities to landowners. Crop raiding by wild animals, especially elephants, has increased sharply as animals have moved out of parks after the ivory trade ban of 1989. Predation by hyenas and lions has risen in many areas, causing acute hardship among herders and often reprisal killing and extensive poisoning. Here again, the costs fall disproportionately on the poorer sector of the population occupying the drier areas.

Macro-economic, political and governance factors are also the cause of the environmental changes seen in the Amboseli area over the last 30 years.

National economic growth directly affects arid land emigration by providing new opportunities in the face of drought and poverty. The strong "pull" effect of the 1980s when the economy was growing has weakened with the prolonged economic recession of the 1990s. This comes at a time when the best lands have been usurped for agriculture, upstream water off take has diminished lowland supplies and the job market is shrinking. The combined effect is to slow the pace of emigration, bottling up pressure on the land and raising the environmental vulnerability of marginalized pastoralists. The erosion of traditional herding strategies is accelerated, leading to a loss of pasture governance and other adaptive husbandry practices. The loss of social networks that provide ecological insurance for their herds also diminish a pastoralist's ability to divest herds or recoup in the face of drought, disease or other risks.

On the other hand, freely available livestock markets and loans can partially replace the social network and offer flexible herd management in the face of unpredictable environmental conditions. Markets and loans are more accessible in the southern areas of Kenya than in the north, but they are still limited among pastoralists relative to other sectors of the society.

Politically, central government control has intensified. The advent of multiparty politics has, in addition, caused acute clan rivalry and resource grabbing. Political power is now seen as the best way to get land title, scholarships, water rights and other new avenues to wealth. The political clout of the pastoralists has also eroded with immigration, the expansion of farming and growth of towns and villages in Kajiado District.

In conclusion, national development should be the release valve for a collapsing subsistence economy in the arid lands. Instead, economic stagnation is putting even greater pressure on pastoralists, creating a poverty trap. Inequality is on the rise as the political and economic power of pastoralists in the marginal lands falls further and further behind in the national struggle for development. The growing inequality has direct environmental consequences. The most obvious is the inability of pastoralists to secure water rights against the politically powerful farming and industrial sectors. Water is the lifeblood of pastoral societies. Yet rivers and swamps throughout the pastoral lands are being tapped and settled, robbing pastoralists of the vital drought resources they need to sustain their herds. So, for example, irrigated farms at Kimana have dried up the once extensive Lenker Swamp in the Amboseli ecosystem and industrial demand has seen the Noolturesh River piped to Ukambani and Nairobi, drying up yet another important swamp, Soit Pus.

The loss of late season pastures throughout Kenya has caused a steady invasion of national parks, forest reserves, ranches and farms over the last decade, often leading to armed clashes.

Most of the trends and changes in the Amboseli ecosystem over the last three decades are common to the pastoral areas of Eastern Africa (Scoones 1996, Southgate & Hulme 2000, Blench 2000, Little, *et al*, 2001). Land loss and fragmentation, falling stock holdings and the problems of economic and social transition among pastoralists are widely acknowledged. Others, especially the environmental problems, are poorly understood or acknowledged. These include the loss of drought refuges (e.g. northern Maasai/Samburu use of the Aberdares and Mt Kenya forests), narrowing ecological adaptability due to loss of drought-adapted breeds, loss of genetic diversity, the loss of energy bonus due to migration, the disintegration of social networks, and the loss of traditional medicinal plants and knowledge (Niamir 1990, Hall & Ruane 1993, Hall & Bradley 1995, Ole Lengisugi & Mziray 1996, Kohler-Rollefson & McCorkle 2000, Huggins 2000)

VI Outlook

We single out four factors that threaten pastoral societies and drive change. There are many others, of course, but the following are among the most universal and important. They also illustrate the interplay of threat and opportunities in pastoral areas.

a) *Declining livestock numbers*:
Decline in livestock holdings have weakened subsistence pastoralism over the last few decades to the point that few communities can survive on their herds (Grunblatt *et al* 1996, de Leeuw & Wilson 1987, Huggins 2000, Little *et al.*, 2001). Those who do build large herds seldom rely on them as their sole strategy (Campbell 1978) due to the risks of drought, raids, predation and disease.

The shift to small stock among cattle pastoralists not only reflects market forces but also the greater drought resilience of sheep and goats in the face of pasture shortages. Declining dependence on herds, the emigration of young men unable to build herds and the loss of flexibility in migration and husbandry practices have repercussions on pastoral society**.** Many herders, for example, have given up the stringent three-day watering regimes that call on the manpower, know how and fortitude of young warriors. The use of distant pastures is falling as areas around settlements intensify. Furthermore, when poor households are forced to sell off livestock to richer stockowners, disparities of wealth within the community widen (see **c** below). Small herds are milked more intensively than large herds, which lowers calf growth and survival during pasture shortage (Lybbert *et al*, 2001).

In the face of falling per capita holdings, pastoralists are forced to seek other livelihoods. Young men migrate to towns in search of employment, or pursue higher education. Married men tend to look for local alternatives in the farming sector or tourism industry.

b) S*edentarization*:
Sedentarization, driven by the demand for social amenities as well as fear of land loss, reduces mobility, productivity, disease avoidance and drought resilience. Continuous grazing around permanent settlement also lowers plant productivity and favors the spread of unpalatable herbs and shrubs. Areas remote from permanent settlements lose the patchiness and diversity of habitats resulting from mobile corrals and the nutrient hotspots they create in the savannas. Finally, sedentarization also threatens the diversity and abundance of wildlife on which new economic enterprises among pastoralists are founded.

The most immediate concern over sedentarization among pastoralists is milk yield. Many pastoral settlers along the Lotokitok-Sultan Hamud pipeline already worry about falling milk output. The depletion of fuel wood and fencing materials close to settlements (Western & Dunne 1979) also adds a heavy burden on women who must travel progressively farther to collect supplies.

The opportunities arising from sedentarization more than offset the risks in the minds most pastoralists. New opportunities include schools, clinics, veterinary services, shops, produce markets, jobs and wage employment, all of which improve welfare measured in human survivorship.

The hardships and risks of subsistence pastoralism on the one hand, and new opportunity of sedentary life on the other, will accelerate the economic transition underway to varying degrees in all pastoral societies. Our concern is less the fact of transition than in making the push-pull forces positive for the Maasai, rather than negative. A negative push-pull will raise the vulnerability of livestock economies, ranching societies, rangeland productivity and biological diversity.

The increased variability in rainfall expected to result from global warming is likely to exaggerate the vulnerability of pastoralists to drought arising from sedentarization. In short, the greater seasonal extremes will add to the vulnerability of pastoralists arising from reduced mobility and lower range production in the vicinity of permanent settlements.

c) Land fragmentation and inequality:

Land loss to agriculture, parks and forests reserves, as well as immigration and land subdivision, are causing land fragmentation and loss of pastoral mobility. Fragmentation and loss of mobility further raise the risk of drought among pastoral societies in several ways:

- Disrupting established migration pathways for livestock, access to drought reserves and flexibility in avoiding disease outbreaks. A common pattern is for politically connected members to acquire the most productive lands, further marginalizing poor families, and widening inequality and drought susceptibility.
- Replacing traditional distributed governance of resources with mandated centralized authority based on political power. The insistence that pastoral lands in Kenya be subdivided regardless of viability is one example of government by fiat.
- Subdivision in turn results in reduction of grazing area and mobility. These small land holdings are likely to be re-amalgamated into larger holdings in due course, but the acquisitions will be made by the richer pastoralists and non-pastoral groups, causing even greater inequality.
- Fencing into too small units adversely affects livestock and wildlife mobility, compounding the risks of drought in arid lands.

The primary factor driving land subdivision over much of the rangelands is fear of land expropriations. There can be no doubt that land subdivision in arable pastoral areas has increased productivity, improved welfare and allowed landowners lower environmental risks (Little *et al,* 2001). Individual land titles also put pastoralists on a par with other sectors of society in being guaranteed the sole returns of their efforts. This lengthens planning horizons and increases investment in the land. Other benefits include the stabilization of production, markets and social services.

The benefits of subdivision in non-arable rangelands, however, is less evident and largely untested. The subdivision and commercialization of the rangelands in the developed world, Australia and the US, for example, did not involve the participation and settlement of indigenous subsistence societies and therefore resulted in large, relatively viable land holdings. Subdivision of the African pastoral lands will create small non-viable holding among peoples whose livestock production was built on mobility and social reciprocity. Whether land subdivision causes stock losses, social strife and ecological degradation will depend on what sort of reciprocal arrangements landowners establish among individual land holdings. Share-holding grazing associations could presumably get around the problem of sub-optimal holdings by setting aside grass-reserves, establishing reciprocal grazing rights and diversifying the economic base through wildlife and other enterprises. It is hard to see how this could be achieved without greatly reducing the number of herders on the land.

d) ***Human-wildlife conflict:***

The creation of national parks and state ownership of wildlife has raised the temperature of human-wildlife conflicts. Most wildlife resides in the pastoral rangelands. Moreover, with some 65% to 75% of Kenya's wildlife outside parks, the stage is set for even deeper conflict as pressures on the land build and tolerance of wildlife falls (Eriksen, *et al* 1996). For the Maasai, their "second cattle" have become "government cattle" and a burden rather than relief in times of drought. With wildlife benefits accruing almost exclusively to government, councils and the tourist industry and the costs wholly on rural communities, resentment of wildlife runs deep. Wildlife moves freely out of parks onto pastoral lands, spreading disease to livestock and often causing stock and human deaths (Sindiga 1999). Newly farmed plots have become common targets for elephant, buffalo and other wild herbivores.

As a result, wildlife numbers have been in steep decline over most of the rangelands over the last thirty years (Grunblatt *et al.* 1996, Blench 2000) due to poaching, predator poisoning and the enclosure of water holes and pastures. The decline threatens wildlife in parks no less than outside and in turn the lucrative tourist and hunting industries across Africa (Sindiga 1999, Gibson 1999, Jones 2001). The Amboseli case study stood in stark contrast to these national trends, though here too the failure of Kenya Wildlife Service to liberalize wildlife policies threatens these gains and the future of wildlife (Western 2002).

The opportunity to reduce the conflict and raise the value of wild products (including those that serve as traditional medicines) is great (Waithaka 2002). There is a good deal more potential to diversify rangeland income through wildlife utilization than there was traditionally. Wildlife enterprises do, however, call for user rights and spreading the cost burden (Emerton 2001). Amboseli may have been the first experiment to show that communities could derive income from wildlife and would willingly engage in tourism and hunting enterprises, given the opportunity. Other examples in Kenya, Zimbabwe, Tanzania and elsewhere in Africa have since made greater progress in demonstrating the value of wildlife and related industries to rural communities (Hulme & Murprhree, 2001).

Despite the progress, wildlife returns to the community at large do not automatically reduce depredations. To the contrary, conflict often increases as wildlife numbers climb and animals lose their fear of people. The challenge of resolving the conflict has, in other words, been transferred from national to local level and remains no less pressing.

VII. RESPONSES

The response to the challenge of the pastoral lands has been broad and varied. Here, for the sake of simplicity, we only list some of the most significant by the pastoralists, the Government, and other stakeholders.

a) The Maasai community in the Amboseli region has responded to the environmental changes in many ways. Here we note a few that apply widely to pastoralists throughout eastern Africa.

Arable farming (including crop-sharing and land leases) and wage employment are the main responses to environmental threat (Southgate & Hulme 2000). The outcome is a diversified economic base that raises income and reduces drought vulnerability.

Yet another common response is a diversification of livestock production from a subsistence economy to subsistence-cum-market economy. Typically, pastoralists sell livestock and expand their small-stock holdings as a result. Where markets are close, they also enter the dairy industry (Little *et al.,* 2001).

The Maasai have also rallied politically to secure title to their lands and discourage immigrants. Land subdivision and entitlement is an assurance of the exclusive proceeds from their land. Private land, in turn, becomes a commodity for sale or rent. Unfortunately, this often works to the disadvantage of the poorer Maasai who are soon persuaded to sell out under political coercion or economic hardship (Huggins 2000, Southgate & Hulme 2000).

Yet another response is the emergence of Maasai NGOs and community-based organizations, aimed at securing rights, raising financial assistance, building local capacity and opening up new opportunities. New sector-based institutions (farming, ranching and wildlife) are also on the rise, promoting products and pursuing markets. Yet other local initiatives are gradually emerging to tackle the new environmental threats by promoting grazing associations and grass-reserves among landowners on private and communal lands.

Maasai communities are rapidly diversifying wildlife-based revenues derived from tourist and hunting concessions. These new industries include eco-tourist lodges, community wildlife reserves, guiding, scouting, cultural villages and the sale of cultural artifacts. Employment in wildlife lodges and the service industry in and adjacent to parks has also expanded rapidly due to political lobbying.

b) The Government has contributed to both the environmental problems facing pastoral communities and their solution. Both the colonial and independent government has

viewed pastoralism as an inefficient and outmoded method of livestock management largely to blame for the state of the rangelands. Numerous government schemes have been directed at changing pastoralists to modern commercial ranchers. Most paid little attention to the rationale of pastoral production or its adaptation to drought cycles. Prejudice against "ungovernable" mobile herders also played a large role in government efforts to sedentarize and administer pastoral communities. Many studies over the last three decades (including the present study) challenged the views and argued that government action was actually contributing to land degradation (Lane & Moorhead 1996). The environmental circumstances in the arid savannas, it was argued, called for a new view of pastoralism and new development paradigms.

Historically, government action aimed at rectifying the perceived "Tragedy of the Commons" created by pastoralism. This included enforced settlement, livestock markets, "improved" husbandry practices and modern range management techniques. Other less debatable inputs included roads, water improvements, schools, health services, veterinary support, agricultural extension services and assistance in marketing produce. Donor support secured by governments for building social and managerial capacity in the pastoral areas has been significant.

Both colonial and independent governments also did much to establish modern administrative and political structures for governance and rural development. These included county councils, provincial administrations, government chiefs, and so on. In the last few years policies have shifted towards decentralization and rural empowerment, but so far with little tangible outcome. For the most part bureaucratic inertia and vested power structures have prevented policy from being realized in practice. Recently (1999) a Commission of Inquiry into the Land Law System in Kenya was gazetted by the President to deal with issues that have arisen out of the failures of land policies. This exercise is still ongoing.

c) Other stakeholders have responded to the changing situation in pastoral areas in a number of ways. The following are a few examples:

1) **Other communities and large agricultural businesses**: In response to the subdivision, privatization and commercialization of land, other communities and investors have immigrated into pastoral areas, establishing farms and irrigation schemes, using up scarce water resources (Southgate & Hulme 2000). Examples include smallholdings, horticulture (including export crops) and wheat farming.

2) **Commercial enterprises involving tourism** began with the establishment of hotels and tour companies catering for mass tourism in Kenya's most important parks, including Amboseli and Masai Mara. Such business offered little to pastoral communities initially. More recently, however, a number of tour operators and concessionaires have entered into direct contractual arrangements with communities to established partnership lodges. A few communities have exclusive ownership of ecotourism lodges. A number of the more progressive large lodges are also entering into business arrangements with communities and preferentially employing staff

locally. Ecotourism ratings now under development by the industry will rate enterprises on environmental and social criteria, opening up a marketing incentive to responsible operators and a promotional tool to communities engaged in ecotourism enterprises.

3) **Conservation NGOs and other wildlife-based initiatives.** These groups originally focused on wildlife research and conservation. Recently they have started to help communities build the capacity to engage in enterprises and undertake their own wildlife conservation activities, including their wildlife sanctuaries, lodges, tourist services and security coverage by community scouts. In another new innovation, a number of NGOs are actively exploring land trusts, conservation easements and leasing fees with local communities in an effort to address environmental threats and turn conservation to economic and social advantage.

4) **Organizations providing assistance and relief.** These include mission services, development agencies and charitable organizations, largely targeting social and economic development leading to the sedentarization of pastoral communities. Livestock development agencies have also targeted improvements in animal health and production through better animal husbandry, although not always with an understanding of the advantages conferred by nomadic pastoralism as a response to environmental conditions (Scoones 1996). Other organizations, including the Arid and Semi Arid Lands projects actually attempt to halt land fragmentation by improving on and diversifying pastoral strategies. Finally, a number of agencies provide famine relief that has done much to buffer pastoral societies from drought in recent years. These include World Vision, Mennonite Central Committee, donor agencies and mission societies.

VIII. CONCLUSIONS

Nomadic pastoralism is a highly specialized production system that compares favorably to commercial ranches in the rangelands. Pastoralism supports a large human subsistence population dependent primarily on milk and secondarily on meat. Pastoralists have, in addition, developed a flexible set of herding and husbandry practices and reciprocal social networks that allow them to track the highly variable primary production of the arid areas in space and time and avoid the localized impact of drought. This contrasts with commercial ranching in the arid areas, which generally maximizes beef production and economic profitability by stabilizing environmental and market fluctuations.

Subsistence pastoralism is in a state of transition due to both a rising human population on the land and outside social and market forces. The Amboseli case study shows that pastoralists are diversifying their livelihoods and lifestyles out of choice and necessity. Diversification into arable agriculture and the wage economy is seen as a way of reducing environmental risk and uncertainty and enjoying new economic and social opportunities. For those unable to make the transition, however, the environmental risks are greater than ever. The poor and least educated face loss of land, drought refuges and water sources, sub-division, land fragmentation and above all, loss of herd mobility.

The options and risks open to pastoralists are neither simple nor constant. In most respects, the options have narrowed and risks intensified in recent droughts compared to the 1970s, due to rising human numbers, increased pressure on the land and stagnating economic and social opportunities off the land. The pressures are most severe in arid remote areas. In northern Kenya where firearms are readily available, recent droughts have seen an upsurge in raiding, social disruption and mass emigration to frontier towns, marginal agricultural areas, forest reserves, refugee camps and even national parks.

To counter these threats, the national economic and social outlook will have to improve considerably. The plight of the pastoral peoples and pastoral environment will, for the most part, be dictated by the national political and economic climate. Both local and national opportunities are equally spurred or retarded by the same forces. In the pastoral areas, however, extra efforts will be needed to extend communications, social services and economic opportunities to the more marginal regions ordinarily ignored in developmental priorities. Unless the disruption and poverty of transition from subsistence pastoralism to a diversified economy is eased, the dislocation will spill out into non-pastoral lands and fuel social tensions.

Policies and actions should dispense with myths that surround and stigmatize pastoralists and retard development. These include the belief that pastoralism creates deserts, herders won't change, that there are more cattle than ever, that sedentary commercial ranching is superior to mobile pastoralism and that pastoralists will recover and resume life as normal after big droughts. Policies and actions should be grounded in realities. The reality is that there is no return to subsistence. The productivity of the rangelands is low but pastoralists have been able to maximize productivity through their highly evolved traditional strategies. Mobility has productive and survival value in drought-prone areas. Diversification on the land is possible but limited. Wildlife utilization and tourism have considerable potential to complement rangeland productivity.

In the final analysis though, the future of those living in pastoral lands lies more in opportunities off the land than on. The disruption caused by drought in particular calls for short-term relief, as well as long term measures to resolve poverty and marginalisation in the arid lands.

Short term measures:

- Make provisions for emergency migrations to pasture reserves in extreme droughts based on limited rights of access.
- Improve relations between private ranches and pastoralist communities to investigate possible co-operation and reduce conflicts and invasions of farms
- Establish markets close to drought-stricken areas to buy up surplus stock, including raw animals hides.
- Repair water outlets and curtail banditry in areas abandoned due to ailing services and insecurity.

Long term measures:

- Ensure that rights and responsibilities over natural resources are devolved to the lowest appropriate level.
- Adjust land holding size and configuration to seasonality and aridity.
- Encourage reciprocal grazing arrangements among closed-membership landowner associations to allow mobility and access to pastures, taking into account seasonality, drought and the benefits of mobility.
- Diversify opportunities on the land, including dry-land agriculture, irrigation, wildlife-based income, cultural tourism, and value-added livestock industries such as tanning.
- Diversify opportunities off the land by improving health, education and welfare of pastoral societies, providing access to trade skills and higher level educational facilities.
- Encourage the formation of trade associations and self-help organizations
- Learn production and survival skills from pastoral societies that can be adapted to market ranching.
- Apply modern ranching practices and new technological developments selectively to the arid lands, based on experimentation and performance rather than imported blue-print plans.
- Integrate land-use planning to avoid negative impacts on certain sectors and marginalized communities and include local knowledge in impact assessments.
- Improve the monitoring of local environmental conditions by deploying community staff among professionals in order to anticipate environmental risks and diversify coping strategies.

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