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# Turkana Pastoralism: A Case Against the Tragedy of the Commons

**J. Terrence McCabe**[1]

*This paper examines land-use practice among the Turkana pastoralists of Kenya. Drawing on work of both ecologists and anthropologists, it examines the argument that posits that pastoralism is inherently destructive to the environment, commonly referred to as the "Tragedy of the Commons." Results of this research suggest that the livestock management practices of East African pastoralists do not degrade the environment, that livestock numbers do not exceed the carrying capacity of the land, and that social institutions successfully function to cope with environmental problems.*

**KEY WORDS:** East Africa; pastoralism; degradation; nomads; development.

## INTRODUCTION

The keeping of livestock is the principal subsistence strategy of many people inhabiting the developing world's arid and semi-arid lands. In Africa, it has been estimated that between 25 – 30 million people depend on livestock as their major source of food and money (Sandford, 1983). Although anthropologists have been studying Africa's pastoral peoples since the 1940's and international donor agencies have spent many tens of millions of dollars trying to improve management strategies to increase production, some of the most basic questions regarding indigenous methods of livestock management and their effects on the environment remain unresolved. One of the most hotly debated of these issues concerns overgrazing and environmental degradation.

[1]Current mailing address: Department of Anthropology, University of Colorado, Hellems Building, Campus Box 233, Boulder Colorado 80309-0233.



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The nature of the relationship that exists among populations of nomadic pastoralists, their livestock, and the environment in which they live has been a contentious issue for more than 20 years. A review of the literature reveals two distinct positions: some researchers remain entrenched in the position that pastoral nomadism is inexorably caught in the cycle of livestock accumulation that leads to overgrazing, environmental degradation, and famine (Lamprey, 1983; Ingold, 1980; Picardi and Siefert, 1976). Other researchers hold the position that pastoral nomadism is environmentally sound and that it has been the disruption of the normal system that has caused the environmental problems (Hogg, 1987; Sinclair and Fryxell, 1985; Swift, 1977). Because much of the recent research conducted among pastoral nomads has occurred in areas where the local populations have been subject to significant disruption due to policy decisions at the national level and to the influence of development projects, the case for or against environmental degradation has been weakened by the necessity to reconstruct past management strategies and environmental conditions (e.g., Watts, 1987; O'Leary, 1984; Swift, 1977). In this article, I present data from my own work among the Ngisonyoka Turkana of Kenya, and also draw on the work of ecologists who have been examining land/livestock/human interactions as part of the South Turkana Ecosystem Project (STEP). Using a synthesis of anthropological and ecological data, I argue that the case which postulates that traditional nomadic populations are inherently destructive to the environment cannot be supported, that recurrent environmental perturbations prevent livestock populations kept by pastoralists in East Africa from exceeding the carrying capacity of the land, that pastoral people are aware of the need to protect their resource base, and that certain social institutions do function to cope with environmental problems.

## THE DEBATE

Although the accusations that livestock-keeping people destroy the environment have certainly not been limited to the last two decades (Horowitz and Little cite Ibn Khaldun as discussing this issue in the fourteenth century, 1987, p. 64), a number of recent events have forced both social and environmental theoreticians as well as development planners to seriously address the issue. Garrett Hardin's publication in 1968 of his now famous article entitled "The Tragedy of the Commons" provided those with an anti-nomadic perspective the theoretical underpinning for their convictions (Hardin, 1968). Hardin's article was published just prior to the onset of the Sahelian drought in which hundreds of thousands of livestock died and an unprecedented destruction of productive rangeland was observed. Donor

agencies and national governments adopted the position that pastoral nomadism was inherently destructive to the environment and advocated the implementation of development programs that in one way or another attempted to privatize formerly communal rangelands. These projects have met with almost uniform failure, and have in many instances contributed to increased human suffering and the further degradation of the land (Horowitz and Little, 1987; Peters, 1987; Sanford, 1983; Swift, 1977). The failure of these projects influenced researchers to reexamine the validity of the assumptions upon which the projects were based.

Hardin's original article concerned control over human population increase, not range use. However, he utilized the concept of a communal pasture to illustrate his point that individual self-interest will result in the abuse of any commonly held resource. The "tragedy of the commons" theme has been applied to population increase, air pollution, exploitation of fisheries, as well as to communal use of rangelands (for further information see McCay and Acheson, 1987). Bonnie McCay summarizes the tragedy of the commons argument as it applies to livestock and range use as follows:

> A herdsman puts his animals on a pasture that he uses in common with other herdsmen. Even though there are signs that the condition of the pasture will worsen with additional stocking, it is only rational for each herdsman to add more animals to his herd because he gains the full benefits of each additional animal while sharing the costs of overgrazing with the other herdsmen. The positive utility to the individual herdsman of adding an extra animal is +1; the negative utility is but a fraction of −1. (McCay and Acheson, 1987, p. 3).

Although this view was, and remains, widely accepted, it has been criticized on both theoretical and historical grounds (see Kimber, 1981; Runge, 1981; Gilles and Jamtgaard, 1981). With regard to livestock-keeping people one of the most cogent criticisms involves the confusion engendered when pastoral rangelands, in which use is regulated by a variety of social institutions, are confused with "open access systems" in which there is no regulation of access or use. As Peters has stated, "It is an error to suppose that an individual calculus can explain the commons system—rather, one has to understand the socially and politically embedded commons to explain the individual calculus" (Peters, 1987, p. 178). I am not aware of any pastoral system in which the range operates according to the "open access" paradigm. Range use among pastoral populations varies from owned pastures, as among some nomads in Afghanistan (Barfield, 1981), to highly regulated movements incorporating the planting/harvesting cycle of local cultivators, as among the Fulani of West Africa (Gallais, 1972), to systems of free access to pasture but owned rights to water, as among many East Africa pastoralists (Gulliver, 1955; Spencer, 1973).

A second major issue is the contention that pastoralists will accumulate livestock until the carrying capacity of the land is exceeded, resulting in environmental degradation and eventually in massive livestock

mortality and famine. This position is illustrated in the following quotation from Ingold concerning reindeer herders in the Arctic.

> The irruption of the animal population, and its over-concentration on the pastures, leads to the imposition of the "Malthusian" checks of famine and disease, which in turn may reduce the herds of the less fortunate households below the numbers necessary to provide for their subsistence. My argument here is in direct opposition to the view that social and cultural institutions of pastoralism are adapted to the purpose of maintaining long-term environmental equilibrium. . . (Ingold, 1980, p. 202).

Although Ingold is discussing a unique form of pastoral subsistence, "carnivorous pastoralism," the notion that pastoralists will increase herd size without regard to environmental degradation can be found among those working with more traditional pastoralists as well. Hugh Lamprey, when discussing the concept of carrying capacity among East African pastoralists has stated:

> If it is true that, under managed ranching conditions, rangeland carrying capacities are apt to be overestimated, it seems even more likely that most pastoralists, whose objective and strategy is to encourage the greatest possible increase in their herds, and who do not appear to understand the concept of carrying capacity, will tend to over exploit their savanna habitats. (Lamprey, 1983, p. 656)

Lamprey goes on to reaffirm the position stated by Ingold that pastoralism is basically unstable: "In balance it seems that the symbiosis of pastoral man and his domestic animals has been very successful if viewed as a survival strategy in the short term. In the long term it appears less successful since it tends to destroy its own habitat" (Lamprey, 1983, p. 656).

Steven Sandford has taken issue with this position by proposing that pastoral management strategies can be either "opportunistic" or "conservative" depending upon the environmental conditions (Sandford, 1982). An opportunistic strategy occurs in areas where rainfall, and thus forage resources, are highly variable. In this paradigm, pastoralists will increase herd size whenever conditions allow, realizing that losses will occur when the unpredictable but nevertheless inevitable drought reoccurs. This model differs from that proposed by Ingold and Lamprey in that although herd losses are tied to environmental events and management decisions, livestock losses are not density dependent. I argue later in this paper that there is little evidence to support the notion that in the arid and semi-arid regions of East Africa livestock populations, without outside inputs, have been able to increase to the extent that environmental degradation has led to density-dependent mortality.

Sandford's "conservative" strategy argues directly against the position taken by Ingold and Lamprey and posits that some pastoralists regulate the number of animals below the maximum carrying capacity of the land in both good and bad years. This paradigm requires more predictability of the

resource base, and seems to apply primarily to some Middle Eastern pastoral populations (e.g., Nyerges, 1982).

Although the discussion above indicates that there are significant opposing positions regarding pastoral land use, there are few, if any, studies that have combined the necessary anthropological and ecological components upon which to support arguments for either position. The joint anthropological–ecological study of the Ngisonyoka Turkana provides some data upon which we can evaluate the appropriateness of the "commons" argument.

## NGISONYOKA TURKANA

The Ngisonyoka number about 10,000 and are one of 19 named sections that comprise the approximately 200,000 people of the Turkana tribal group (Ecosystems Ltd, 1985; Gulliver, 1951). They occupy approximately 10,000 sq km of desert and arid to semi-arid rangelands in northwestern Kenya (see Fig. 1). The topography consists of sand and lava plains punctuated with mountains rising 2000 – 3000 meters above the floor of the Rift Valley. Precipitation averages approximately 220 mm per year, but is highly unpredictable in amount, intensity, periodicity, and location. Drought is common and rainfall records in Turkana, as well as information recorded by organizations such as the International Livestock Center for Africa, suggest that a severe drought occurs in the East Africa rangelands at least once every 10 years (Ellis, Galvin, McCabe, and Swift, 1987; ILCA, 1986).

The Ngisonyoka subsist in this harsh environment by keeping five species of domestic livestock: camels, cattle, sheep, goats, and donkeys. According to recent estimates they number approximately 9800 camels, 9800 cattle, 85,200 small stock, and 5300 donkeys (Ecosystems, 1985). They practice no agriculture and live off the products of their herds; either directly through the consumption of milk, meat, and blood, or indirectly through the sale of livestock and the purchase of grain products, primarily maize meal. Although they were severely affected by the 1979 – 1981 drought, they did not receive famine relief food; a situation in marked contrast to that of northern Turkana district where approximately 80,000 people were being fed in famine relief camps by 1981 (Hogg, 1987; Snow, 1984).

### Fieldwork

The fieldwork upon which this article is based began in March of 1980 and continued, with interruptions, until October 1986. The author has spent

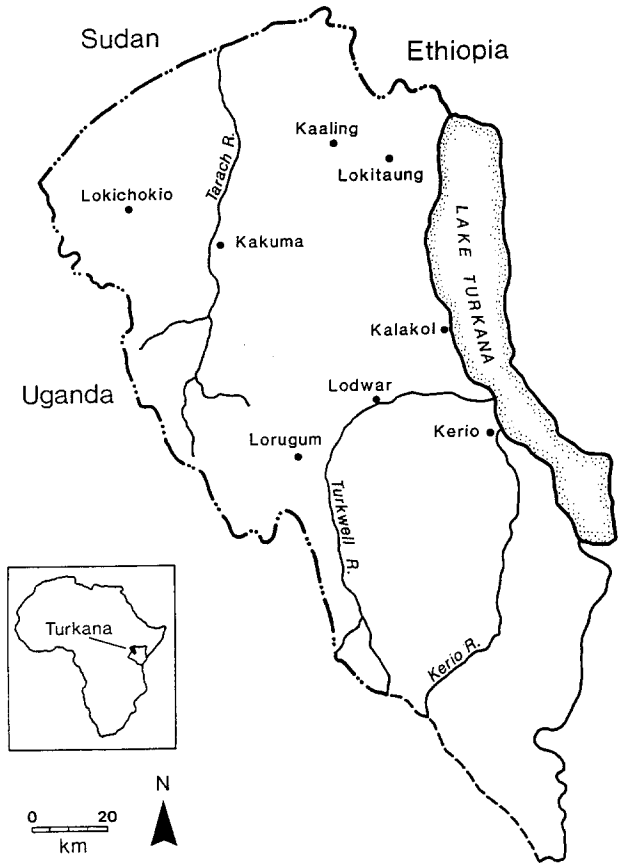


**Fig. 1.** Turkana District in Kenya.

more than 40 months among the Ngisonyoka as a member of the South Turkana Ecosystem Project. STEP is a multi-disciplinary research project that has incorporated both anthropologists and ecologists within an ecosystems studies framework. Data on land use and livestock management practices were collected by accompanying the homesteads and herds of four Ngisonyoka families throughout two continuous years of migration, supplemented by interviews conducted among a wide sample of herd-owners during return visits.

## RESULTS OF THE ECOLOGICAL STUDIES

One of the major advantages of multi-disciplinary research is the ability to draw on the work of experts in the field when the problem to be ad-

dressed cuts across disciplinary boundaries. Below I present a summary of some of the ecological work, which relates to the question of land use, undertaken by members of the STEP project and reported in a recent article published in *Science*.

Ecological analyses of the environmental impact of Ngisonyoka land use point out that: (1) Ngisonyoka subsistence incorporates a complex food web that facilitates long-term system stability, (2) the range is stocked well below the theoretical carrying capacity, and (3) there is no evidence of environmental degradation (Coughenour *et al.*, 1985). Studies of East African rangeland ecosystems have shown that complexity in the food chain is associated with mature stable ecosystems (McNaughton, 1979). The Ngisonyoka food web is complex, involving over 31 plant-livestock-human pathways. This figure is based on forage groups utilized and would be substantially higher if individual species were used in the calculations. The most reliable human food was camel milk, which results from the exploitation of dwarf shrubs and other woody plants. The most ephemeral resource was grasses, which remained nutritious for only a few months a year. Cattle are more efficient than camels in converting herbaceous vegetation into food available for human consumption, and the practice of keeping multiple species herds not only contributes to system stability, but also averts risk, and allows a herd-owner to balance the need for long-term security with the possibility of short-term gain.

Estimates of rangeland carrying capacity are notoriously difficult to determine (Pratt, 1984; Sandford, 1983), but a conservative estimate assumes that environmental degradation will not occur when less than 50% of the above-ground net primary production (AGNPP) is consumed (Coughenour *et al.*, 1985). Studies conducted in 1981 and 1982 demonstrate that Ngisonyoka livestock consumed less than one-quarter of the AGNPP, suggesting that the stocking rate was well below the theoretical carrying capacity (Coppock, 1985). Even if one assumes that the stocking rate was unusually low due to the impact of the 1979 – 1981 drought, the livestock population would have to increase by a factor of four before the carrying capacity threshold would be approached.

The ecologists on the STEP project have explicitly stated that they have found no evidence of environmental degradation in the study area with the exception of that land immediately adjacent to settlements (Coughenour *et al.*, 1985; McCabe, Ellis, and Hart, 1983). They based their conclusions both on the analysis of vegetation communities, and on the interpretation of aerial photographs taken of southern Turkana over the last 40 years. Their findings are summarized by Coughenour as follows:

> Our analysis suggests that traditional patterns, including livestock diversity, mobility, low energy efficiency, and biomass maintenance, may be cornerstones of stability and sustainable productivity, rather than prescriptions for degradation and famine (Coughenour *et al.*, 1985, p. 624).

The ecological studies of Ngisonyoka land-use practice have important implications for the interpretation of pastoral land use throughout Africa. If the results of these studies are correct, then the validity of the assumptions upon which the "nomad as father of the desert" argument are based can be seriously questioned.

## ANTHROPOLOGICAL INTERPRETATION OF THE ECOLOGICAL STUDIES

In order to understand how this "ecological balance" (if one wishes to call it that) has come about we have to examine first the utilization of natural resources, or as Pauline Peters has stated, we need to place land use in a social context (Peters, 1987). Second, we need to understand how livestock numbers are regulated.

### The Utilization of Natural Resources

Critical components in an analysis of pastoral land use are the means by which individuals gain access to natural resources and the manner in which these resources are utilized. For the Ngisonyoka, as with most pastoral populations, the critical resources are pasture and water; the principal adaptive strategy for the utilization of these resources is mobility.

#### *Access to Pasture*

There are no individual rights to forage resources among the Ngisonyoka. Every Ngisonyoka herd-owner has the right to exploit any pasture within the section's territorial boundary. Figure 2 depicts the Ngisonyoka in relation to other Turkana sections, and Fig. 3 illustrates rough habitat division within Ngisonyoka territory. Ngisonyoka herds may cross sectional boundaries, and the herds of individuals from neighboring sections may cross into Ngisonyoka territory, but only after permission is requested, the elders meet and agree, and the senior "emeron," or soothsayer, also concurs. Boundaries are defended and fights are reported to occur between Ngisonyoka and members of other sections who attempt to "steal" water or vegetation. The most recent hostilities occurred during the dry season by 1983 between the Ngisonyoka and the Ngibocheros, their neighbors to the north. During this season, the Ngisonyoka, fearing attacks from their southern neighbors, the Pokot, had moved to the northern edge of their sectional territory. Some Ngisonyoka herd-owners crossed into Ngibocheros territory and were beaten at water holes; others were subject to harassment by local "bandits." Local leaders, old men, and the most power-

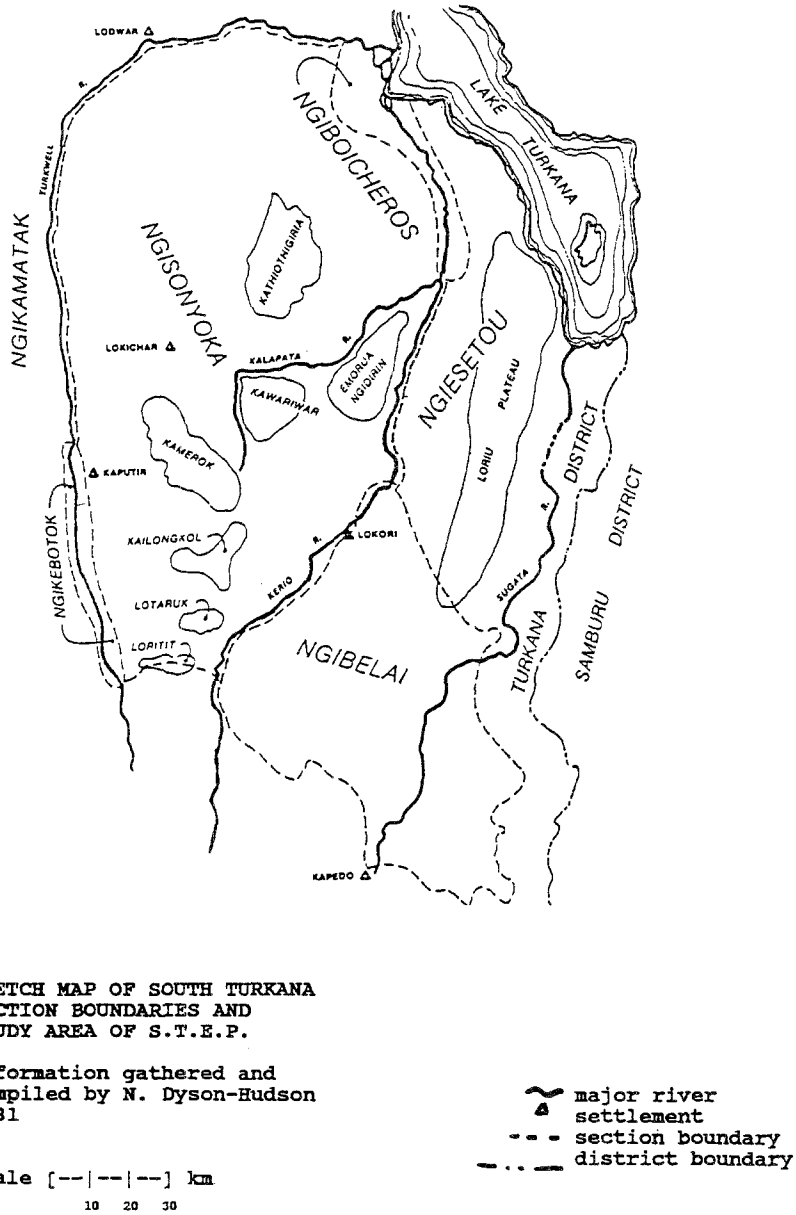


**Fig. 2.** Sketch map of South Turkana section boundaries.

ful "emeron" were called in to help diffuse the situation, which they were able to do.

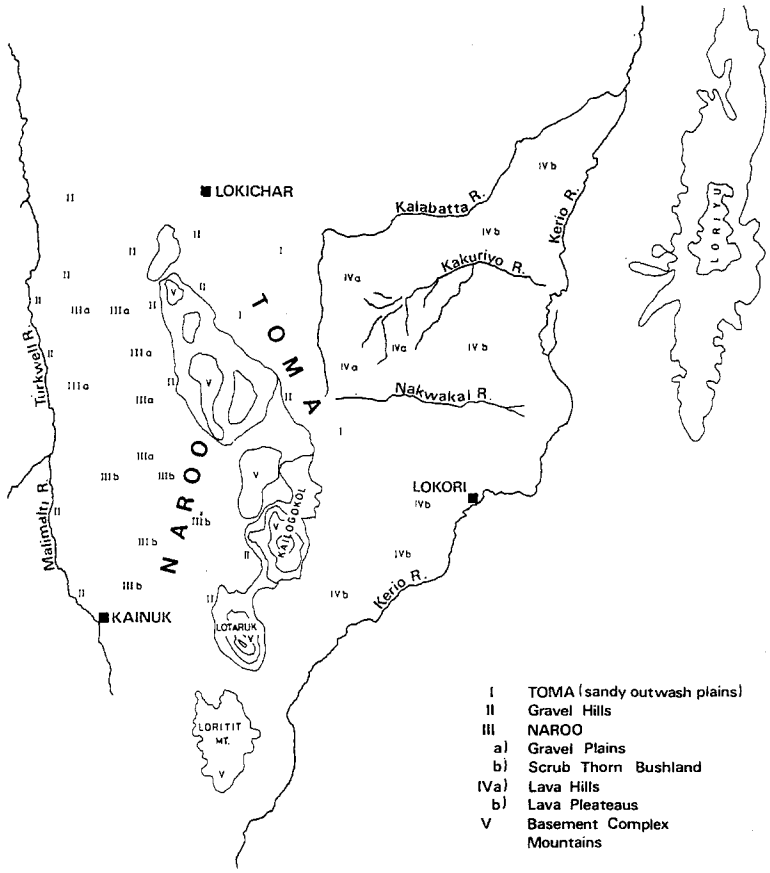


**Fig. 3.** Habitat types in South Turkana.

Rights of access to pasture do not, however, translate into utilization. Approximately one-fourth of Ngisonyoka territory is rarely used due to threats of attack from enemies or because of the presence of disease. The area labeled "Naroo" (Fig. 3) was only used for one dry season from 1978–1986, despite being the most forage-rich area available to the Ngisonyoka. Raiding has become endemic to this area with raids and counter-raids occurring among the Turkana, the Pokot, and the Karamojong of Uganda. The abandonment of portions of territory because of insecurity is not unusual among pastoral people who are often at war with one another. Similar situations have been reported for the Rendille (O'Leary, 1984; Lamprey, 1983) and Pokot (Conant, 1982). These infrequently-utilized areas act as grazing reserves when forage resources are depleted in

other areas. This occurred for the Ngisonyoka during the drought of 1980/81 when most of the Ngisonyoka livestock moved into the "Naroo" despite frequent raids by the Pokot on their herds.[2]

### *Access to Water*

Individual rights to water are restricted when the water is drawn from wells, and unrestricted when drawn from open sources such as rivers (when flowing), pools, or springs. This is a pattern of water use common throughout the pastoral regions of Africa. Access to wells is restricted to members of the immediate family of the man who dug the well and his close agnatic relatives. Thus, there are areas in which forage is available during the dry season only to those individuals who have well water rights within walking distance. During moderate to severe dry seasons individuals without wells must locate their herds within walking distance of the shallow wells located in the dry river beds of major rivers.

### *Mobility and Land Use*

The Ngisonyoka are a highly mobile people, with no fixed residences nor regular annual pattern of movement. Like all nomadic Turkana, the Ngisonyoka live in a homestead referred to as an *awi.* Physically, the *awi* consists of temporary structures built primarily from saplings of various acacia species. The human population of the *awi* fluctuates seasonally, but typically consists of a man, his wives, their children, and often dependent women. Data collected among the Ngisonyoka suggest that an "average" *awi* consists of between 9–15 people (McCabe, 1985).

An idealized annual migration route can be abstracted for the pastoralists with whom the STEP researchers are most familiar. This is based on data collected over 8 years of fieldwork, with interview data relating to the 2 years before the fieldwork began. Here, approximately 2000 pastoralists and their herds congregate in the central plains area (referred to as "Toma" in Fig. 3), and disperse into smaller aggregates of humans and animals with the progression of the dry season. Typically, as the dry season intensifies, families separate from one another and the livestock are divided into milking and non-milking herds of each species. A family's ability to divide the herds, of course, depends on access to labor. The cattle are usually the first species to be taken from the homestead to the higher elevations

[2]Although the ecologists report that only ¼ of the AGNPP is consumed, the amount of AGNPP actually consumed by livestock in any one area may be considerably higher. Nevertheless, Ngisonyoka will move into these "reserve" areas in times of stress, rather than overgraze depleted forage resources.

to graze on the grasses that grow in the more mesic highlands. The non-milking small stock (goats and sheep are herded together) are sent to the foot slopes of the central mountains, while the major *awi* travels slowly with the milking small stock and camels. If conditions are dry and labor is available the non-milking camels will also be separated to reduce grazing pressure close to the *awi*.

The strategies of separation of livestock into smaller herding units and frequent changes of location allow for a more efficient use of the forage resources, and also tend to spread the grazing impacts over much of Ngisonyoka territory. Most studies of nomadic pastoral people present a "typical" migration pattern in an ideal format. The unit of analysis is often the entire ethnic group, or a major section of the group. Rarely has there been information available on individual migration patterns (one major exception to this is the Dyson-Hudson and Dyson-Hudson (1969) *Scientific American* article). However, data concerning the frequency of movements, and the distances moved by individuals and their livestock are important if we are to understand the impact of pastoral land use on the environment. Although the data on livestock numbers suggest that population size fluctuates around a mean (see next section), even a small herd can have deleterious environmental impacts if its range is restricted for an extended period of time. Below I present data relating to 3 years of movements by four individual herding complexes.

The tables presented have been constructed using data collected for four herd-owners and their herd complex during the years 1979 – 1980, 1980 – 1981, and 1981 – 1982. In many cases, the author accompanied the major *awi* or the satellite herds on their migration; in other instances, the data were collected from interviews conducted throughout the study period.[3]

The years 1979 and 1980 were drought years and the entire Ngisonyoka population was divided into individual herding units for most of this period. The wet season concentration in the Toma lasted for approximately 7 weeks before it began to break up. Although herding units acted independently, the migration pattern tended to the south during this period. Primary productivity is greatest in this region, but it is also adjacent to the Ngisonyoka/Pokot border, where raiding was particularly intense during these years. In 1981 precipitation was above average, and the migration pattern was reversed, with *awis* moving primarily to the north. Although the number of moves during this time remained about the same, very few people separated their livestock into species specific herds.

Table I presents data relating to a single herd-owner and is presented separately because the annual variability in herd division, distances traveled, and frequency of movement is clearly illustrated.[4] Tables II – V sum-

[3]Many of the interviews were conducted in conjunction with the work of Rada Dyson-Hudson.
[4]Data relating to the herd dynamics and impact of drought for this individual have been previously published in *Human Ecology* (McCabe, 1987).

**Table I.** Summary of Movements, *Awi* of Angor, 1979–1981

| | 1979-1980 | 1980-1981 | 1981-1982 |
|---|---|---|---|
| Distance traveled: *awi* | 205 km | 104 km | 232 km |
| Number of moves: *awi* | 15 | 13 | 21 |
| Distance traveled: cattle | 152 km | 284 km | – |
| Number of moves: cattle | 10 | 9 | – |
| Distance traveled: small stock | 8 km | 127(105)km[a] | – |
| Number of moves: small stock | 2 | 17(4) | – |
| Distance travelled: camels | – | 140 km | – |
| Number of moves: camels | – | 15 | – |

[a]During 1980–1981, Angor separated his small stock into two flocks.

marize much of the important data for four herd-owners and their herds for a 3-year period, although it is impossible to present all the data relating to individual herding complexes here. If the reader is interested in pursuing the issue in more depth I suggest Dyson-Hudson and McCabe (1985) and McCabe (1985).

Table I refers to the *awi* of Angor, and the annual variation in distance traveled and livestock division is clearly illustrated. In each year the *awi* changed location more than once a month, but what distinguishes the years from one another is the degree to which Angor separated his livestock into smaller herding units. As conditions became drier and the resource base more patchy, the livestock were divided and the frequency of movement of the satellite herds increased. It is also important to note that during the period that the herd complex was traveling together, they actually moved a greater distance and moved more frequently than during the drought years.

Although the data presented above illustrate the complexity of the mobility pattern of a single herd complex, we also need information that can help place these data in a larger context. Tables II – V summarize data for four families and their herds for the period 1979 – 1981. The aggregate data mask annual variation but they do allow for a deeper appreciation of the frequency of movement and herd division as they pertain to individual herd-owners.

Table II illustrates that for a 3-year period, the major *awi* changed location approximately once each month. Each herd-owner responded to

**Table II.** Summary of Movements of the major *Awi* for Four Herd-owners, 1979–1981

| Herd-owner | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Number of changes of location | 49 | 36 | 42 | 38 |
| Average duration per location | 26 d | 36 d | 34 d | 36 d |
| *SD* duration per location | 12 d | 26 d | 23 d | 27 d |
| Total distance traveled | 541 km | 359 km | 538 km | 455 km |
| Average distance between locations | 11 km | 10 km | 13 km | 12 km |
| *SD* distance between locations | 13 km | 12 km | 12 km | 12 km |

**Table III.** Summary of Cattle Movements for Four Herd-owners, 1979 – 1981

| Herd-owner | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Number of months separated from *awi*[a] | 21 | 24 (24) | 36 (24) | 23 |
| Number of changes of location | 19 | 18 (19) | 35 (15) | 11 |
| Average duration per location | 29 d | 48 d (39) | 27 d (?) | 44 d |
| *SD* duration per location | 18 d | 28 d (19) | 17 d (?) | 31 d |
| Total distance traveled | 436 km | 259 km (344) | 722 km (384) | 379 km |
| Average distance between locations | 23 km | 14 km (19) | 16 km (26) | 36 km |
| *SD* distance between locations | 26 km | 18 km (24) | 12 km (33) | 27 km |

[a]Numbers in parentheses refer to a second herd owned by the same individual.

changes in climatic conditions by dividing his livestock into smaller herding units and by choosing a location which he found best suited to his particular mix of livestock and the labor available to him. The frequency of movement and the distances traveled by the major *awi* demonstrate a relatively high degree of consistency among the four herd owners. Each herd-owner changed the location of their major *awi* once a month or more during the 3-year period, rarely separated the camels from the major *awi,* and tended to keep their cattle separate from the rest of the livestock.

The area where there is substantial variability is in the distances traveled by the cattle and the extent of herd separation for the small stock. These variations reflect the individual strategies that herd-owners choose in order to cope with changing environmental conditions. However, within the con-

**Table IV.** Summary of Camel Movements for Four Herd-owners, 1979 – 1981

| Herd-owner | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Number of months separated from *awi* | 5 | 4 | – | 8 |
| Number of changes of location | 7 | 2 | – | 12 |
| Average duration per location | 20 d | 10 d | – | 20 d |
| *SD* duration per location | 12 d | – | – | 9 d |
| Total distance traveled | 140 km | 55 km | – | 161 km |
| Average distance between locations | 20 km | 28 km | – | 13 km |
| *SD* distance between locations | 12 km | – | – | 8 km |

**Table V.** Summary of Small Stock Movements for Four Herd-owners, 1979 – 1981

| Herd-owner | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Number of months separated from *awi*[a] | 5 (5) | 11 | 18 | – |
| Number of changes of location | 7 (3) | 11 | 17 | – |
| Average duration per location | 24 d (42) | 29 d | ? | – |
| *SD* duration per location | 13 d (18) | 15 d | ? | – |
| Total distance traveled | 140 km (105) | 156 km | 720 km | – |
| Average distance between locations | 20 km (36) | 14 km | 42 km | – |
| *SD* distance between locations | 13 km (18) | 15 km | 29 km | – |

[a]Numbers in parentheses refer to a second flock owned by the same individual.

text of this discussion, it is important to note that all herding units move frequently, if not great distances at any one time. As previously mentioned, the separation of the livestock into species and production-specific herds allows a herd-owner to more efficiently exploit the forage resources in a particular area. With respect to environmental impact, it also reduces the grazing pressure close to the major *awi,* and in conjunction with mobility is one of the first management responses to increasingly dry conditions. However, if livestock numbers steadily increase, no amount of movement will prevent overgrazing and degradation. Data from Turkana, as well as from other pastoral areas in East Africa, however, suggest that livestock numbers fluctuate around a mean that is well below the carrying capacity of the land. I will now turn my attention to this issue.

## Environmental Constraints on Herd Size

Much has been made of the fact that individual pastoralists manage their animals in such a way as to maximize livestock numbers. This statement applies equally well to the Ngisonyoka as to other pastoral groups for whom this strategy is reported (Hopcraft, 1981; Ingold, 1980). Individuals attempt to increase their livestock holdings both as insurance against non-density-dependent perturbations, to even out food supply in a system in which the number of lactating females fluctuates both seasonally and annually, and because men who are wealthy (wealth is measured in terms of livestock holdings) are respected and influential.

Many Western rangeland scientists and development planners cite this desire for accumulating livestock as inevitably leading to overpopulation, overgrazing, and environmental deterioration. However, studies of

livestock dynamics in non-improved African rangelands suggest that non-density-dependent factors such as disease, drought, and raiding impose severe constraints on the ability to build large livestock herds at the population level (Sperling, 1987; Swift, 1975; Spencer, 1965), while lack of labor constrains herd growth at the household level (Stryker, 1984). I have previously reported that during the 1979–1981 drought, the Ngisonyoka lost between 60–90% of their livestock holdings (McCabe, 1987), a figure that corresponds with other estimates of stock loss for African pastoralists during drought. For example, Dahl and Hjort cite Jacob's estimate of 80% loss for Maasai cattle during drought, and the Ethiopian Government's estimates of 88% loss of cattle and 69% loss of camels during the 1973 drought (Dahl and Hjort, 1976, p. 115). Other recent studies in which 60% mortality or more is reported during drought can be found in Homewood and Lewis (1987) and Campbell (1984).

Drought is a recurrent phenomenon in the dry African rangelands. The International Livestock Center for Africa reported that serious drought occurred in northeastern Africa in 1918–1919, 1928–1929, 1933–1939, 1943–1945, 1958–1959, 1970–1973, 1975–1976, and 1983–1984 (ILCA, 1986). Rainfall records for Turkana district indicate that drought may occur as frequently as every 3–4 years. In addition, it has been estimated that severe epizootics may occur with a periodicity of 25 years (Dahl and Hjort, 1976).

The ability to recover from severe loss depends on the natural reproductive capacity of the livestock. Dahl and Hjort simulated the expected rates of increase of livestock species managed under typical pastoral conditions and estimated that cattle could double in numbers in 6.5 years under maximum growth conditions, but that under "normal" conditions the expected doubling time should be 24 years. Estimating the time it takes for a herd of camels to double is far more difficult than it is for cattle, due to the lack of data relating to reproductive rates of camels managed under traditional pastoral conditions. Using what data were available, Dahl and Hjort estimated a minimal doubling time for a camel herd as 15 years, with a maximum time of over 50 years. Small stock can reproduce much more rapidly than large stock, and sheep were estimated as being able to double their number twice in 6–8 years, with the number of goats being able to double twice in slightly less time (Dahl and Hjort, 1976). Ngisonyoka stress that a successful strategy for recovery from drought incorporates a dependence on small stock during the initial stages, but that labor constraints, the desire to diversify to reduce risk, as well as cultural perceptions of the proper mix of livestock species requires exchange of small stock for large stock following the initial stages of recovery.

Evidence abounds that attests to the fact that pastoralists are well aware of the severe periodic crashes of their livestock population (e.g., In-

**Table VI.** Summary of Census Data for Human and Livestock Populations in the NCA 1957 – 1988[a]

| Year | People | Cattle | Small stock |
|---|---|---|---|
| 1957 | 10,633 | | |
| 1960 | | 161,034 | 100,689 |
| 1962 | | 142,230 | 83,120 |
| 1963 | | 116,870 | 66,320 |
| 1964 | | 132,490 | 82,980 |
| 1966 | 8,728 | 94,580 | 68,590 |
| 1968 | | 103,568 | 71,196 |
| 1974 | 12,645 | 123,609 | 157,568 |
| 1978 | 17,982 | 107,838 | 186,985 |
| 1980 | 14,645 | 118,358 | 144,675 |
| 1987a | 22,637 | 137,398 | 137,389 |
| 1987b[b] | | 113,431 | 307,832 |
| 1987c | | 133,680 | 145,240 |
| 1988 | 20,594 | 122,513 | 152,240 |

[a]Data taken from the Ngorongoro Ecological Monitoring Program; Semi Annual Report, April 1989.

[b]Small stock figures for this year should be treated with caution. In addition, figures for 1970 were omitted as they appear to under-report both the human and livestock populations.

gold, 1980; Dahl, 1979; Dahl and Hjort, 1976; Spencer, 1973). Given the large numbers of animals that die during a drought or disease outbreak, and the periodicity of perturbations, I feel it is safe to say that only through expert management can pastoralists maintain livestock numbers. One of the major problems in assessing limitations to growth among livestock populations in East Africa has been the lack of reliable census data. One area in East Africa where census data are available, and where the quality of data is quite high, is the Ngorongoro Conservation Area in northern Tanzania. Periodic censuses of the livestock in this region have been conducted in conjunction with debates over land use policy, and thus provide one of the few data sources with any historical depth. A summary of the human and livestock population data for 30 years in the Ngorongoro Conservation Area is presented in Table VI.

The data presented in Table VI reveal some quite obvious trends. The human population is increasing, but the livestock population fluctuates around a mean. The data also suggest a shift from a pastoral subsistence based on cattle to one based on small stock. This may be a temporary feature of the pastoral economy that is related to a recovery period, or it may reflect a long-term trend. Nevertheless, it does suggest that the livestock population remains fairly stable over long periods of time. A similar conclusion has been reached by Sperling, who cites government census figures that suggest that the Samburu cattle population was approximately the same in 1984 as it was in 1915 (Sperling, 1987).

The argument presented so far leads to the conclusion that African pastoralists, living under traditional rangeland conditions, have rarely, if ever, had to confront the dangers posed by steady increases in the livestock population. For the Ngisonyoka, this is reflected in the fact that there are no social institutions that serve to limit overall numbers of Ngisonyoka livestock. The lack of social mechanisms to control livestock increase at the level of the individual appears common to African pastoralists. Some may argue that this is indicative of "irrational" behavior (see Lamprey, 1983; Livingstone, 1977), but should be viewed as an expected outcome of the management strategy where livestock accumulation at the individual level does not threaten the productive capacity of the resource base. On the other hand, social institutions do exist among the Ngisonyoka, as well as among other East African pastoralists, that limit access to rangeland resources to local populations, and others that serve to re-distribute livestock among families, issues that are seen as problematic by the pastoralists themselves.

## Social Institutions and the Regulation of Livestock Numbers

The impact of any environmental perturbation is not felt evenly among the pastoral population. Drought will certainly have an impact on all herd-owners, but there is some evidence that demonstrates that wealthy herd-owners who are able to divide their herds may not suffer as severely as poorer herd-owners (McCabe, 1987; Starr, 1987; Dahl, 1979). Disease outbreaks may be widespread or very localized, and raiding often leaves a few families destitute while not affecting others. The Ngisonyoka cope with these risk factors through a variety of loans and gifts, which usually involve the transfer of livestock and food from wealthier to poorer families. The pastoral literature is replete with examples of successful pastoralists who have become paupers overnight, and the role that exchange networks play in pastoral social organization is well documented (Baxter, 1975; Gulliver, 1955). Although the transfer of livestock from wealthier to poorer families may potentially limit individual herd size, institutions that facilitate livestock exchange should not be construed as societal attempts to achieve an environmentally-optimal herd size, e.g., as Leeds (1965) has proposed for the Chukchi. Rather, it suggests that temporary periods of non-viability are common problems among livestock-keeping people, and in order that individual families survive over the generations, social institutions have developed that help insure their ability to cope with periods of stress.

Exchange networks operate at the level of the individual herd-owner. The maintenance of sectional boundaries operates at the level of the tribal section. As previously mentioned, Ngisonyoka territory is bounded, and the boundaries are defended against incursions from other Turkana who are

not Ngisonyoka. This fact suggests that the Ngisonyoka are aware of the need to protect their resource base from over-exploitation resulting from the influx of large numbers of animals. Considering the frequency and severity of environmental perturbations, and the time required to rebuild flocks and herds, the resource base does not appear to be threatened by increases in the local livestock population. However, if the rangeland was subject to an "open access" system, the vegetation and water resources would become quickly over-exploited as pastoralists and their herds migrated into the area during periods of localized drought or disease.

The point I am making here is that social institutions do exist within pastoral societies to cope with environmental problems. Individual families are protected by institutions that facilitate livestock exchange; the resource base is protected by the identification and defense of territorial boundaries. The presence of these social institutions will come as no surprise to those who study pastoral peoples. However, these institutions have not been adequately explored by those advocating the destructive capacity of a subsistence pastoral economy.

## DISCUSSION AND CONCLUSIONS

The argument that I have presented has focused on the interaction of a pastoral people with their environment. I have attempted to demonstrate that pastoral populations do not sacrifice long-term stability for short-term gain at the expense of the environment. I have also attempted to demonstrate that pastoral populations do recognize the necessity of preserving their resource base and that some social institutions operate in a manner to avert risk stemming from environmental perturbations, while others protect local resources from over-exploitation.

Results of research conducted among the Ngisonyoka undermine the validity of two of the major criticisms of pastoral peoples: (1) that their land-management practices lead to the over-exploitation of the environment because there are no means of controlling access to resources—the "tragedy of the commons" argument, and (2) that local livestock populations will increase through natural reproduction to the extent that the carrying capacity of the land is exceeded. The ability to draw on both ecological and anthropological data strengthens the argument presented here considerably, and supports the position of those who have long called for the need to conduct multi-disciplinary research (Little *et al.*, 1984).

In addition to furthering our understanding of nomadic pastoral people, the results of this research may help explain why alterations in the resource base have had such environmental and social impact on pastoral populations inhabiting Africa's arid regions. As Sandford has proposed,

and this research supports, pastoralists living in environments subject to recurrent perturbations will attempt to maximize livestock numbers on an individual basis. The introduction of veterinary care for livestock and the digging of deep wells has removed some of the non-density-dependent checks on the ability of livestock herds to increase. The preemption of grazing land for dry land agriculture has forced pastoralists to use land far more intensively than under traditional management strategies. By changing the nature of the relationship that has developed over generations among the environment, the livestock, and the human population, pastoralists are confronted with entirely new environmental problems. Under these conditions, the traditional ethic of individual maximization of livestock can potentially lead to overgrazing and environmental degradation.

The new conditions resulting from the alteration of the resource base require the development of social institutions that can control access to new resources, e.g., boreholes, and that will protect the sustainability of the group's forage resources. There is certainly evidence that non-traditional institutions have developed among some pastoral people precisely to cope with changes in the land/livestock/human relationship. Examples of these types of change can be found in the work of Behnke (1988), Peters (1987, 1983), and Bernus (1974). These examples demonstrate a perception and willingness on the part of pastoralists to change as circumstances warrant. However, each pastoral group is unique and the time required for one group to adapt to changing circumstances will not necessarily be the same for another group. Thus, there will be both examples of pastoral people who have successfully adapted to changing environment/man relationships, and examples of pastoral people who have not adapted quickly enough and are now in the midst of an environmental disaster. I hope work such as that presented here will help clarify important environment/livestock/man relationships as occur under traditional conditions, and will help dispel some of the faulty assumptions upon which many livestock-development programs are based.

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