FACTORS AFFECTING THE DISTRIBUTION OF WILD UNGULATES ON A RANCH IN KENYA. PRELIMINARY REPORT

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ABSTRACT

This paper gives a preliminary report on the factors affecting the distribution of wild ungulates on a ranch in Kenya. The study covers only one phase of an overall project on the compatability of wild and domestic ungulates. The major factors considered are vegetation, water, fire, cattle grazing, hunting and animal behaviour. These factors are related to five major wild ungulate species which occur on Akira – Coke's hartebeest (kongoni), Grant's gazelle, Thomson's gazelle, eland and giraffe.

The major influence on wild ungulate densities and distribution was vegetation. The condition of vegetation was determined by rainfall, fire and grazing intensities. Generally game populations increased with cattle populations which indicated that vegetation conditions were improving during the period of this study. Overgrazing was generally detrimental to all species except to the Thomson's gazelle which was attracted to short grass areas around water, bomas and overgrazed sites. Kongoni were found usually in tall grass areas while Grant's gazelle were not as selective as Thomson's gazelle or eland. Giraffe were confined mostly to *Acacia* communities and eland, though found in grassland, were most frequently in high bush country where the variety of shrubs was greater.

The effects of other factors on each of the ungulates are also presented. The interrelationships of all factors are being considered as the study continues.

In 1969 a project was initiated in Kenya by Texas A & M University to study the utilisation of wildlife in East Africa. We were contracted to study the compatibility of wild and domestic ungulates on livestock ranches. Our approach has been to investigate the nutrition and reproduction of ungulates on three ranches and then to relate these data to population dynamics, carrying capacities, stocking rates and interrelationships of wild and domestic ungulates.

This report describes those factors which affect the distribution of wild ungulates on one of the ranches. Because the study is still in progress this is a preliminary report and the data and conclusions presented now may be altered by the end of the project.

STUDY AREA AND PROCEDURE

Akira Ranch is owned and operated by Peter Gaymer and family. It is located about 50 km northwest of Nairobi in the Rift Valley between Longonot and Suswa mountains. The ranch consists of 31 566 ha and lies mostly between 1 500 and 2 200 m above sea level. Its south and west boundaries border on Masailand.

The vegetation consists of three main communities namely a grassland association and two bush-grassland associations. The grassland association occurs below 1 600 m elevation and includes about six main species dominated by *Themeda triandra*. Patches of *Acacia drepanolobium* may be found within the grassland. Between 1 600 m and 1 800 m and in some poorly drained areas the grassland is associated with *Acacia drepanolobium* which may be 6,5 m tall in the wetter areas but is usually not more than 2 m.

At elevations between 1 800 and 2 100 m this vegetation intergrades with medium height bush-grassland where the aromatic shrub *Tarchonanthus camphoratus* is dominant in many parts. *A. drepanolobium* remains scattered throughout the area, being dominant at some sites, while

Themeda is associated with *Cymbopogon afronardus* and *Setaria* spp. Patches of *Tarchonanthus* and associated smaller shrubs of the genera *Aspilia, Lippia, Ocimum* and *Solanum* occur occasionally at lower altitudes.

The grassland community falls within ecological zone IV of Pratt, Greenway and Gwynne (1966), the *Tarchonanthus* community in their zone III and the *Acacia-Themeda* community is intermediate. These zones correspond with annual indices of available water of 30–40 and 40–50, respectively (Woodhead 1970).

The annual rainfall varies between 500 and 635 mm with poor seasonal distribution, although the long and the short rains tend to fall in the periods of March–May and November–December respectively. The volcanic soils, although fertile, do not retain moisture long and hence the range is semi-arid. The availability of free water for animals is critical. The ranch gets some of its stock water from steamjets (condensation of steam), some from the Kedong River and some from the escarpment about 20 km distant.

Game Counts

We used both ground and aerial surveys. The portion of the ranch which could be driven over, generally that lower than 1 800 m, was divided into "blocks" which had distinguishable boundaries. A sample of 10 of these blocks was selected at random (Fig. 1). Each month, these were traversed in a systematic manner to obtain complete visual coverage. In addition, six observation points were selected in the high inaccessible country from which a defined area could be seen quite easily. Observations were made at these sites normally in early morning or late evening for at least one hour when animals were most active. The number and also the sex and age of all animals seen were recorded when possible.

Aerial counts were made quarterly. For this the ranch was divided into low and high country with 1 800 m being the general demarcation elevation. The low country corresponded generally to the grassland and *Acacia-Themeda* associations, whereas the high country was the *Acacia-Tarchonanthus* association. On our first count the lower country was sampled by using random transects, whereas an attempt was made to count all the game in the high country. Thereafter a system of random blocks was used. On the last count these random blocks were redefined being based upon smaller units and abundance of animals. A reconnaissance flight was made to determine general distribution and abundance of animals and then the area to be surveyed was stratified as low and high density units. Square kilometre (km^2) units were then selected at random for the counts. Game count data have been analysed by Method II of Jolly (1969).

Major species of wild ungulates

Akira Ranch harbours a large variety of wild ungulates including Coke's hartebeest (kongoni) *Alcelaphus buselaphus cokii*, Grant's gazelle *Gazella granti*, Thomson's gazelle *Gazella thomsoni*, Masai giraffe *Giraffa camelopardalis tippelskirchi*, eland *Taurotragus oryx pattersonianus*, African buffalo *Syncerus caffer*, bushbuck *Tragelaphus scriptus*, bush duiker *Sylvicapra grimmia*, Kirk's dik-dik *Rhynochotragus kirki*, impala *Aepyceros melampus rendilis*, Bohor reedbuck *Redunca redunca*, Chanler's mountain reedbuck *Redunca fulvorufula chanleri*, steenbok *Raphicerus campestris*, waterbuck *Kobus defassa* or *ellipsiprymnus*, warthog *Phacochoerus aethiopicus* and

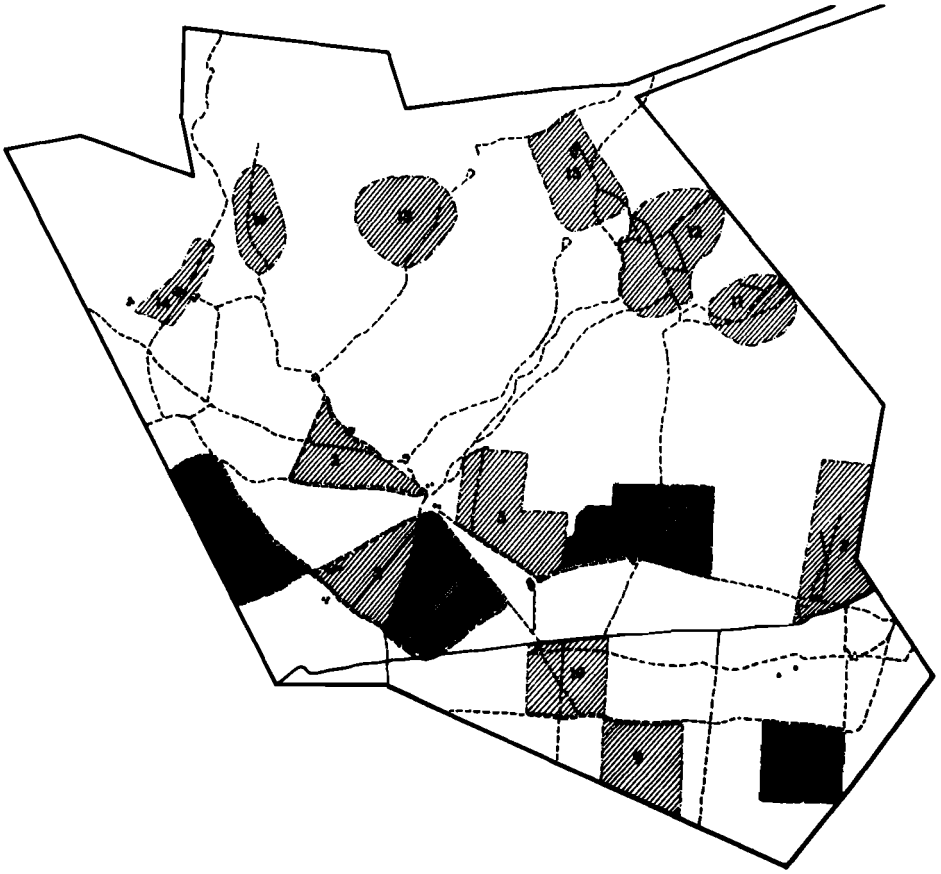

FIGURE 1
Map of Akira Ranch showing the boundaries, prominent roads, tracks and study blocks. The darker shaded blocks are the ones used for vegetation clippings.

Burchell's zebra *Equus burchelli granti*. Of these only the first five are considered in this paper. The first three are primarily plains game, occurring in grassland areas although some use the bush-grassland association up to 1970 m at certain times. Kongoni have been seen above 2 275 m. Giraffe and eland seem as much at home in the low country as in the high although giraffe were more frequently seen in the bush-grassland around 1 600 – 1 970 m.

During the past year, starting in March, 1970, the estimated populations for the five species are shown in Table 1. We have calculated confidence limits at the 95% level and at present these are quite large. With more counts and some revision in the technique we hope to reduce these limits to more acceptable levels.

Distribution of Ungulates

Maps were used to plot the general distribution of wild and domestic ungulates on the ranch and

TABLE 1

THE ESTIMATED NUMBERS OF WILD AND ACTUAL NUMBERS OF DOMESTIC UNGULATES ON AKIRA RANCH BY MONTHS

Month	Coke's Hartebeest	Grant's Gazelle	Thomson's Gazelle	Eland	Giraffe	Total No. of game	Number of cattle	Total No. of ungulates
March 1970 ..	1 074	393	473	158	171	2 269	—	—
April	725	453	349	991	283	2 801	3 492	6 293
May	889	592	424	196	525	2 626	2 742	5 368
June	1 106	551	739	883	271	3 550	2 934	6 484
July	739	730	621	212	217	2 519	3 110	5 629
August	759	540	791	1 083	387	3 560	5 080	8 640
September ..	1 267	1 097	742	137	229	3 442	5 789	9 241
October.. ..	1 870	1 071	684	383	221	4 229	5 054	9 283
November ..	1 518	736	1 247	425	275	4 201	4 532	8 733
December ..	751	655	1 137	237	154	2 934	4 593	7 527
January 1971 ..	2 959	652	1 966	171	204	5 952	4 661	10 613
February ..	5 819	817	1 807	441	366	9 250	5 497	14 747
April	1 412	753	1 899	924	346	5 334	4 615	9 949

also to plot specific distributions on the blocks where most of the studies occurred. These distributions were charted especially in reference to vegetation type, water, fire and livestock.

Vegetation

The ranch was divided into broad vegetation zones at the beginning of the study from information gathered by ground and aerial reconnaissance. Since then more detailed data have been gathered, especially from clippings of plants for chemical analyses. The clippings were done on a series of about twenty, 100 m square blocks which were located at random on maps of the area. Vegetation within six random quadrats was clipped 2,5 cm above ground level in five of the 100 m square blocks every three months for a year. Common grass species were separated and weighed. The distal 60 cm of the nearest plant of *Acacia* or *Tarchonanthus* was removed and the distance from the quadrat centre to the bush was measured and recorded.

Ranch Records

The ranch manager keeps a record of livestock numbers, distribution, number of days cattle are on an area, sales, etc. He also maintains records on wildlife utilisation. From this information we were able to compile a history of livestock use, carrying capacities and stocking rates.

FACTORS AFFECTING DISTRIBUTION OF UNGULATES

Vegetation

Since the majority of game animals occurred below 1 800 m we decided to investigate in detail the vegetation of four study blocks, Nos. 1, 4, 6 and 8, below this altitude. The distribution of four important species of plant has been plotted on base maps of the areas (Figs. 2–5). Frequency of

occurrence is indicated by shading (0–6) of the quadrats occupied. The weights of the main grass species have been calculated in Table 2 from clipping of thirty quadrats 45 x 30 cm in each block four times a year. The percentage composition of the species is shown in Table 3.

Block 1 lies adjacent to the western boundary of the ranch with Masailand and is bounded on the remaining three sides by tracks. It includes a rocky volcanic hill, part of a lava flow bearing *Tarchonanthus* bushed grassland and some poorly drained grassland with *Acacia drepanolobium*. From Fig. 2 the following differences in distribution of grasses are apparent. *Cynodon dactylon* occurred in all quadrats on the east side and most of those to the south. It was much less common in quadrats to the west and north. In contrast to this, *Themeda triandra* was most abundant in quadrats to the south and west. It was absent however, from quadrats to the east and north-east. *Digitaria* spp. were widespread through the area. The bush, *Tarchonanthus*, occurred to the north and west and appeared to be associated with *Themeda*. *Acacia* occurred throughout the area, but was most common on the east side.

Both *Cynodon* and *Digitaria* contributed between 26% and 47% of the total weight of the grass layer. *Themeda* showed large fluctuations, due to the distribution of the quadrats, but reached 31% on one occasion while the remaining plants were within the range 8% – 18%. There was a steady decline in total weight of herbage by 86% from more than 5 668 kg/ha in June, 1970 to 806 kg/ha in April, 1971.

Block 4 is defined by the Nairobi-Narok road to the south, the ranch access road to the north-east and the airstrip access road to the north-west. It consists of a medium height grassland with a little *Acacia* extending into the area from the north-east. The ranch headquarters lie to the north and the area between it and the airstrip is mostly shorter grass. From Fig. 3 it is apparent that *Cynodon* is most abundant to the north where the grass is short and well-grazed. As in Block 1 *Themeda triandra* has a complementary distribution, being more abundant to the south. *Digitaria* spp. do not show a well defined distribution. The tufted perennial *Harpachne schimperi* is also widespread. It is indicative of degenerate grasslands.

Themeda was the main constituent of the grass layer and contributed between 41% and 49% by weight. *Chloris*, *Cynodon* and *Digitaria* reached maxima around 18% but sometimes fluctuated considerably. *Harpachne* remained between 5% and 10%. The total weight of herbage fell by 71% from more than 6 051 kg/ha in June, 1970 to 1 742 kg/ha in April, 1971.

Block 6 is bounded by a ranch track running parallel with, but two km north of the Narok road. A cattle boma (Grid ref. BJ 127 880) is near the middle of this boundary. Drainage lines and tracks mark the eastern and western boundaries some 1 400 m and 2 000 m from the boma respectively. The northern boundary is an east-west bearing 2 400 m north of the boma.

This block lies in the transition zone between the *Themeda-Acacia* association and the *Themeda-Tarchonathus* region. The distribution of some important plants is shown in Fig. 4. *Themeda triandra* is common in most areas, but slightly less abundant to the south-west. In contrast, both *Digitaria* spp. and *Harpachne schimperi* are common in the south-west and less common to the north-east. *Acacia drepanolobium* occurs throughout the area, but is less abundant to the north where it is succeeded by *Tarchonanthus*. The latter occurs some 1 400 m north of the boma, its boundary being very distinct at about 1 850 m elevation.

Themeda is the dominant grass, contributing between 56% and 71% of the total weight. *Chloris*, *Digitaria* and *Harpachne* each form between 5% and 15% of the total. The standing crop biomass

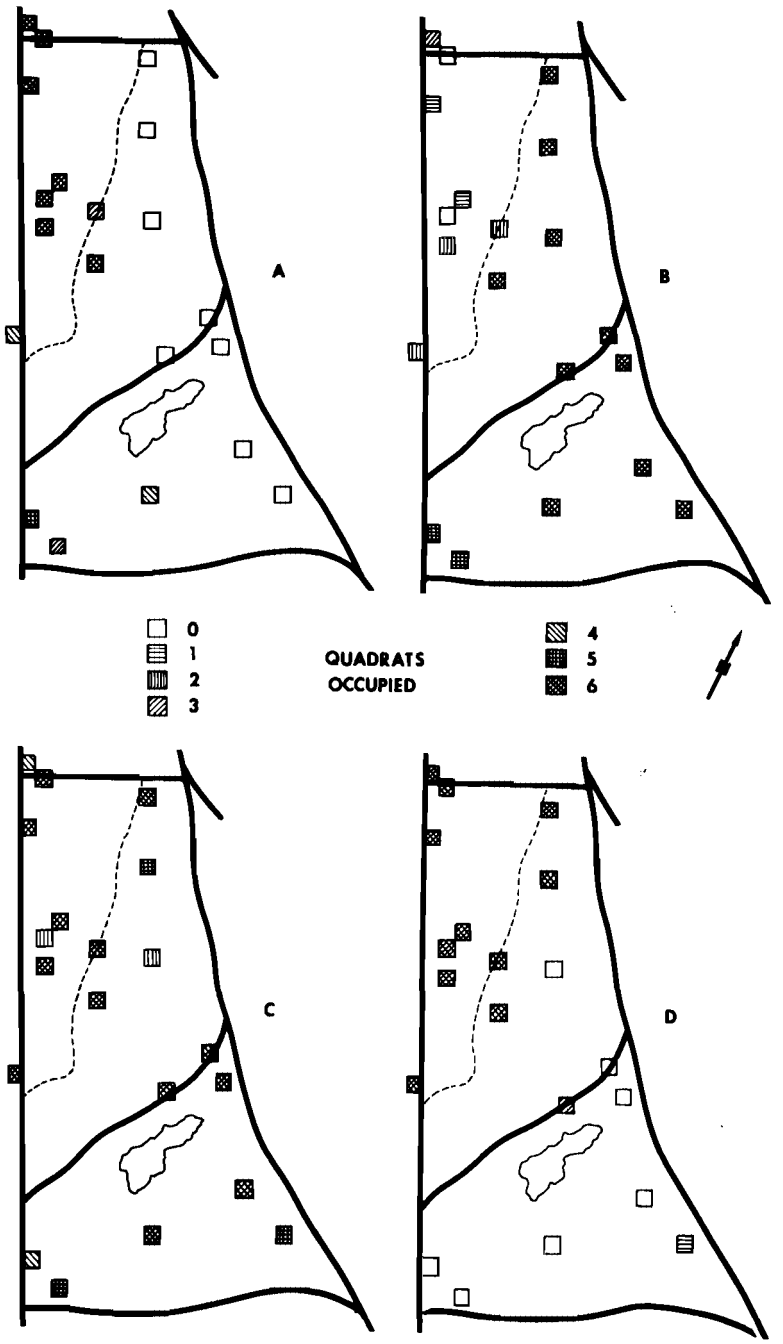

FIGURE 2
The distribution and relative density of some common plant species in block 1, Akira Ranch.
A – *Themeda triandra*
B – *Cynodon dactylon*
C – *Digitaria* spp.
D – *Tarchonanthus camphoratus*

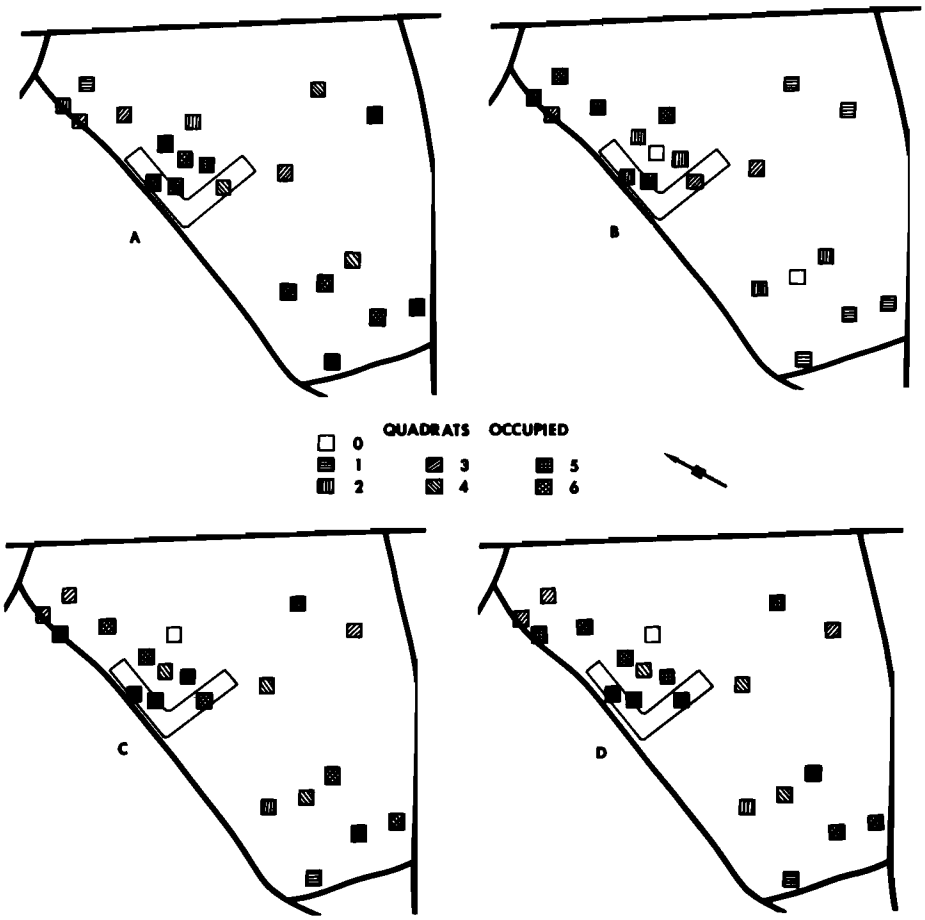

FIGURE 3

The distribution and relative density of some common plant species in block 4, Akira Ranch.
A – *Themeda triandra*
B – *Cynodon dactylon*
C – *Digitaria* spp.
D – *Harpachne schimperi*

of the grass layer fell by 72% from more than 6 695 kg/ha in June, 1970 to 1 869 kg/ha in April, 1971.

Block 8 lies to the south of the Narok road and is bounded by Kedong ranch to the south and ranch tracks to the east and north. It is approximately 2 km square and occurs in the transition zone between the *Themeda* grassland and the *Themeda-Acacia* association. A tongue of *Acacia* enters the area from the north (Fig. 5). *Themeda* is most abundant in the southern half of the area while *Harpachne* shows a tendency to increase towards the north. *Digitaria* spp. are irregularly scattered, possibly because the different species have varying habitat requirements.

Themeda formed between 38% and 54% of the total weight of the grass layer. *Digitaria* was also

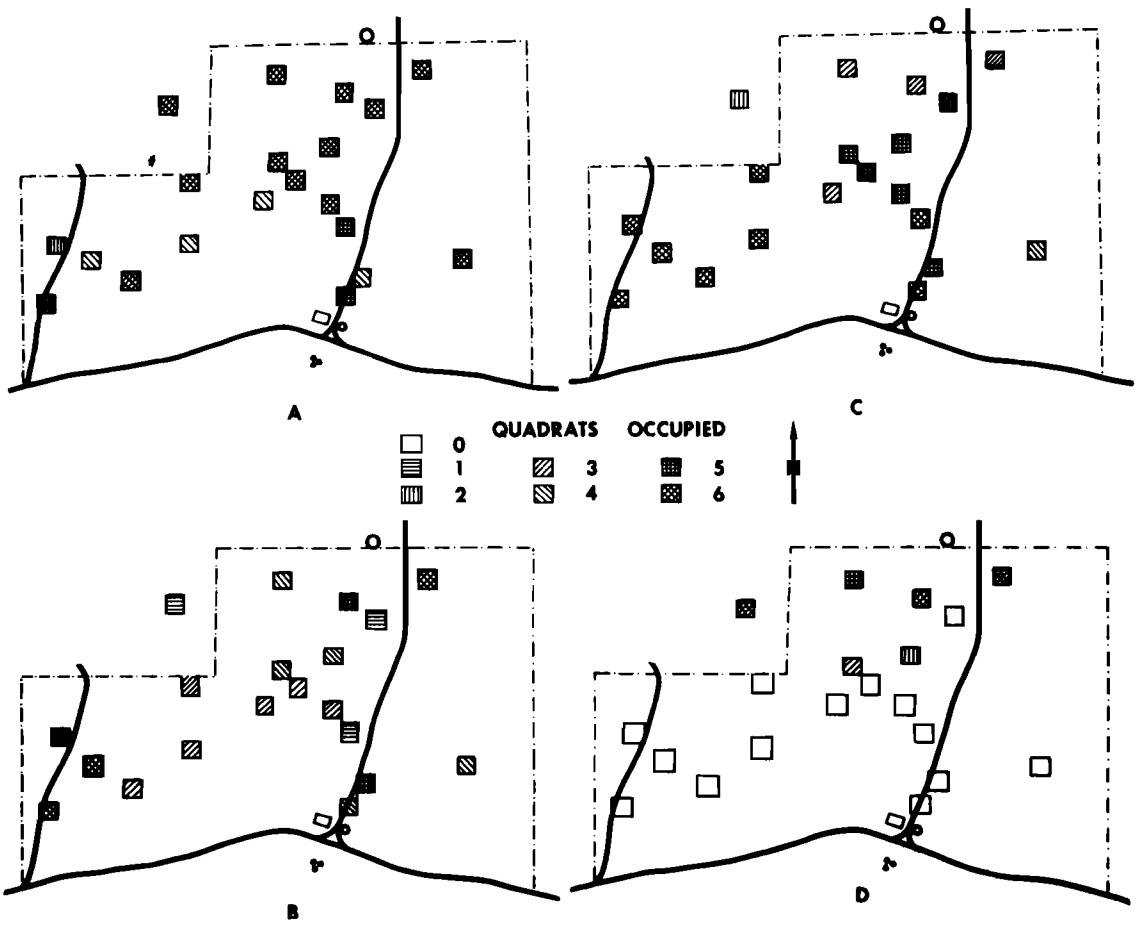

FIGURE 4
The distribution and relative density of some common plant species in block 6, Akira Ranch.
A – *Themeda triandra*
B – *Digitaria* spp.
C – *Harpachne schimperi*
D – *Tarchonanthus camphoratus*

important with between 17% and 29% of the weight. *Chloris, Harpachne, Hyparrhenia* spp. and *Sporobolus* occasionally reached significantly high proportions. The standing crop biomass of the grass layer fell by 89% from more than 5 148 kg/ha to 546 kg/ha. This is partly attributed to a fire in October 1970.

Water

Soils on the ranch are mostly composed of volcanic ash and are very porous. Hence standing water is uncommon. Water has been introduced for cattle however, troughs being placed just to the

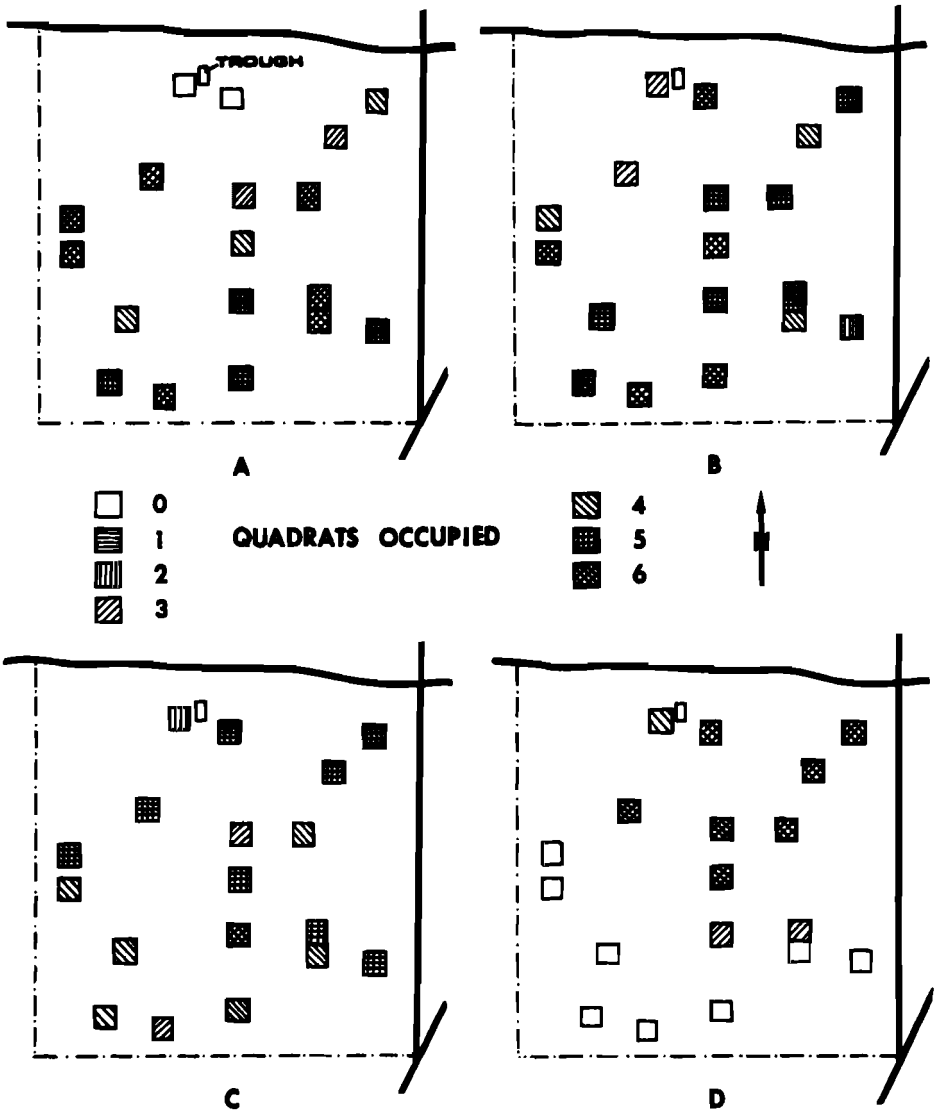

FIGURE 5

The distribution and relative density of some common plant species in Block 8, Akira Ranch.
A – *Themeda triandra*
B – *Digitaria* spp.
C – *Harpachne schimperi*
D – *Acacia drepanolobium*

TABLE 2

THE STANDING CROP BIOMASS OF THE GRASS LAYER OF FOUR STUDY BLOCKS ON AKIRA RANCH

In kg/ha 1970–1971

		BLOCK 1				BLOCK 4				BLOCK 6				BLOCK 8			
Species	Month:	6	9	1	4	6	9	1	4	6	9	1	4	6	9	1	4
Chloris gayana	..	—	—	—	—	805	1430	455	104	325	234	338	156	624	—	—	13
Cynodon dactylon	..	1716	1222	1145	208	1015	130	156	182	143	26	104	104	507	130	26	26
Digitaria spp.	..	2496	1183	820	234	727	1391	507	299	715	468	182	273		637	312	91
Harpachne schimperi	..	—	234	—	26	545	403	338	130	728	312	117	221	663	156	104	39
Hyparrhenia spp.	..	—	—	—	—	460	—	—	—	—	—	—	—	793	T	13	—
Sporobolus spp.	..	—	—	—	26	39	13	169	91	—	117	26	13	624	91	26	78
Themeda triandra	..	1456	273	13	247	2460	3731	1678	858	4784	2899	2040	1050	1937	1066	650	273
Rest	..	N.R.	507	442	65	N.R.	468	143	78	N.R.	260	91	52	N.R.	117	78	26
Total	..	(5668)	3419	2420	806	(6051)	7566	3446	1742	(6695)	4316	2898	1869	(5148)	2197	1209	546

N.R. = Not recorded T = Trace

TABLE 3

PERCENTAGE COMPOSITION OF THE GRASS LAYER

	BLOCK 1				*BLOCK 4*				*BLOCK 6*				*BLOCK 8*			
Species Month:	*6*	*9*	*1*	*4*	*6*	*9*	*1*	*4*	*6*	*9*	*1*	*4*	*6*	*9*	*1*	*4*
Chloris gayana ..	—	—	—	—	13,3	18,9	13,2	6,0	4,8	5,4	11,7	8,3	12,1	—	—	2,4
Cynodon dactylon ..	30,3	35,7	47,3	25,8	16,8	1,7	4,5	10,5	2,1	0,6	3,6	5,6	9,8	5,9	2,1	4,8
Digitaria spp.	44,0	34,6	33,9	29,0	12,0	18,4	14,7	17,2	10,7	10,8	6,3	14,6		29,0	25,8	16,7
Harpachne schimperi ..	—	6,8	—	3,2	9,0	5,3	9,8	7,5	10,9	7,2	4,0	11,8	12,9	7,1	8,6	7,1
Hyparrhenia spp. ..	—	—	—	—	7,6	—	—	—	—	—	—	—	15,4	T	1,1	—
Sporobolus spp. ..	—	—	—	3,2	0,6	0,2	4,9	5,2	—	2,7	0,9	0,7	12,1	4,1	2,1	14,3
Themeda triandra ..	25,7	8,0	0,5	30,6	40,6	49,3	48,6	49,3	71,5	67,2	70,4	56,2	37,6	48,5	53,8	50,0
Rest	N.R.	14,8	18,3	8,1	N.R.	6,2	4,2	4,4	N.R.	6,0	3,1	2,8	N.R.	5,3	6,4	4,8

N.R. = Not recorded T = Trace

south-east of Block 1 and to the north of Block 4. In Block 6 there is a drinking trough about 100 m north of the boma while in Block 8 there is a trough near the middle of the northern boundary (Figs. 4 & 5). All these troughs contained water throughout the study period.

Fire

Fire is common in the area. During the observations it affected Blocks 1 and 8 (Fig. 6). In the former the north-west corner was burnt on 21/11/70. More than half of Block 8 was burnt on 1/10/70. It is apparent that the area not burnt in Block 8 was coincident with the range of *Acacia*. Some 6 100 ha of grassland were burned by this fire. Other fires occurred, especially near Blocks 1; 4 and 8 which may have indirectly influenced animal activity on these blocks. These fires were all accidentally set.

Animal Behaviour

Social and feeding behaviour help determine the distribution of some species. Whereas certain species tend to run in small herds such as Grant's gazelle (2 to 38 in this study) others such as eland have been seen in herds up to 200 animals. Large herds of eland tend to occur farther apart and range over much larger areas than do the small herds of less gregarious species. The eland browse in dry conditions and graze during the rains which probably have much effect on this animal's distribution. Also, as noted in following discussions, breeding behaviour and/or reproductive condition frequently will influence an animal's distribution in relation to others of the same species. Reproduction and nutrition will form the subjects of later papers.

Land Management

The major land-use on Akira is cattle grazing. The cattle are mostly Boran and have varied in numbers from 2 900 in June, 1970 to 5 800 in September, 1970 to the current standing population of 3 900 (Table 1). The average stocking rate for this period varied from 1,8 ha to 4,7 ha per head. It was possible to increase the stocking rate because of the lush growth of grass due to above average rainfall in early 1970. With better distribution of water more of the land may have been utilized, but as it was, only 13 820 ha were grazed before the 1 October fire and 10 100 ha since then.

Cattle are handled as in Masailand and on many ranches in Kenya, that is, they are allowed to graze between 0700 to 1800 h and then put in a boma at night. Normally the cattle are herded in a rather compact group as they graze, spending a proportionately larger amount of time in the vicinity of bomas and water than elsewhere.

Other activities on the ranch which may have affected game distribution included hunting. Part of this was done by a professional hunting organisation, during October, 1970 through March, 1971. However, the ranch manager also collects game animals regularly under a quota system for consumption by the labour force. In addition we have collected about 40 animals of six species quarterly for information on meat production, nutrition, pathology and reproduction.

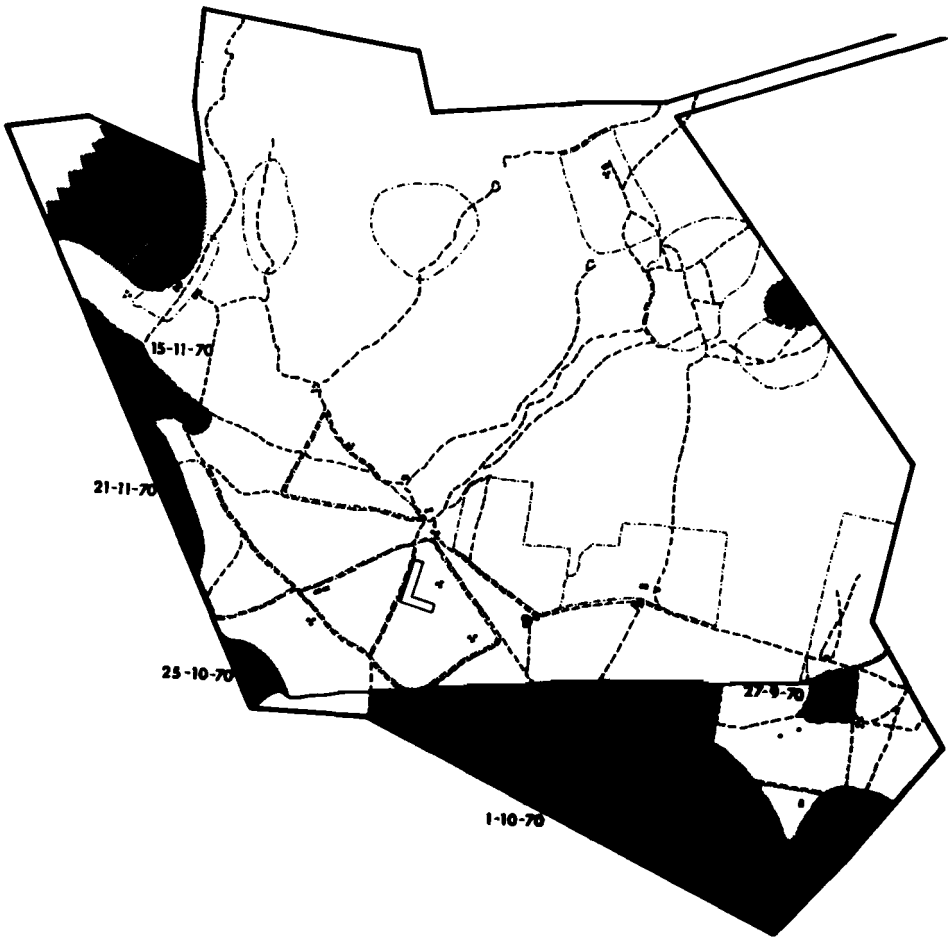

FIGURE 6
Map of Akira Ranch showing the location and approximate extent of wildfires during 1970.

RESULTS AND DISCUSSION

In order to relate various factors to the distribution of wild ungulates each species will be considered separately.

Coke's Hartebeest

This species is one of the most abundant and its numbers vary more than the others (Table 1). It is highly mobile being greatly affected by vegetative conditions although more widespread in all habitat types on Akira than the other species (Figs. 7-10). The population fluctuations on Akira are also influenced greatly by habitat conditions in adjacent Masailand with animals moving on and off the ranch as conditions degenerate or improve.

Kongoni tend to be more in the tall grass areas like mature *Themeda* whether in bush or open grassland (Table 4 and Figs. 7-10). In early 1970 more kongoni were in bush because of better grass at elevations above 1 600 m. With the rains the open grassland improved and more kongoni were observed there. The 1 October fire forced many of these animals into the unburned areas, mainly the bush. November showers caused some new growth especially on the burned area so the kongoni population moved back into more open grassland. The lack of December rains again forced most of the animals into the bush. Showers in January not only encouraged more use of

TABLE 4

THE NUMBER OF ANIMALS* OCCURRING IN GRASSLAND AND BUSH-GRASSLAND BLOCKS† ON AKIRA RANCH, KENYA

	Coke's Hartebeest		*Grant's Gazelle*		*Thomson's Gazelle*	
	Grass	*Bush*	*Grass*	*Bush*	*Grass*	*Bush*
1970:						
March	77	326	112	24	131	33
April	68	183	129	28	66	55
May	122	186	156	55	89	58
June	144	239	111	80	250	6
July	136	120	197	56	189	26
August	140	123	131	56	183	91
September	155	284	162	208	117	140
October..	195	453	190	181	222	15
November	270	256	98	157	381	51
December	35	225	109	118	378	16
1971:						
January	869	156	188	38	671	10
February	1474	542	158	125	548	78
April	366	123	256	5	656	2

* Actual counts.

† Grassland blocks – 3; 4; 8; 9 and 10.
Bush-grassland blocks – 1; 2; 5; 6 and 7.

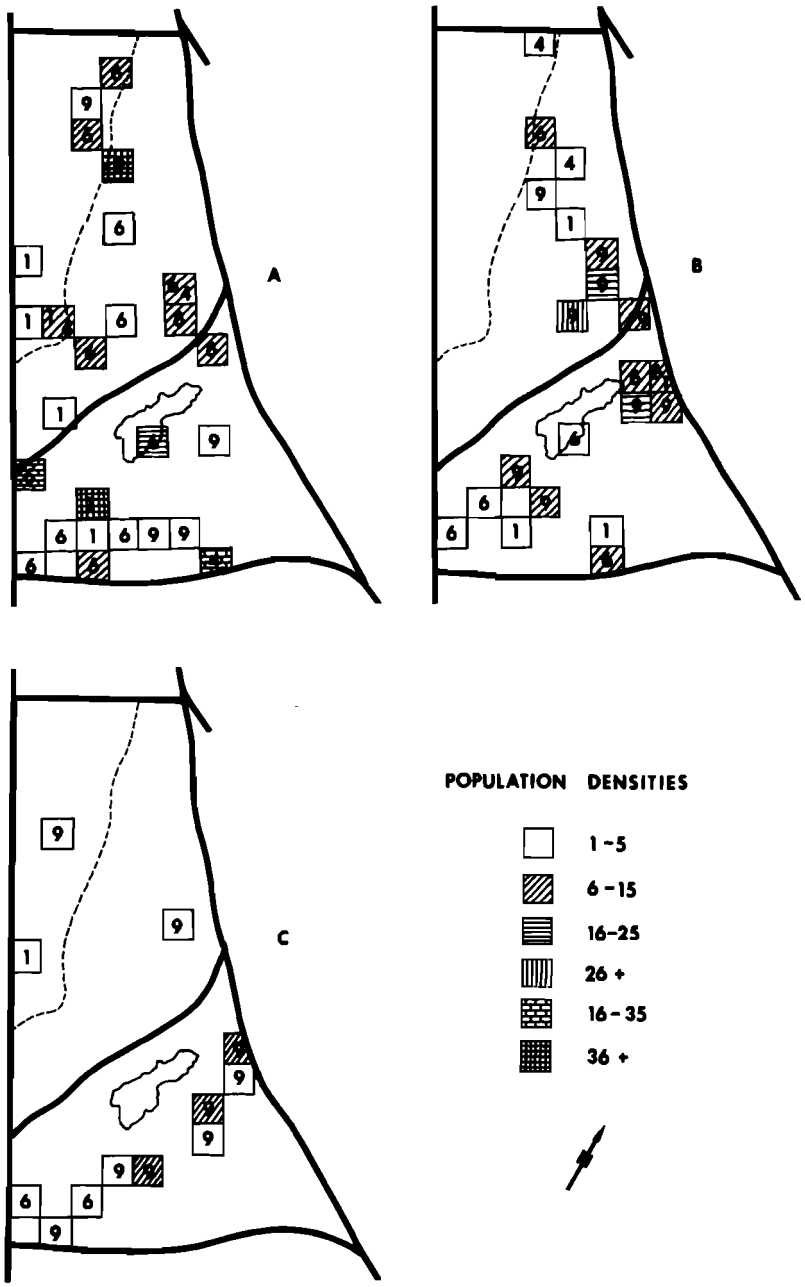

FIGURE 7
Distribution and relative density of ungulates during four months of special vegetation analysis on Block 1 (6 – June, 1970; 9 – September, 1970; 1 – January, 1971; 4 – April, 1971).
A – *Coke's Hartebeest;* B – *Grant's Gazelle;* C – *Thomson's Gazelle.*

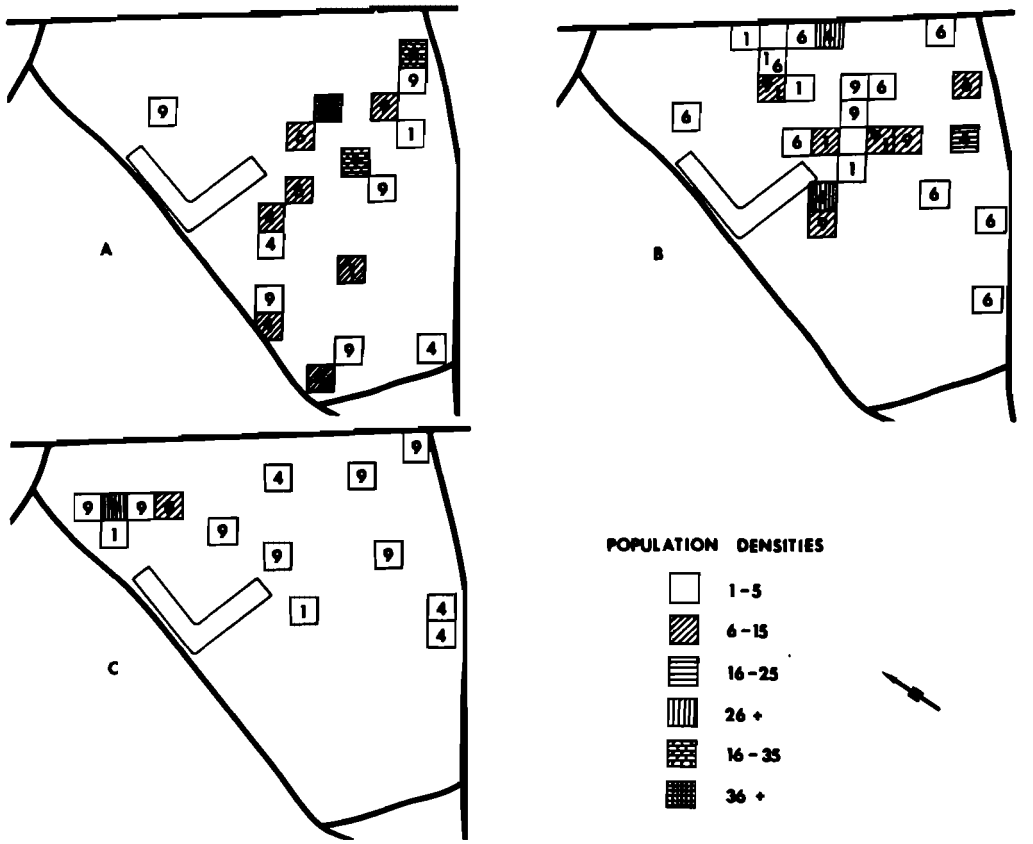

FIGURE 8
Distribution and relative density of ungulates during four months of special vegetation analysis on Block 4 (6 – June, 1970; 9 – September, 1970; 1 – January, 1971; 4 – April, 1971).
A – *Coke's Hartebeest;* B – *Grant's Gazelle;* C – *Thomson's Gazelle.*

new grass in the open grassland but also attracted more kongoni from Masailand where rain had not fallen. As the rains increased and began to cover Masailand the kongoni drifted back off the ranch again.

Standing water did not seem to influence the distribution of kongoni. Although they were seen in the vicinity of water troughs it was an infrequent occurrence.

There seemed to be little relation between cattle numbers and kongoni distribution, other than that the highest populations of kongoni occurred generally when the highest stocking rates of cattle existed. This is probably an indication of vegetation conditions beneficial to both species. Although kongoni did not seem to be wary of cattle herds neither did they remain too close to cattle very long.

The average size of over 80 kongoni herds was 32 with a range from two to 589. Individual animals were frequently seen and these were usually lone territorial males or pregnant females

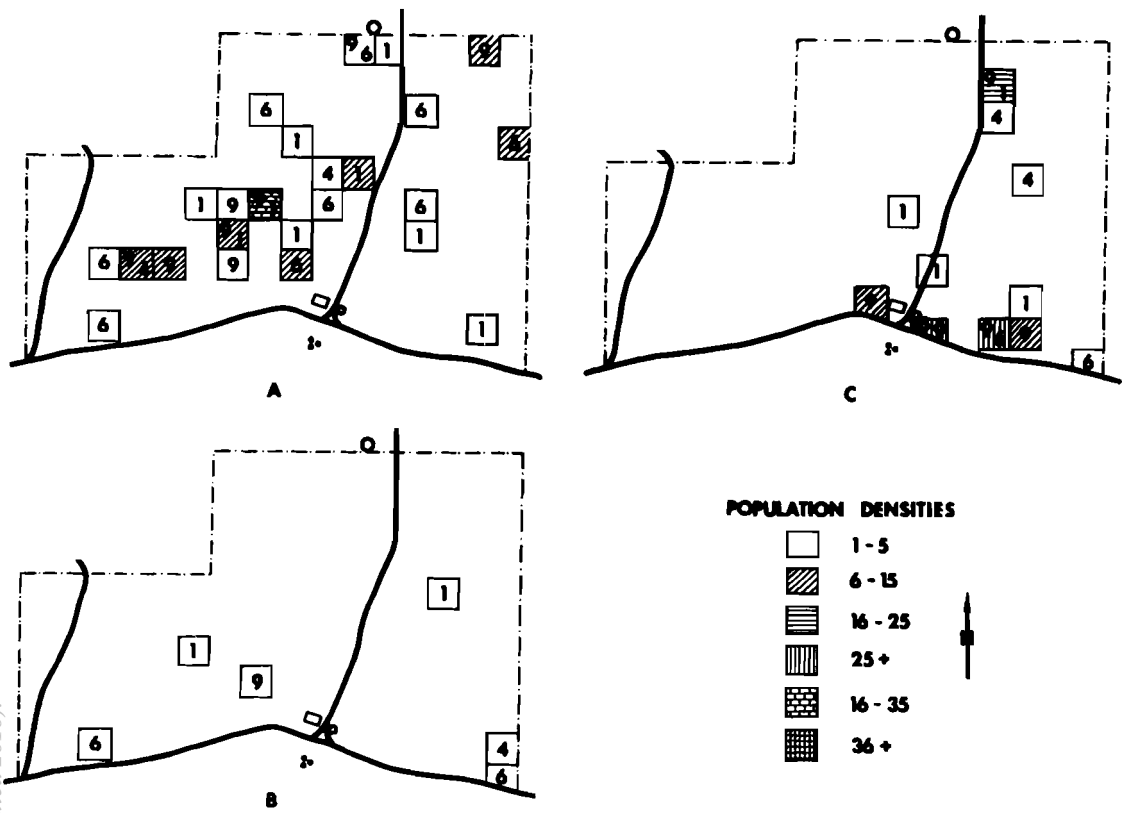

FIGURE 9
Distribution and relative density of ungulates during four months of special vegetation analysis on Block 6 (6 – June, 1970; 9 – September, 1970; 1 – January, 1971; 4 – April, 1971).
A – *Coke's Hartebeest;* B – *Grant's Gazelle;* C – *Thomson's Gazelle.*

nearing parturition. Although some herds tend to be separate units, especially in the less densely populated areas, there is a considerable amount of intermingling where larger numbers occur. Hunting has a tendency to make this species quite wary. After a group has been fired upon it will flush quite rapidly when approached again whether or not for shooting. Normally, these animals will run at distances over 1 000 m. One animal or herd will then cause other animals in the vicinity to run also. Consistent harassment will cause some animals to leave the general area in which they would normally be found.

Grant's Gazelle

This species probably shows a greater affinity for grassland than Coke's hartebeest and although it will use short grass and open grassland as much as Thomson's gazelle it seems to prefer taller grass, edges of bush and grass and disturbed areas such as roadsides. These relations can be seen by comparing the vegetation and Grant's gazelle distribution maps for four blocks (Figs. 2-5 & 7-10).

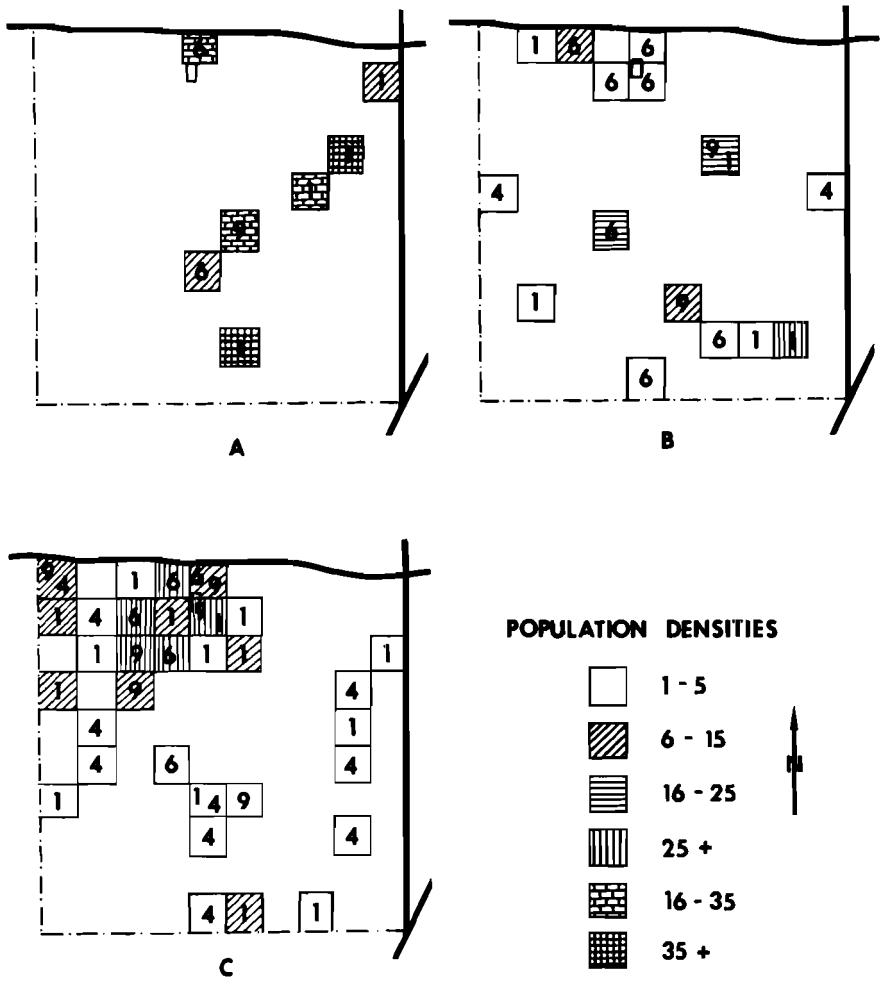

FIGURE 10
Distribution and relative density of ungulates during four months of special vegetation analysis on Block 8 (6 – June, 1970; 9 – September, 1970; 1 – January, 1971; 4 – April, 1971).
A – *Coke's Hartebeest;* B – *Grant's Gazelle;* C – *Thomson's Gazelle.*

In Block 1, the distribution of gazelle seems to follow the distribution of *Cynodon* and the edge of bush. In Block 4, gazelle again were seen adjacent to bush and in the more heavily grazed tall grass part. Very few animals occurred in Block 6. In Block 8, gazelle were rather generally distributed but the greatest concentrations were adjacent to bush, in *Cynodon* areas or adjacent to tracks.

Although this species is more sedentary than kongoni the population on Akira increased in 1970 as the grass conditions improved. The largest numbers occurred at the height of the dry season and just before the big fire; this indicates a considerable influx from the drier and shorter

grass areas of Masailand. Afterwards the population stabilised as conditions again improved outside the ranch. Although the animals were generally more numerous in the grassland than in the bush (Table 4), at the peak of the dry season when most of the grass was mature many of the gazelle had moved into the bush country where grass was greener. Following the fire and subsequent showers the grassland again became the most heavily used by this species.

Grant's gazelle herds were smaller in size than kongoni herds, averaging around 11 animals thus far. The largest herd seen had 38; this may have been a combined herd since there seems to be frequent intermingling between herds. One herd may move over as much as 10-12 km² in a 24-hour period. Single animals were often territorial males. These males were frequently separated from their harem and would return only if some disturbance occurred near or within the harem. Pregnant females were occasionally seen alone also. Quite often these females were found in bush areas. After parturition the female with her calf returns to the herd.

Like kongoni, this species was seen near water but the presence of water was primarily an indirect influence. Probably the major attraction of water sites was the disturbed condition of the soil which encouraged dicotyledons and grasses such as *Cynodon* used by the animal. Disturbances created by cattle around bomas usually improved the situation for Grant's gazelle. Otherwise their association with cattle was again similar to that of kongoni in that as grasslands improved the numbers of gazelle increased.

Hunting created a rapid wariness in gazelle and they were as prone to flight as kongoni. Normally with mild harassment these animals eventually circled back to their usual feeding ground but if pursued they left an area completely although all other conditions were suitable.

Thomson's Gazelle

This species prefers short grassland such as *Cynodon* (Figs. 2-4 & Table 4). During the peak of the driest season, it occurred in bush-grassland but only where short grass was dominant. For example, in September, 1970, of the 140 animals in bush-grassland, 73 were in the disturbed and short grass area of a water trough in Block 6 and 46 were adjacent to an air-strip which was regularly mowed in Block 4. The animal most likely to be found in tall grass or bush was the lone territorial male or an old male no longer involved in breeding.

After the fire, which covered the major Thomson's gazelle range on the ranch, the animals moved back onto the area as soon as new short grass appeared. Henceforth, numbers continued to increase on the burned area reaching a peak in January, 1971 (Table 1). Within the burned area the animals responded quite rapidly to local showers which fell sporadically from one part to another.

Disturbances by cattle, such as trampling and overgrazing, old boma sites heavily fertilized by their dung and water, influenced the distribution of Thomson's gazelle. The short grass and especially *Cynodon* resulting from these factors, was the main attraction. The vegetation maps for Blocks 1, 6, and 8 show this clearly when compared with the distribution maps (Figs. 2, 4, 5, & 7–10). Thus a closer association can be shown between cattle and Thomson's gazelle on Akira, than with the previous two species.

This gazelle was also affected by hunting, but its reaction was probably more unpredictable than with the other two species. Sometimes Thomson's gazelle would flush at a distance and at other times would not move away even at 100 m. Larger herds were more wary than smaller groups. The average herd size was 19 although herds of up to 181 animals were recorded.

Eland

Less information was gathered on eland than the other species primarily because of its behaviour. Normally animals occurred in herds of forty or more, were quite mobile and were generally in higher bush country. Food and water were probably major controlling factors to the distribution of eland but since they are more mobile than the other species they manage quite well under extreme conditions.

During the drier seasons more eland are found at altitudes above 1 800 m than at lower ones. Also, as Masailand becomes drier, large eland herds tend to move onto Akira. In the wet seasons herds of 100–200 may be found in the open grassland for several days at a time. However, little use was made of the burned areas until the rains of April and May, 1971 had caused new grass to reach 30 cm or more. Then a herd of 130 eland was found consistently around Blocks 8 and 9 for over a week.

Herds of eland and cattle often occurred in the same block at the same time but this seemed to be the only association. It would appear that, although eland are primarily browsers, intensive use by cattle would drive them from an area. Generally as a range deteriorates either from over-grazing or drought eland tend to move out.

Giraffe

The distribution of this species was affected much less by the various factors under consideration than were the antelope. Cattle grazing and water availability have no apparent effect. The only hunting was our collecting and under these conditions when one animal was shot from a herd the others usually stood and watched. When the herd did move on, it was at a normal pace including time to browse.

Giraffe were associated primarily with *Acacia drepanolobium*, either in continuous stands or arms which extended into the grasslands. Animals were often seen walking across open grassland but only to reach another stand of *Acacia*.

Although quite mobile, a herd might stay in one area for several days. Movement which occurred was probably due to some social behaviour or survival pattern rather than to a shortage of food. At times there were more giraffe in the high country than in that below 1 800 m. This seemed to be mostly during the dry season when browse as well as grass was greener at the higher altitudes. The highest counts for the low bush country occurred during the wet season.

Herds numbered up to 26 but the average size was seven. The size of an individual herd seemed fairly consistent but it would often be scattered over a large area. Sometimes part of the herd would be straggling behind as much as 1 600 m. Males joined or left a herd, probably according to the breeding condition of the females. Thus, males were frequently seen browsing alone. Usually single animals in the high country were males although some pregnant females seemed to seek out high secluded canyons in which to give birth to young.

CONCLUSIONS

The number and distributions of both wild and domestic ungulates have varied greatly on Akira. Most of the variation has been due to changes in vegetation condition or factors which act to alter vegetation such as cattle activity, water and fire.

It is clear that the vegetation is heterogeneous over quite small areas. Indeed McKay (1971) found on the adjacent Kedong ranch, that *Themeda* was not always the most abundant grass there and that *Digitaria setivalva* appeared to be favoured by bush clearance and grazing. Communities are created by variation in soils and their drainage, rainfall, grazing, trampling and fire. Impeded drainage in black cotton soils appears to favour *Acacia*, while improved drainage, but a higher rainfall, is more suited to *Tarchonanthus*. Grazing and trampling particularly near bomas and water troughs, favours short stoloniferous grasses such as *Cynodon* and *Digitaria macroblephara* and less palatable species of disturbed soils such as *Harpachne* and *Eragrostis tenuifolia*. These conditions are unsuitable for *Themeda triandra* which thrives in lightly grazed areas. Fire is able to penetrate these areas through the abundance of fuel and this favours the germination of *Themeda*.

It is unfortunate that in many cases the water troughs were situated near night bomas since cattle, which are most dependent on drinking water, spent much of their time in the morning, mid-day and evening trampling and feeding within a relatively small area. This effect and their high stocking rate were the prime factors in the creation of the heterogeneous mosaic of vegetation and thus the distribution of other ungulates on the ranch.

Since kongoni occurred mainly in the longer *Themeda* grassland including that in the bush-grassland the major influence of cattle on this species would be caused by overgrazing. Actually any activity or climatic condition altering the vegetation such as overstocking of cattle, drought or fire would affect the numbers and distribution of this species. At the other extreme is the Thomson's gazelle which was closely associated with the short grass around water, bomas and on burned areas. This gazelle reacted quite rapidly to any new growth on burned areas, whereas, kongoni would not move onto such areas for some while after the Thomson's gazelle. Grant's gazelle seemed to be somewhat intermediate between the previous two species in its reaction to vegetation changes due to cattle activity and fire. It was more widely scattered but seemed to stay mostly in the open grassland except in extreme dry seasons when it moved more into bush-grassland. Even in these latter areas the species confined most of its activity to the open spots and edges. Disturbed sites such as roadsides and tracks where herbs could be found seemed to be attractive to Grant's gazelle.

Giraffe are more frequently associated with the *Acacia-Themeda* community since their diet is composed chiefly of the former. Eland remain, with a few exceptions noted earlier, on the high ground where they utilise the larger variety of shrubs already named. *Tarchonanthus*, however, does not appear to be very attractive to either species. Cattle probably would not affect either species except in extreme situations where overgrazing occurred or numbers caused spatial competition.

Akira Ranch has not seemed to reach its potential carrying capacity of ungulates. According to the data in Table 1 at one time there were nearly 15 000 head of domestic and the wild ungulates studied, using the ranch. Many other wild ungulates were not included in the compilation. Still the ranch was not over-crowded, especially since less than half of the ranch was being grazed due to limitations set by water distribution and fire. If water becomes more evenly distributed over the ranch and allows a greater utilisation by cattle we may see a greater influence of cattle on wildlife.

We intend to continue the documentation of animal numbers and distribution plus the various factors which affect these. For more detailed information on vegetation, 20 weld mesh cages, 1,2 x 1,2 x 1,1 m have been established within the four study blocks in an attempt to eliminate the effects of herbivores. The offtake during four periods of the year will be calculated by comparing

vegetative growth inside and outside the cages. This should provide an indication of the relative effect of grazing and drought on plant growth. With these data we plan to make a further statistical analysis on the associations and interactions of animals and their environment.

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