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"Turkana Herds under Environmental Stress"

Jan Wienpahl

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TURKANA HERDS UNDER ENVIRONMENTAL STRESS

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The ability of livestock-raising households to make a living from their animals is dependent on maintaining sufficient numbers of the animals. Herd sizes are determined by human manipulation but also, very importantly in the low-technology conditions of subsistence pastoralism in harsh environments, by uncontrolled environmental stresses or disasters. The occurrence of the latter has given impetus to ecological anthropologists' efforts to provide a rationale for seemingly excessive numbers of livestock kept by subsistence pastoralists. These numbers had been interpreted by earlier observers to be the result of the "cattle complex" value system (Herskovits 1926), expressed in the pastoralists' esteem of livestock (cattle) for reasons of prestige and social status, and having little connection to objective economic or ecological conditions, and so (it is argued) they do not follow rational grazing practices that would maintain environmental quality or limit themselves to rational subsistence uses of the animals. According to ecological anthropologists, on the other hand, the "adaptive value" or "selective advantages" (Netting 1977: 6) of large herds in harsh and unpredictable environments explains the cultural attitudes and resultant herd-maximizing practices of traditional pastoralists:

> The keeping of large herds is closely linked to the need to protect the household against the effects of drought or epidemics as well as to food requirements during a particular dry period. A sufficient number of animals must survive a disaster in order that the household can exist while the herd is being rebuilt. An understanding of this central feature of nomadic livestock economics is essential...for the comprehension of pastoral land use and for the planning of alternative land uses, such as ranching (Dahl and Hjort 1976:17).

It should be noted that this explanation does not deny the important prestige, emotional, and other values of cattle; rather it functionally integrates the values into a large ecosystemic context.

The economic/ecological argument may be widely recognized and accepted, due to the writings of Dahl and Hjort (1976), the Dyson-Hudsons (e.g., Dyson-Hudson and Dyson-Hudson 1969), Netting (1977), and others, although there is still concern about environmental effects of the large herds needed to support increasing numbers of people. What is lacking is not an explanation of herd sizes acceptable to ecological anthropologists, but quantitative data on the survivability of individual household herds during periods of severe environmental conditions, and on actual numbers of livestock associated with seemingly viable households during and following these periods. For example, Dahl and Hjort's (1976) study of the economic aspects of livestock had only scanty actual data on the disasters they analysed.

In this paper I will examine, with quantitative and qualitative data, the herds

of four nomadic pastoral households of the Ngisonyoka Turkana (Northwest Kenya), focussing on the effects of the seyere environmental stresses that occurred during a period of fieldwork in 1980-81.

The maintenance of multi-species holdings of goats and sheep, camels, and cattle is as integral to the Turkana pastoral adaptation as is maintenance of animal numbers per se. The combination of small stock with one or both species of large stock is characteristic of East African pastoral herds. The history of research on East African pastoralists has exhibited a concern mainly with large stock (particularly cattle), giving little consideration to the nearly ubiquitous small stock. It seemed to the early, ideologically inclined, researchers (e.g. Herskovits 1926) that cattle were the center of the emotional attentions of the people, and thus they were led to focus on cattle. No doubt the researchers' own cultural predilections influenced this process as well. The focus on cattle carried over into studies done from other perspectives, including the ecological. This is indicated by the fact that Dahl and Hjort, working with secondary data, devoted 89 pages of their book exclusively to cattle compared to 46 to small stock (and 22 to camels, which, probably because of geographical location in the most marginal environments, have also not been the subject of much study).

This is not to say there has been lack of recognition of the economic/ecological role of small stock, but, in addition to lack of data, there is not complete agreement as to what that role is in times of stress. "Goats will be the first to breed and produce milk (after a drought), and so must be encouraged, not elminated as some aid administrators have suggested" (Swift 1973: 77). There seems to be no disagreement concerning this phenomenon, that is, that goats are the first animals to recover after a drought (cf. Nicolaisen 1973: 42, Dahl and Hjort 1975: 236-7), although in their chapter on the "long term effects of disaster to pastoral herds," Dahl and Hjort stated that "small stock are kept mostly as a supplementary source of meat and milk and are of secondary importance in the present analysis" (Dahl and Hjort 1975: 114). There are also discrepant and undocumented observations concerning what happens to small stock during a drought, and concerning impacts of disease on small stock versus large stock. For example, Dahl and Hjort stated that small stock herds are especially subject to rapid decline due to diseases and drought (Dahl and Hjort 1975: 231, 267), whereas Prole (1967: 95) noted that goats and sheep "were practically unaffected" by a drought in 1960-61, which was "a disaster for all areas of Masailand" (i.e., apparently for cattle), and Spencer (1965: 3) said that the combination of small stock with the large stock helped the Samburu survive the same drought. Dahl and Hjort's remark, in regard to complementarity of different stock species, that "African sheep and goats are...very liable to rapid death due to epidemics" compared to cattle and camels, "which would not be affected in the same way as the small stock" (Dahl and Hjort 1975: 221-222), was supported by little specific evidence. Other opinions have indicated that small stock are not any more vulnerable than large stock to disease. For example, one of the reasons given by Gulliver that the Turkana survived the 19th century cattle epidemics of rinderpest better than many groups was that "the people were still able to rely on camels, goats and sheep, which were largely untouched... Neighbors had no camels and fewer goats and sheep upon which to rely" (Gulliver 1951: 151). Spencer (1973: 11, 12) indicated that Rendille camels seemed quite susceptible to various diseases, which was one reason for the very slow rate of increase of the camel herds; no quantitative evidence was given, however. Although the more northern parts of Rendille country are "generally too harsh for small stock," the latter seem to flourish further south, and Spencer did not mention particular

problems with disease in either place (Spencer 1973: 14). In summary, there have been few quantitative data collected on small stock, and most of the ecologically informed writing on East African pastoralists must use data on cattle to illustrate their points (e.g., Dyson-Hudson and Dyson-Hudson 1982). Even the latter data are scanty as far as documentation of the effects of disasters on household herds is concerned. In consequence, discussions of herd diversification and differences and complementarity of types of stock (such as in Dahl and Hjort 1976: Chapter 10) are necessarily based on many assumptions to make up for the lack of data.

Thus, a particular concern of this discussion will be to document differences and complementarity in survivability and recovery among the small and large livestock during and following periods of environmental disasters. This will help in understanding the adaptive role of each species, particularly small stock, in East African pastoral herds. I will begin with a brief ecological and ethnographic note (see also Dyson-Hudson and McCabe 1983), followed by a description of data collection. Difficulties in collecting quantitative data, especially on small stock, have been and are no doubt a contributing factor, in addition to intellectual biases, for the dearth of quantitative studies of pastoral herds, particularly the small stock component.

The data were collected in 1980-81, which began during the culmination of a drought that occurred from 1979-81 and was broken in mid year (March 1981) by unusually heavy, therefore damaging, rains. Other environmental stresses during the year included enemy raiding and livestock disease.

Most of the approximately 20,000 Ngisonyoka are nomadic pastoralists with no fixed settlements; they rely almost entirely on their livestock for subsistence (including donkeys for transport, which will not be discussed in this paper). So far there has been very little integration into the national economy. The social unit of production, consumption, and nomadic movement is the household, or awi, which consists most basically of a married male herdowner, his one or more wives, and their unmarried children. The livestock herds are individually owned by the heads of awis.

Data Collection

Data were collected on the herd complexes of four Ngisonyoka awis during the approximately one-year period of September 1980 through October 1981. Problems of research in Turkana prevented the study in detail of a larger sample of awis, and the four awis were not a random sample of all the awis in the area. Nevertheless, qualitative observation and verbal information indicate that what happened to these awis and their herds in the course of the year was representative of Ngisonyoka herds in general.

Data on small stock herd numbers and dynamics were obtained by direct herd counts, in combination with periodic interviews with the herdowners and other family members to ascertain the reasons for changes in the herds indicated by the counts. Turkana do not count animals per se (cf. Dahl and Hjort 1976: 132). They did not, however, inhibit us from counting their herds overtly, but lack of control especially over the numerous and rapidly moving small stock made it

impossible to obtain very accurate detailed counts incorporating age, complete sex structure, and young animals until near the end of the fieldwork period. Additionally, for certain periods of the year the herds or portions of them were absent from the awi (i.e., major homestead) and inaccessible to us for counting. Although the herdowner or at least the herder claimed to know each goat and sheep individually, it was difficult to collect verbally information about small stock because they were quite numerous, had rapid turnover rates, and were usually not given distinct personal names (generally being called by color terms by the milker). During periods of heavy losses the Turkana were unable to say how many small stock had died; rather I received answers such as "many", "everyday", and "always". Therefore the mortality data represent estimates arrived at through herd counts, and sales and slaughterings and related information, which seemed to be reasonably, though not completely accurate.[2] Causes of death are based on interview information and qualitative observation. In 1980 I was able to count the newborn animals in only one of the three herds present, and this herd was divided in the early dry season of 1981 when the herdowner's stepmother separated from the awi and took her animals with her. Therefore quantitative data on kid/lamb mortality for the year are lacking; the magnitude of the mortality is neverthless well illustrated by the available data.

Data on the camel herds were also obtained through direct herd counts and interviews. As with small stock, the Turkana claimed to know each camel individually; verbal data were more easily obtained than with small stock, as there were fewer camels, and adult females were given distinctive personal names and were thus more readily identifiable. The verbal data on the current conditions and losses of the animals seemed quite accurate, although historical accounts (i.e., of events in the lives of individual animals, prior to 1980) were sometimes garbled. Even though camels were easier to keep track of than small stock, again it was only near the end of the fieldwork period that the counts were (almost) error-free, and there are some discrepancies between these and earlier counts.

The data on cattle herd dynamics are scanty. No cattle were present at the awis from the time I arrived in the field until May 1981, following the rains. In the first part of the 1980-81 dry season the cattle, in distant dry-season grazing areas, were completely inaccessible. Later in the dry season we were able to observe and count some cattle, but two to five herds were usually mixed together, and "many" of the cattle were lost. ("Losing" animals is a common phenomenon in Turkana husbandry. The animal(s) may be found within a few days or weeks, or not at all.) The first counts and assessments of individual herds and herd structure were possible only during the latter part of the fieldwork period, by which time mortality was very low. The information on herd losses, with which pre-1981 herd sizes were reconstructed, was gathered by interview exclusively, and it was not possible to check its veracity. Nevertheless it does indicate the magnitude of the effects of the environmental stresses on animals, especially in conjunction with the observations and verbal information on the (lack of) surviving 1980 calves.

Small Stock Herd Sizes and Dynamics, Sept. 1980 - Oct. 1981

Table 1 summarizes the total sizes and losses of the small stock herds of three of the four study families during the period of fieldwork. Data for the third awi (included in some of the later tables) cover only the end of the

Table 1

Total Size and Losses of the Small Stock Herds of Three of the Four Study Awis.
Mid Dry Season 1980 - Mid Dry Season 1981

	Mid Dry Season 1981	Dry and Early Wet Season 1980-81	Latter Part of April 1981	Late Wet-Mid Dry Season 1981	Oct. 1981
Awi 1					
Environmental Losses		571 adults		102	
Social Losses		35 adults		48	
Herd Size	991 adults		385 total		234 adults 57 newborn
Awi 2					
Environmental Losses		220 adults		1	
Social Losses		28 adults		+4(net add.)	
Herd Size	359 adults		111 total		107 adults 48 newborn
Awi 4					
Environmental Losses		40 total		17 awi head	
Social Losses		37 adults		15 only	
Herd Size: Awi head and Stepmother	190 adults 83 newborn		196 total		
Awi Head Only	no data		111 total		75 adults 14 newborn

Environmental losses include starvation, rain, disease, human and animal predation.
Social losses include slaughterings, sales, trades, etc.
The awi head and his stepmother had a combined herd until the early wet season, when the stepmother split off her animals and then moved away (see text).
Raiders stole all of Awi 4's small stock in December 1981.

fieldwork period because, due to a series of circumstances involving flight from bandits, none of this awi's small stock were present at the awi or anywhere nearby until that time. Although reducing the number of small stock herds monitored to only three, this phenomenon helped to demonstrate a high degree of inter-awi variability in herd composition and pastoral strategy. Table 2, including data gathered by J. Terrence McCabe in 1982, summarizes the small stock herd sizes over a period of 2 yearly cycles. It is especially valuable in illustrating the severity of the 1980-81 year, which was my fieldwork period and is the focus of this paper. Table 3 includes a more detailed breakdown of the compositions of the small stock herds, and Table 4 details the effects of environmental stresses on the herds for two climatically and vegetationally contrasting periods of drought plus early rains and latter wet plus subsequent dry season. Table 5 adds information on the effects of rain stress. As noted above, the herdowner-controlled sources of animal disappearance from the herds (slaughtering, sales, etc.) are not discussed in this paper.

With respect to herd sizes at any point in time, there was a large variation among the three (or four) awis, which appeared to be well within the range of herd sizes generally seen in the area. In the case of Awi 4 the generally smaller small-stock herd size was correlated with a small awi and smaller camel (and probably cattle) herd size, but in the cases of the other three awis small-stock herd sizes were not particularly correlated with awi or large-stock herd sizes. Although herdowners generally tried to maintain multi-species livestock holdings--goats, sheep, camels, and cattle (and the essential donkey as pack animal)--there were differences among individuals in their interest in and concentration on any particular species. For example, herdowner 1 emphasized his small stock much more than herdowner 3 did. The former, who had focused on small stock all his life (starting out and remaining as a chief small stock herder of his father until the latter's death left him with a large herd), was recognized as being rather rich in small stock--at least prior to the disasters of 1980-81, and several years prior to that he had been even richer in small stock, according to verbal information. Even with a herd decimated by the 1980-81 events he was still the richest of the four awis in small stock, giving him a large headstart in the recovery process. (This points to an advantage of large herds to pastoralists living in precarious conditions, to be further discussed below.) Herdowner 3 focused his attentions on and was most interested in his camels; he had herded camels as a child, and considered them the best animals of the Ngisonyoka. (Turkanas' valuations of the different species are discussed further in Wienpahl 1984). Despite his lesser emphasis on small stock, herdowner 3 was quite interested in the sheep component of his herd, which was proportionately larger than in the other awis' herds. He said this was because the sheep were so good for their fat (especially in the tails and rumps of Turkana sheep). All Turkana would agree that sheep are good for their fat, but it just seemed to be this herdowner's idiosyncratic preference to disproportionately emphasize sheep over goats. The qualities of goat versus sheep will be mentioned further later. To conclude, it should be emphasized that all the herdowners did maintain small stock as well as camel and cattle herds; reasons for the Turkana herdowners' goal of multi-species herds will be stressed throughout this paper.

With respect to animal losses, the severity of the classic environmental stresses--drought, disease, and (not just a hazard of past times) raiding--are apparent (Table 4). Approximately two-thirds of the adult small stock of Awis 1 and 2 succumbed to these stresses during this year. In the personal estimation of herdowner 1 the total decrease of his herd (from 991 to 234 animals) represented

Table 2

Small Stock Herd Sizes of the Four Study Awis: Changes Over Two Yearly Cycles

	Awi 1	Awi 2	Awi 3	Awi 4
Herd Size 1980				
Goats	722	289	-	No data on
Sheep	269	70	-	herdowner's
Total	991	359	-	herd only
Herd Size 1981				
Goats	213	129	23	83
Sheep	78	26	41	6
Total	291	155	64	89
1981 as % of 1980	29%	43%	-	-
Herd Size 1982				
Goats	294	163	20	9
Sheep	105	41	44	0
Total	399	204	64	9
1982 as % of 1981	137%	132%	100%	10%

Dash indicates no data.
1982 data supplied by McCabe.

Table 3

Detailed Composition of the Small Stock Herds of the Four Study Awis at Different Seasons.

	Beginning Mid Dry Season 1980			Mid Dry Season 1981		
	Goats	Sheep	Total	Goats	Sheep	Total
Awi 1						
Adult females	536	191	727	166	34	200
Adult males	186	78	264	23	11	34
Adult animals total	722	269	991	189	45	234
Ratio of goats to sheep (adults only)	2.7			4.2		
Kids and lambs	-	-	-	24	33	47
Awi 2						
Adult females	-	-	-	80	16	96
Adult males	-	-	-	9	2	11
Adult animals total	289	70	359	89	18	107
Ratio of goats to sheep (adults only)	4.1			4.9		
Kids and lambs	-	-	-	40	8	48
Awi 3						
Adult females	-	-	-	12	24	36
Adult males	-	-	-	3	4	7
Adult animals total	-	-	-	15	28	43
Ratio of goats to sheep (adults only)	-			0.5		
Kids and lambs	-	-	-	8	13	21

	Mid Dry Season 1980 Goats	Sheep	Total	Mid Wet Season 1981 Goats	Sheep	Total	Mid Dry Season 1981 Goats	Sheep	Total
Awi 4 Herdowner plus Stepmother									
Adult females	130	26	156	86	10	96	-	-	-
Adult males	30	4	34	23	5	28	-	-	-
Adult animals total	160	30	190	113	15	124	-	-	-
Ratio of goats to sheep (adults only)	5.3			7.5			-		
Kids and lambs	70	13	83	61	4	65	-	-	-
Awi 4 Herdowner only									
Adult females	-	-	-	51	3	54	56	4	60
Adult males	-	-	-	11	4	15	13	2	15
Adult animals total	-	-	-	62	7	69	69	6	75
Ratio of goats to sheep (adults only)	-			9.4			11.5		
Kids and lambs	-	-	-	40	1	41	14	0	14

Dash indicates no data.

Figures for "mid dry season 1981" include 1980-born animals ("kids and lambs" in 1980) as adults (they would be about one year old). There were 12 such yearling goats (no sheep) in Awi 1's herd. See Table 3.9.

There were 11 yearling goats (no sheep) in Awi 2's herd in the mid dry season 1981. See Table 3.9.

Awi 3's small stock were unavailable for counting until the 1981 dry season. (See text).

The herds of awi head plus stepmother were combined until the 1981 wet season, when the stepmother separated her herd and then moved away some weeks later.

These numbers are suspect when compared to the numbers for the mid dry season 1980. There are too few females, too many males, and possibly too many 1980-born (still in the "kids and lambs" category) animals here (according to verbal data, 17 males had been slaughtered, and only 13 females; and the kid mortality seems very low [around 13%]). I cannot explain these discrepancies, and include them here partly to illustrate difficulties of data collection in this field. Probably the 1980-born animals, counted in 1980 only at Awi 4, caused the problem -- they may in some instances have been counted as small adults (and/or the latter counted as 1980-born kids). Nevertheless, the decline of goats from 230 to around 174 gives a reasonable estimate of the total decline.

Two of these were newborns, i.e., spring lambs.

The mid dry season 1981 figures for adults include 1980-born animals. There were 13 female yearling goats and 12 male yearling goats (no sheep).

Table 4

Effects of Environmental Stresses on the Small Stock Herds of Three of the Study Awis: Causes and Magnitude of Losses

Dry and Wet Seasons 1980-1981		Post-Wet Season 1981		Summmary	
Awi 1					
Dry season starvation:	310	Disease (CCPP):	100	Total losses:	673
and predation:	30	Other:	2		
Rain:	80	Total:	102	Percent original herd (673/991):	68%
Enemy raid:	151				
Total:	571				
Percent lost (571/991):	58%	Percent lost of 385 animals at start of season:	26%		
(Percent sheep lost: about 80%)					
Awi 2					
Dry season starvation:	160	Cause unknown:	1	Total losses:	221
Rain:	60				
Total:	220			Percent original herd (221/359):	62%
Percent lost (220/359):	61%				
(Percent sheep lost:	100%)				
Awi 4					
Starvation, rain, and predation:	42	Disease (CCPP):	13	(Cannot summarize because herd was split in the wet season.)	
		Lost:	4		
Percent lost (42/473):	15%	Total:	17		
(Percent sheep lost:	about 60%)	Percent lost of 111 animals at start of season: (herdowner's herd only)	15%		

Table 5

Effect of Rain Stress on Two Camp Herds of Small Stock

	Animals in Turkwell Area Shortly After Start of Rains	Animals Returning to Awi from Turkwell Area
Awi 1	20 goats 70 sheep 90 total	12 goats 7 sheep 19 total
Awi 2	89 goats 8 sheep 97 total	30 goats 0 sheep 30 total

Table 6

Reproduction of Small Stock at the Four Study Awis, Sept./Oct. 1981

	Awi 1		Awi 2		Awi 3		Awi 4	
	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep
Total mature females	154	34	75	18	11	19	43	3
Mature females w/baby	24	33	42	8	8	13	14	1
Percent females w/baby	16%	97%	56%	50%	73%	68%	33%	33%
Mature females said to be still pregnant	119	1	30	1	3	5	7	2
Maximum possible 1981 offspring	143	34	72	9	11	18	21	3
Maximum possible kidding/lambing rate	92%	100%	96%	56%	100%	95%	49%	100%

a change from approximately two "flocks" (ngisipan, sing. esipan) to "one flock or more like half a flock." This may not have been the worst year he had ever experienced--one year (probably 1973[3]) he had lost two out of four flocks; another year (probably 1976) two out of three flocks--nevertheless it was clearly an environmental low-point.[4] Thus these and the subsequent data document the often postulated but infrequently observed effects of disaster on pastoral herds.

The major killer of small stock in the dry season was starvation ("hunger"-- akoro, "thinness"-- erogo, and "dry season"-- akamu) due to lack of forage. Manifest disease or parasites were minor, and, except for an occasional case of ticks, were not mentioned by the Turkana as causing loss (although the presence of ticks was a factor influencing herd movement decisions). There was some predation by wild animals, in the case of small stock these being mainly jackal, baboon, and sometimes eagles.

Human predation--raiders from the neighboring Pokot tribe (Turkana bandits not being a major factor in small stock losses)--was a source of major loss for Awi 1 during my period of fieldwork and a source of complete loss for Awi 4 after I had left the field. In November 1980 the entire milking herd of some 300+ animals of Awi 1, plus the herds of the 3 awis then associated with Awi 1, totalling about 50 animals, were taken from near the awi, and 2 young herdboys killed. Somewhat more than half the herd was recovered two days later by combined local Turkana and police action, but 151 animals[5] were lost in the bush or died. (The raider escaped but with none of the livestock.)

Many kids/lambs suffered from their mothers' absences and later Fortunately for Awi 1, by this time in the dry season the small stock herd had been divided into its milking and non-milking components, and the latter, in a movement orbit separate from the awi's, was not affected by the raid. A number of herdowners suffered losses in Pokot raids during the year, have in the past, and continue to do so currently. Raiding exerts a major influence on herds and awi movements, and loss of herds to raiders has been a direct cause of the drop-out of individual Turkana herdowners and their families from the pastoral way of life. (The importance and effects of raiding in South Turkana are discussed in more detail by Dyson-Hudson and McCabe (1982).) The effects of Pokot raiders on the small stock herd of Awi 4 in December 1981 will be mentioned below.

The rains that broke the drought in March 1981 were devastating, particularly for the non-milking goats and the sheep that had been taken to the Turkwell River area. The animals were already weak from the dry season, especially the sheep which could not withstand the (apparent) cold stress brought on by the rain. Disease was said to be an important factor in killing goats in the Turkwell area.[6] There was known to be disease in that area, and a loss of all animals, 100% complete mortality had occurred three out of four times Awi 1's small stock had been taken there in the past. However, the desperate conditions throughout South Turkana in 1980-81 left many of the herds with no good alternative but to retreat there because some grazing existed at the end of the dry season.[7] In any case the combination of heavy rains and disease laid waste the small stock there (Table 5).

Thus the events of the dry and early wet season killed around 60% of the adult small stock of two of the three awis. This contrasted sharply with the

situation of Awi 4, which lost only around 15% of its small stock during this time, probably only about one half of which were adult animals (i.e., around 17 of 190, or 9%, of the adult animals died.) This difference was correlated with, and probably a result of, the different management practices of herdowner 4 throughout the 1980-81 dry/early rains season: Awi 4 and its entire small stock herd remained nearly stationary in a relatively lightly occupied area on the periphery of the Ngisonyoka traditional wet-season grazing area, whereas Awis 1 and 2, along with the majority of other awis, migrated south. By staying where it did, the small herd of Awi 4 was able to exploit without as much competition the forage resources there that were still of reasonable quality (apparently) but were not abundant enough to maintain large numbers of animals. There was no danger of Pokot raids in the area, with so many awis and herds between Awi 4 and the Turkana/Pokot border area to the south. Whether herdowner 4 did not divide his relatively small small stock herd into milking and non-milking components, sending the latter elsewhere to forage, only because his small labor force prevented it, or on the other hand because he felt that conditions were best where he had located the awi,[8] nevertheless the results were beneficial, as seen by the very high survivorship of his small stock.

Personal observation and conversations with Turkana indicated that Awi 4's experience with small stock during the 1980-81 dry season and rains was not very representative of the general experience in South Turkana, which was more like that of Awis 1 and 2 (not excluding Awi 1's experience with the Pokot). Nevertheless, the experience of Awi 4 versus the others shows the possibility of large differential effects of a generally disastrous season among individual households within a group. Such differential effects can be due to various factors--such as combinations of herdowner-controlled management decisions (e.g., to stay in one area versus another), enforced management decisions (e.g., inability to divide the herd due to lack of labor), fortuitous circumstances (e.g., the ability of Awi 4 to stay where it did precisely because of its small herd), and good or bad luck (e.g., Awi 1 was raided even though it was not the only awi in a vulnerable position). Awi 4's experience also illustrates that at least over the short run it is not necessarily the case that "during dry spells a large percentage of the herd will die, so the more...units a man owns during normal times, the better off he is" (Moran 1979: 50), paraphrasing Spencer 1965). (It can be seen [Table 1] that Awi 4 came through the dry season and rains with 196 animals to Awi 2's 111, although Awi 2 started with 359 compared to Awi 4's 190 adult animals). Such a generalization cannot be assumed for individual households subject both to conscious management decisions and to possibly unforeseen good fortune. Significantly, however, Awi 4 did eventually lose all its small-stock, to Pokot raiders in December 1981, and was subsequently struggling on the fringes of pastoral existence. One reason Awi 1 did not lose all of its small stock in the November 1980 raid was because by that time the non-milking component of the relatively large herd had been separated from the awi. Had the raid occurred a month earlier the entire herd would have been with the awi, but it is doubtful that the small raiding party (reportedly about 6 men) would have chosen to attack such a large herd or would have been successful in making off with all the animals. Over the long term, in an unpredictable and uncontrollable and hazard-filled environment such as that of the Turkana pastoralists, larger herds and households no doubt are the most likely to survive.

Small stock mortality dropped to essentially zero with the growth of new forage in the wet season, indicating high survivorship under favorable conditions. This trend continued for Awi 2's herd throughout the following months. In late

May, a disease diagnosed by a veterinary officer as contagious caprine pleuropneumonia (CCPP)--affecting only goats, not sheep--broke out in the area; Awi 1 was one of the first affected, losing approximately 25% of the herd, and later Awi 4 was affected, losing approximately 12% of its herd (Table 4). In addition to the mortality, the disease caused a number of pregnant females to abort, thus reducing or delaying the 1981 kid crop. (Most of these females were to be reimpregnated, to kid several months later.) Efforts made to halt the disease with antibiotics were not very successful.[9] It was difficult to ascertain the effects of other management actions. Herdowners did attempt some separation of healthy from sick animals, and some awi associations were altered--for example, Awi 4 moved away from Awi 1, close to which it had been located, but Awi 4 did not ultimately escape the disease. I do not know why Awi 2's herd was not affected; herdowner 2 did not pursue any obvious preventative measures. Good and bad luck probably again played a part in the course of the disease throughout the area.

The kidding season beginning around September 1981 represented the most visible beginning of the regeneration of the small-stock from the large losses of 1980-81 (Table 6). Because kidding was still underway when I left the field--partly due to the normal seasonality of the event, partly because of the delays caused by CCPP--the final kidding/lambing rates were not determined. The detailed, animal by animal, surveys of the herds done at the end of the fieldwork period, however, gave an indication of the potential kid/lamb crop. Due to probable overestimation by the Turkana of the number of still-pregnant animals, and also allowing for some pregnancy wastage, the potentials indicated in Table 6, generally between 90% and 100% kidding/lambing rate, would not be achieved; nevertheless, the actual crop promised to be high,[10] reflecting the good forage resulting from the high 1981 rainfall. Among the eight figures for the four awis are two exceptionally low ones, which again illustrates potentially large variation among awis and even among different components of the small stock herd within an awi. Herdowner 2 said the reason for his low lambing rate was that he did not have a ram--sheep with lambs had been impregnated before he acquired them that season, or had come with their lambs. (It should be noted that all but one of the sheep in Awi 2's herd in September 1981 had been acquired that year, as the sheep of the previous year had experienced 100% mortality in the dry season and rains. This is not apparent from annual tables of herd size and increase.) I do not know why Awi 4's goats were kidding so poorly, except that the CCPP had still been affecting the herd as late as August; some animals had aborted nearly live kids, and others had probably not been reimpregnated. In any case, these two exceptions did not seem to be representative of what the final kid/lamb crop would be in most awis in 1981.

To summarize the effects of the 1980-81 events on the small stock, I observed that the drought and rain killed approximately 60% of the 360 adult animals in Awi 2's herd; a raid and disease killed additional animals in Awi 1's herd so that the total environmental disasters (including raiding as "environmental") accounted for approximately 670 out of 755 animals gone from an initial herd of 990 animals--68% of the herd lost to these disasters. Awi 4's herd suffered small losses in comparison--probably around 9% of its total 190 adult animals to drought and rain, and about 12% of its animals to disease--due to a combination of circumstances, reviewed above, that resulted in a very different movement pattern during the dry season.

The year's stresses were more severe for the sheep than the goats. The ratio of goats to sheep in Awi 1's herd went from 2.7 to 4.2 (Table 3) and in Awi 4's herd from 5.3 to 7.5 (over the dry and wet seasons). Awi 2's goat/sheep ratio went from 4.1 to 4.9, which masks the fact that all of Awi 2's sheep died in the dry and wet seasons and were subsequently replaced by socio-cultural mechanisms. These goat/sheep mortality differences were no doubt due to the superior adaptation of the goats to the browse-type forage available in the arid environment and thus their less-stressed physical conditions. (This goat/sheep difference has been noted by a number of researchers, including Gulliver 1951: 22.) On the other hand, the sheep seemed to recover as rapidly as the goats with the growth of new vegetation (which included grasses) with the rains, and the major disease (CCPP) that affected small stock that year affected only goats. Nevertheless, the goats ultimately suffered less. These observations point to the reason for large numbers of goats compared to sheep in most herds (of which Awi 1's can be taken as representative), despite some very desirable qualities of the sheep to the Tukana, especially its much larger production of fat than the goat's. Do the Turkana keep sheep just for their fat, however? Judging from the rapid physical recovery of the sheep, and from various statements of the Turkana--e.g., that in a good year a lamb will gain weight/grow faster than a kid (although I have no measurements, this seemed to be the case with the few lambs in the 1981 wet season)--I believe another reason that Turkana keep sheep is that the latter have the potential to surpass the goats in productivity in favorable years. This may be part of a strategy that can make the most of environmental flushes, while maintaining the baseline adaptation to aridity. I believe that cattle are an even more important component of this strategy, as will be noted below.

A final demonstration of the effects of the environmental stresses on the small stock is the young (1980-born) animal mortality for the year. Due to the difficulties in counting small stock, especially births, the data on survivorship of the 1980-born kids/lambs are incomplete. From information acquired in the detailed herd surveys done at the end of the fieldwork period, however, it is possible to indicate the magnitude of the environmental effects (Table 7). Awis 1 and 2 (and probably 3) must have suffered greater than 90-95% mortality of the kids along with 100% mortality of the lambs. Awi 4, as I have discussed, suffered much lower mortality of the small stock, in general, but its lamb losses were high. Excluding Awi 4, we will see that the very high mortality of the young stock was not excessive compared to the situation with the camel and especially the cattle calves; it can be concluded that the estimate of magnitude is reasonable. Inasmuch as the Turkana did not sell or slaughter young stock, and none were taken directly by raiders, the almost complete loss of the 1980 generation of the herds reemphasizes the severity of the drought, rain, and disease stresses of the 1980-81 season.

Camel Herd Sizes and Dynamics, 1980-81

The sizes of camel herds, and seasonal changes and reasons for loss in the camel herds of each of the four study awis are shown in Tables 8 and 9. With respect to herd sizes, there were more camels than had been observed by Gulliver in 1949 in northern parts of Turkanaland. Gulliver estimated an average of 10 camels per awi, and he "never $saw a camel herd of more than about 70 and few over about 15" (Gulliver 1951: 15, 83). He noted that "an average figure for camels is particularly difficult since in some areas there are very few, whereas in others...., they are very important, and few cattle are to be seen" (Gulliver

Table 7

Survivorship of 1980-born Small Stock in the Four Study Herds

	Awi 1	Awi 2	Awi 3	Awi 4
Goats in Herd 1980	536 females	289 total	No data	No. Kids Mid Dry 1980:70
Yearling Kids in Herd 1981	12 (11-13)	11	1	No. Kids Mid Wet 1981:61
Sheep in Herd 1980	191 females	70 total	No data	No. Lambs Mid Dry 1980:13
Yearling Lambs in Herd 1981	0	0	4	No. Lambs Mid Wet 1981: 2

I was not able to count the numbers of kids and lambs in 1980 in the herds of Awis 1, 2, or 3. For Awis 1 and 2 the number of adult females or total animals is shown to give a rough idea of how many kids and lambs may have been produced. E.g., if every female goat in Awi 1's herd had produced a kid, there could have been 536 kids, of which about 12 were remaining a year later. Although 100% production in 1980 is very unlikely to have occurred, there was substantial production (personally observed, though not counted) of kids and lambs as Awis 1 and 2 in 1980. Awi 3's small stock herd was not observed at all in 1980 (see text). In any case, the very low numbers of yearlings in 1981 indicate low survivorship of 1980-born small stock.

See Table 3. I was able to count the kids and lambs of the combined herd of awi head plus stepmother at Awi 4 in 1980. The 1981 figures are for the combined herd, to show survivorship over the dry season and early rains, which was when the majority of young animals died.

Table 8

Camel Herds of the Four Study Awis: 1980, 1981, and 1982

Age-Sex Category	Awi 1 Number	Awi 1 % Herd	Awi 2 #	Awi 2 %	Awi 3 #	Awi 3 %	Awi 4 #	Awi 4 %
Beginning Dry Season 1980								
Adult females	26	38%	39	49%	31	39%	13	43%
Immature females	11	16%	19	24%	11	14%	8	27%
Adult males	7	10%	2	3%	7	9%	2	7%
Immature males	11	16%	13	16%	13	16%	2	7%
1980 calves	14	20%	7	9%	18	23%	5	17%
Total	69	100%	80	101%	80	101%	30	101%
1980 calving rate (# calves/adult females)	54%		18%		58%		38%	
Beginning Dry Season 1981								
Adult females	19	43%	21	49%	23	39%	6	67%
Immature females	6	14%	11	26%	14	24%	1	11%
Adult males	5	11%	0	0%	5	8%	0	0%
Immature males	8	14%	8	14%	12	20%	0	0%
1980 calves	2	5%	0	0%	3	5%	1	11%
1981 calves	6	14%	5	12%	2	3%	1	11%
(months born)	(2 May, 3 June, 1 Aug.)		(3 June, 2 July, + 2 stillborn)		(1 May, 1 June)		(June)	
Total	44	101%	43	101%	59	99%	9	100%
Total as % of previous year	64%		54%		74%		30%	
1980 calf mortality	86%		100%		83%		80%	
1981 calving rate	32%		24%		9%		17%	
1982 Data (supplied by J.T. McCabe)								
1982 herd size	33		37		78		9	
1982 as % of 1981	75%		86%		132%		100%	
1981 calf mortality	0%		60%		17%		(no data)	
1982 calving rate	47%		62%		59%		(no data)	
	but half the calves died, so 24% living calves		31% living calves					

Table 9

Causes and Magnitude of Camel Losses at the Four Study Awis, 1980-81

Cause of Loss	Awi 1 1980 Dry & Rains	Post-Rains	Total	Awi 2 1980 Dry & Rains	Post-Rains	Total	Awi 3 1980 Dry & Rains	Post-Rains	Total	Awi 4 1980 Dry & Rains	Post-Rains	Total
Social causes:												
Slaughter	2	-	2	6	-	6	3	-	3	2	1	3
Given away	-	5	5	-	-	-	2	1	3	-	1+3	4
Environmental causes:												
Died-starvation	14	-	14	9	-	9	15	-	15	-	-	-
Died-rain	-	-	-	3	-	3	-	-	-	-	-	-
Died-gland dis.	2	1	3	-	6	6	9	2	11	-	-	-
Died-other dis.	1	-	1	6	1	7	2	-	2	-	-	-
Killed by predator	4	-	4	9	1	10	-	-	-	3	-	3
Died-fell off hill	3	-	3	-	-	-	1	-	1	-	-	-
Died-misc. causes	1	-	1	-	-	-	-	-	-	1	-	1
Stolen by bandits	5	-	5	1	-	1	-	-	-	10	-	10
Lost	1	-	1	2	-	2	1	-	1	-	-	-
Total environmental losses	31	1	32	30	8	38	28	3	31	14	-	14
Total losses	33	6	39	36	8	44	33	3	36	16	5	21
Original herd size (from Table 3.10)			69			80			80			30
Percent loss			57%			55%			45%			70%
Acquired thru debt, trade, other	3	3	6	1	1	2	1	5	6	-	-	-

Dash indicates none reported by the informants.
One given away plus 3 left with stepmother.
Miscellaneous causes of death: Awi 1 camel, unknown; Awi 4 camel, burned.

1951: 15). The latter situation was particularly true in the area of fieldwork during the first two-thirds of the fieldwork period. The greater importance of camels to the southern than to the northern Turkana is correlated with "the relative abundance of highly nutritious browse and the numerous mineral springs $which make South Turkana particularly suitable for raising camels" (Dyson-Hudson and McCabe 1982: 6), the vegetation of North Turkana being primarily herbs and grasses (Dyson-Hudson and McCabe 1982: 5).

Among the four study awis, Awi 4 was the only one with an obviously smaller camel herd. This correlated with the smaller awi size and smaller small-stock herd. In the previous year (1979), however, this awi was said to have had a larger camel herd (a legacy of the herdowner's deceased father); "many" animals had died of a disease seemingly associated with an area where the awi had located, between 1979 and 1980.[11] As mentioned above, herdowner 3 was particularly fond of camels, but his herd was no larger than Awi 2's, and not much larger than Awi 1's, in the fall of 1980. The herd sizes of the four awis seemed representative of a lower to upper-middle range of Ngisonyoka camel-herd sizes. Heavy reliance of the Ngisonyoka on camels was indicated by these herd sizes (by themselves and in comparison with the cattle herd sizes), by observations and informants' comments to the effect that camel herds larger than those observed by Gulliver were almost always present at the awis in the fieldwork area (and almost no herdowners had no camels), and finally by food production from the livestock, which is not dealt with in the present paper.

Despite their high level of adaptation to the aridity and other environmental characteristics of South Turkana (Dyson-Hudson and McCabe 1982, and see above), the camels were seriously affected by the environmental stresses of 1980-81: approximately 21% (Awis 1 and 3) or 38% (Awi 2) of the adult animals were lost to various environmental causes, while calf mortality was 72%-100% for Awis 1-3. Again Awi 4 is anomalous; in this case because so many of its camels were stolen by bandits while they were in another man's herd after Awi 4's herder had temporarily or permanently departed from the household.

Starvation ("hunger", "thinness", "dry season") was the main reason given for the deaths of the calves as well as of many of the older animals during the dry season. Awi 2 suffered particularly high losses to predation; this seemed to be largely due to the inept herding practices of the boy assigned to the task.[12] Another cause of high mortality and morbidity was a disease, called longari by the Turkana, characterized by swollen neck glands. The heavy rains probably contributed to the prevalence of the disease, which was said to be exacerbated by dampness, and the especially high mortality in Awi 3's herd may have been because this awi had moved to a wetter-than-average area at the end of the drought and during the initial rains. The disease persisted following the rains, and was said to be partly responsible for the relatively poor calving and milk production of the camels. Informants said that many camels impregnated in 1980 aborted; if that is true, it was probably a combination of stress from the unusually severe dry and rainy seasons as well as the disease.

The 1981 camel crop was, in any case, small. Informants said that nearly all the females that had not freshened in 1981 were impregnated to calf in 1982, although as will be seen subsequently (in connection with comparative recovery rates), this may have been as much an optimistic assumption on the part of the

informants as a statement reflecting the true state of affairs. Regardless, given a 12-13 month gestation in camels, the 1981 calving rate of camels would reflect the events of 1980-81, and the 1982 calving rate would reflect the events of 1981-82. (The small stock, which, with their much shorter birth intervals, reflected in the September 1981 kid crop the events of the previous 5 months). Additionally, the moderately high mortality of the adult animals and the very high mortality of the 1980 calves reflected the stresses of the 1980-81 dry season, rains, and associated diseases.

Cattle Herd Sizes and Dynamics, 1980-81

As discussed previously, personal observation of the pre-1981 cattle herds was impossible; verbal information on losses allowed estimates of herd sizes, from which it is possible to indicate the magnitude of the effects of the environmental stesses on the herds.

It appears that the cattle herds were comparable in size to the camel herds, perhaps somewhat larger before the 1980-81 dry season and somewhat smaller following the dry season (Table 10). The contribution of the cattle to the subsistence of the awis in 1980-81 was not at all commensurate with the numbers of existing animals. Subsequent events, discussed below, elucidate the reasons for their presence in Ngisonyoka herds.

Losses of adult animals in 1980-81 was quite high, perhaps around 45-65% (excluding theft), and calf mortality was invariably 100% (Tables 10 and 11). (Out of numerous herds surveyed by Dyson-Hudson and McCabe in 1981, only one calf was found to have survived the 1980-81 season.) The primary cause of death was said to be a disease, called by the Turkana loleo, which was probably an epidemic of contagious bovine pleuropneumonia (CBPP); it was difficult to know how much of the mortality was due to the disease and how much was a function of the drought and rains (starvation, cold stress from the rain, etc.), or rather, how many cattle would have died from the latter causes in the absence of a specific disease.

The low 1981 calving rates were due either to low rates of impregnation in 1980 or high rates of pregnancy wastage during 1980-81, or both. The small number of calves born in 1980 suggests that the cattle had been under much stress previous to the culmination of the drought in the 1980-81 dry season. In any case, the 100% 1980-calf mortality and the low 1981 calving rates accurately reflect the severity of the 1980-81 stresses. As with the camels, high impregnation rates were reported in 1981, reflecting good recovery of the cattle due to the favorable conditions produced by the 1981 rains.

Discussion: Differential Effects of Environmental Stresses On Small Stock Compared to Camels and Cattle

None of the livestock species was immune to the stresses of drought, rain, and disease, but there were clear differences among the species in ability to survive and recover from the disasters. These differences point to the complementarity of the different species in the pastoral adaptation.

Table 10

Cattle Herds of the Four Study Awis: 1980 (Reconstructed), 1981, and 1982

	Awi 1	Awi 2	Awi 2 brother	Awi 3	Awi 3 brother	Awi 4
Approximate Herd Size, Beginning Dry Season 1980						
(Reconstructed from verbal information on 1980-81 losses, Table 3.13)	110	318 (combined herd)		44	85	42
1980 Calves (Not included above)						
Born	3	3		0	9	?
Died	3	3			7	"all"
Herd Structure, Mid-1981						
Adult females	13	28	76	9	19	9
Immature females	7	0	7	0	18	4
Adult males: bulls	2	4	5	1	2	0
Adult males: castrates	3	4	14	2	3	1
Immature males	6	2	6	1	2	3
1981 calves	2	4	-	3	-	2
(month born)	(June,July)	(May&June)		(May)		(May)
Total	33	42	108	16	44	19
1981 calving rate	15%	14%	-	33%	-	22%
1982 Data (Supplied by J.T. McCabe)						
1982 herd size	48	36	no data	15	no data	15
% of 1981	139%	86%		94%		79%
1981 calf mortality	0	0		0		0
No. 1982 calves born	19 (2 died)	14		4		6
1982 calving rate	85% living	88%		67%		86%

The combined herds of the two brothers were managed as a unit until mid-1981.
The brother managed this herd separately, in a separate awi. It never joined Awi 3, but the animals, ultimately owned by Awi 3's head (who was the elder brother), were accessible for sale or slaughter.
Dash indicates no data.
Only two cows and their calves were with the awi.

Table 11

Causes and Magnitudes of Cattle Losses at the Four Study Awis, 1980-81.

From verbal information entirely.

	Awi 1	Awi 2 + Brother	Awi 3	Awi 3 Brother	Awi 4
Social causes:					
Slaughter	6	-	-	-	-
Sell	1	10	2	1	-
Environmental causes:					
Disease, loleo	23	142	>29	31	25
Disease, other	3	2	-	-	-
Starvation/rain	14	-	-	8	-
Predator	3	11	-	-	-
Theft	18	-	-	-	-
Lost	3	5	-	-	-
Other (fell off hill, died at calving, unidentified)	8	2	-	3	-
Total	79	172	>31	41	25
%Mortality (excluding social causes)	65%	51%	66%	47%	60%

Dash indicates none reported.
Pokot 10, bandit 8.
Calculated as losses due to environmental causes divided by reconstructed 1980 herd size, x 100.

Small stock experienced higher mortality than camels, and, within the small-stock category, sheep experienced high mortality than goats; sheep were the most vulnerable of the livestock to the combined effects of drought and rain. The mortality records of small stock versus camels confirm Turkana statements that one of the good qualities of camels is that they do not die easily in the dry season (although the calves were quite vulnerable) whereas small stock do die easily in the dry season. The effects of an epidemic disease (specifically CCPP) on the goats was substantial in the herds that were affected, but not as dramatic as Dahl and Hjort indicated to be possible; the combined mortality and morbidity (e.g., apparent effect on pregnant camels and on milk production) of the gland disease longari on the camels seemed to be almost equally serious. Thus it was in their ability to survive drought that the camels were clearly superior to the small stock. The strength of the small stock in respect to the stresses of the arid environment (and other disasters) was in their much more rapid recovery following the stressful period.

The survivability of the cattle compared to the small stock is less straightforward, for two reasons. One is that the mortality estimates for cattle may be too low, based as they are on the herders' ability to remember the death of each animal throughout the previous year. Thus the apparently equal mortality of cattle and small stock may not be real. In any case, cattle clearly experienced much higher mortality than camels did. The 1980-calf mortality of 100% indicates a high vulnerability of the cattle to the stresses of the environment, as do also the low 1980 and 1981 calving rates. The second reason for lack of strict comparability of the cattle with the small stock (and camel) mortality or survivability is the different management practices in respect to the cattle herds. That is, almost none of the cattle were anywhere near the awis during the dry and wet seasons of 1980-81; rather, they were taken to places thought to be less threatening to their survival. Because of this they contributed less to human subsistence, which must be considered the price for what otherwise probably would have been much higher cattle mortality due to starvation. Thus if the small stock were more susceptible to the environmental stresses of drought and rain, it was because of human management strategies that recognized the different adaptive capacities of the small stock in comparison to the cattle. In respect to epidemic disease (CCPP and CBPP), the small stock were less severely affected than the cattle, although again the situations were not strictly comparable--e.g., there was the effort to stop CCPP with antibiotics, and the goats were probably in better condition at the start of the CCPP following the rains than the cattle were at the start of CBPP in the dry season. Nevertheless, a particularly high susceptability of small stock to epidemic disease was not demonstrated by the events of 1980-81.

In summary, small stock were more vulnerable than camels to the immediate effects of the environmental stresses of 1980-81; herded in the same general areas as camels, the small stock experienced higher mortality than the camels. The contrasting cattle management practices, i.e., removing the cattle entirely from the awis to the mountainous areas during the dry season, reflected the Turkana knowledge that cattle are not as well adapted to the environmental conditions of the lowland areas, and resulted in cattle mortality (to drought, rain) perhaps midway between small-stock and camel mortality. (The disease CBPP, however, raised cattle mortality considerably.) If the cattle had been herded in the same manner as the other livestock--certain components of the herd remaining with the awis throughout the dry season--they would probably have fared more poorly than the goats, and similarly to the sheep.

In addition to the animals' abilities to survive the immediate disasters, subsequent regeneration of the herds through reproduction is an important aspect of the different species' adaptations and usefulness to the people who subsist on them. In contrast to the immediate vulnerability to the effects of drought, rain, and disease (and raiding), the small stock excelled over the large stock in rapid recovery and reproduction. This is perhaps obvious because of the small stock's shorter gestation interval, but there is nothing inherent in a short gestation interval to indicate that the animals would recover and breed so fast following a period of such emaciation. The latter phenomenon has been noted, although rarely demonstrated, by some ecological anthropologists (e.g., Swift 1973: 77, Dahl and Hjort 1976).

The small stock (goats and sheep) recovered their physical conditions and began to produce milk the most quickly of the livestock following the rains, although very few young were produced at this time. They were also the first livestock to start mating during the wet season (around April 1981); with the 5-month gestation, the first kid/lamb crop reflecting recovery from the 1980-81 disasters began to be produced (around September 1981) within six months of the beginning of the rains. As discussed above, the kidding/lambing rates promised to be generally high, despite the abortions due to CCPP (except possibly in Awi 4's herd, which had been affected later in the season by the disease). Thus, both the early mating of the small stock in the wet season and their short gestation period were responsible for the rapidity of their regeneration following the disasters.[13]

The camels and cattle reproduced with depressed calving rates in mid-1981, reflecting the stress of the 1980-81 season. The non-pregnant, non-lactating large stock generally mated throughout the months following the rains; and with gestation lengths of 13 and 9 months respectively, the camel and cattle reproduced with substantially higher calving rates in 1982, reflecting recovery from the disasters of 1980-81. By this time the small stock were pregnant with their second (perhaps in some cases their third) crop. These observations are illustrated by the figures in Tables 8 and 10. Also indicated by the data is a contrast between the camels and cattle in their 1982 reproduction: the cattle showed a much greater response to the improved environmental conditions of 1981-82 than the camels did, with the 1982 calving rates of 67-88% and 24-59% (living calves) respectively. The camels' 1982 calving rates were no better than their 1980 calving rates, with only 1981 showing a marked difference. Other quantitative and qualitative observations by researchers in the field in 1981-82 also point to an ability of the cattle to flourish in favorable conditions. It would appear that camels reproduced on perhaps a steadier but generally lower level than cattle. This is in accordance with Spencer's observations concerning the almost negligible growth of Rendille camel herds compared to Samburu cattle herds (Spencer 1973). It also agrees with Turkana statements that in good years a cow could produce a calf a year, whereas verbal genealogies indicated that a camel rarely produced a calf even every two years. Also, cattle begin to reproduce at an earlier age than camels do. Small stock, with their even earlier ages at first breeding (around 1-1/2 years), their shorter gestation lengths and birth intervals, and shorter lifespans,[14] and larger die-offs during periods of environmental stress, would show the largest fluctuations of all.

Summary and Conclusions

The Ngisonyoka pastoralists try to maintain herds of small stock (with goats usually predominating in numbers over sheep), of camels, and of cattle. The population dynamics of the different species in a year of severe environmental stresses due to drought, heavy rains, and diseases (plus uncontrollable effects of raiding), indicated the desirability of multispecies holdings, as well as the desirability of aiming for large numbers of animals in a herd. The small stock were an integral component of the total herds, probably neither more nor less crucial than other species.

The small stock were the least able of the livestock to withstand the dry season and rains, with mortality figures of 60-70% for the adult animals and well over 90% for the young animals at two awis (and probably the same for the third study awi, whose small stock were not available for quantitative documentation). The fourth study awi followed a completely different movement pattern, which was facilitated by its much smaller small-stock herd, during the dry and early wet seasons, and lost a much smaller proportion (around 15%) of its smaller herd. Significantly, however, this awi lost its entire herd of small stock to raiders later in the year; thus the advantage in having smaller herds that seemed indicated by the events of the 1980-81 dry and wet seasons was not demonstrated in the long term.

The greatest strength of the small stock, both in their adaptation to the environment and their usefulness to the Turkana, was in their rapid recovery from the disasters of drought, rain, and disease. They started breeding during the wet season (April) and began producing their offspring 5 months later. Many of the goats that had aborted due to CCPP around June were said to be reimpregnated within a few months, to produce their kids within the same year.

Although the sheep suffered more than the goats from the drought and rains, they showed promise of quick recovery. The most important positive factor concerning the presence of sheep in Turkana herds is that they may surpass goats in being able to take advantage of the occasional flushes of the unpredictable and erratic environment (possibly reproducing at higher rates, and their offspring growing faster). This is in addition to the greater potential to produce fat, which is very desirable to the Turkana.

The small stock were in greatest contrast to the camels, which were much less vulnerable to the stresses of 1980-81, but which promised to be much slower in regenerating their numbers. The adult camel mortality figures were around 20-40%, the calf mortality was 70-100%. The camels reproduced at depressed levels in 1981 (reflecting the stresses of 1980-81), not showing their reproductive recovery until mid-1982, following a 13-month gestation period. Even in 1982, however, the camel calving rates were only moderate. Thus the greatest asset of the camels was their ability to survive during the disasters, but with their long gestatiion periods and only moderately high calving rates they did not exhibit the rapid and high response to the subsequent favorable conditions that the small stock did.

The dynamics of the cattle herds are less directly comparable, both because of the verbal nature of the data and because of the management practices in respect to cattle which took them completely out of the environmental zones frequented by small stock and camels. Given these qualifications, the cattle experienced higher mortality than the camels, perhaps comparable to the small stock. No cattle calves survived the 1980-81 season. Like the camels, the cattle reproduced at depressed levels in mid-1981, but the cattle showed a better recovery than the camels in 1982 with higher calving rates. Comparable to the situation with sheep versus goats, the most important reason for the presence of cattle in the southern Turkana livestock production system may be that the cattle are able to surpass the camels in production and reproduction during good years. In this way the cattle are able to maintain their numbers vis-a-vis the camels, as well as broadening the Turkana's adaptation to the high degree of inter-year variation in the environment.

Thus the population dynamics of the different species in a year of severe environmental stresses indicated the desirability of multi-species holdings, as well as the desirability of aiming for large numbers of animals in a herd to offset the high mortality that occurs at such times. These data begin to document the often postulated but infrequently observed effects of disaster on pastoral herds.

FOOTNOTES

[1] My research was part of the South Turkana Ecosystem Project which is investigating the role of human populations in the dry Turkana Ecosystem. I thank the members of the project for their encouragement and support. The responsibility for all statements and interpretations in this paper, however, rests with the author. Other aspects of South Turkana ecology can be found in Dyson-Hudson and McCabe's report in Nomadic Peoples, Number 14, November 1983, pp. 41-46.

[2] The latter information is included in this paper only insofar as it accounts for changes in herd sizes throughout the year; the focus here is on environmental and other uncontrollable determinants of herd dynamics.

[3] Dates were assigned according to an events calendar.

[4] Animal numbers cannot be assigned to the losses of previous years. Turkana estimate ngisipan by the number and size of pens (sing. anok) that contain them, but there is no standard pen size. The emic data may be a reasonable estimate of relative losses, and at least indicate the Turkana's conceptions of how bad the year (1980-81) was.

[5] The herdowner told me this ("151 animals") without hesitation or doubt. This contrasts markedly with this and other herdowners' answers of "many" when usually asked about small stock losses. I was unable to ascertain how or why he was able to be so precise, beyond the fact that he "counted them by color and by whose goats were whose" (i.e., which goats belonged to each woman), which is the normal response when Turkana say they "know" each animal. Also, I do not have sufficient data from that time to know whether the 151 is accurate.

[6] A "disease of the Turkwell." Awi 1's principal small stock herder, a knowledgeable informant, did not have a name for this disease. He said it "makes the liver rotten, and is also like malaria. The goat plays with its tail, circles around and dies. Ten to 20 die each day."

[7] Some advance herders there had said that the goats were doing well--there was some disease, but not many dying. There was water there. So other herders took their animals there, risking the possibility of having them all finished (according to Awi 1's herder).

[8] Also, "Awi 4's herd" was actually the combined herds of the awi head and his stepmother, who later separated from his awi with her animals. This was the second woman discussed in Wienpahl 1984: 202). The influence of the stepmother on the awi head's decisions was not ascertained.

[9] It can be noted here that the Turkana were very eager to obtain and apply Western veterinary practices (e.g., antibiotics). They were willing to sell animals to purchase pills, injectable medicines, syringes, etc. They were inhibited by the very short and erratic supplies of these items, the long distances required to get them, and, it seemed, the high and escalating prices charged by Somali merchants and other suppliers when the demand was high.

[10] Turkana small stock almost never twin; thus a 100% crop would mean that all adult females had given birth.

[11] It is interesting to contrast this experience with awi 4's 1980-81 goat-experience; in the latter case, the animals in question thrived because of a particular movement strategy. In two different years herdowner 4's movement strategies had apparently raised camel mortality on the one hand, and lowered small stock mortality on the other. It is not clear the extent to which bad and good luck, as opposed to poor versus good judgment, entered into these contrasting experiences.

[12] There also was suspicion that "something was wrong" (witchcraft?) with the awi, and particular with the first wife's component, whose son was the herder and whose camels were suffering the most from the hyenas and also from various miscellaneous disease in the mid dry seasons before other awis' camels were dying in such numbers.

[13] The small stock produced almost no offspring in 1981 as a result of mating events in 1980. The Turkana said that a goat or sheep potentially could reproduce twice in a year--once around September (following the main wet-season breeding period around April) and again around April or May (following a breeding period in November/December). The latter kidding/lambing period was responsible for the small number of young offspring present in July 1980, during my initial visit to the field, and by the even smaller number born in April 1981. That so very few animals produced young in April 1981 reflected the stresses of the previous months. Also, I believe that spring kidding/lambing would be most likely when the "small rains" of November actually occur; they frequently do not or are too small to have much effect. The large stock produced relatively more offspring than had been carried over the 1980-81 dry season, indicating again the higher vulnerability of the small stock to stresses as they were actually occurring.

Verbally acquired life histories of individual goats and sheep indicated that animals often produced an average of more than one offspring per year over several years, but that few, if any, were able consistently to produce two offspring per year. (Twins were very rarely produced, so two offspring per year means two breedings per year.) This is probably largely due to the stressful environment rather than lack of potential among the animals or human interference. The Turkana do not control the breeding, and almost always there are one or more breeding males in a herd.

14 Statements about age at first reproduction, birth intervals, and lifespans are based on generally known facts about the biology of the species, and on genealogies and other verbal information.

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Jan Wienpahl
Ph.D., Department of Anthropology
University of Arizona
(current address: Morgan Hall,
Department of Nutritional Sciences
University of California, Berkeley
Berkeley, California 94720
U.S.A.