

INTERNATIONAL LIVESTOCK CENTRE FOR AFRICA

AERIAL SURVEY UNIT

**WET SEASON AERIAL SURVEY OF THE HUMAN AND LIVESTOCK
POPULATIONS AND ENVIRONMENTAL CONDITION
IN A CENTRAL REGION OF THE PASTORAL ZONE OF NIGER**

**FINAL REPORT
DECEMBER 1982**

Prepared for:
USAID
BP 11201, Niamey, Niger

WET SEASON AERIAL SURVEY OF THE HUMAN AND LIVESTOCK
POPULATIONS AND ENVIRONMENTAL CONDITIONS
IN A CENTRAL REGION OF THE PASTORAL ZONE OF NIGER

FINAL REPORT
DECEMBER 1982

Prepared by:
Dr Kevin Milligan
Aerial Survey Co-ordinator
ILCA, PMB 2248, Kaduna
NIGERIA

being
One of Four Final Reports
under USAID Contract
683-0202-C-00-2034-00
of US\$ 88,930

TABLE OF CONTENTS

	Page
1. SUMMARY	1-2
2. INTRODUCTION	3
3. METHODS	4-5
A) Flight and Sample Procedures	4
B) Survey Team	4
C) Analysis and Presentation of Results	4-5
4. RESULTS	8-15
A) Livestock Populations - Numbers and Distribution	8-13
i) The NRL Project Area	8-9
ii) The Land Management Strata	9-11
iii) The Land Management Units	11-12
iv) The Maliki Strata	12-13
B) Pastoral Populations - Numbers and Distribution	13-14
C) Environmental Conditions	14-15
5. REFERENCES	16

LIST OF TABLES

	Page
1. Wet season livestock population in the NRL Study Area, Niger	17
2. Land Management Strata and Units in NRL Study Area	18
3. Herders' Association regions proposed by Maliki	19
4. Wet Season livestock population in Land Management Strata 1	20
5. Wet Season livestock population in Land Management Strata 2	21
6. Wet Season livestock population in Land Management Strata 3	22
7. Wet Season livestock population in Land Management Strata 4	23
8. Wet Season livestock population in Land Management Unit 1.1	24
9. Wet Season livestock population in Land Management Unit 1.2	25
10. Wet Season livestock population in Land Management Unit 1.3	26
11. Wet Season livestock population in Land Management Unit 2.1	27
12. Wet Season livestock population in Land Management Unit 2.2	28
13. Wet Season livestock population in Land Management Unit 2.3	29
14. Wet Season livestock population in Land Management Unit 3.1	30
15. Wet Season livestock population in Land Management Unit 3.2	31
16. Wet Season livestock population in Land Management Unit 4.1	32
17. Wet Season livestock population in Land Management Unit 4.2	33
18. Seasonal Livestock population in the Maliki Herders Association at Abalak	34
19. Seasonal Livestock population in the Maliki Herders Association at Bermon	35
20. Seasonal Livestock population in the Maliki Herders Association at Tofamanir	36
21. Seasonal Livestock population in the Maliki Herders Association at Tchín Tabaradene	37
22. Seasonal Livestock population in the Maliki Herders Association at Tassara	38
23. Seasonal Livestock population in the Maliki Herders Association at Ingal	39
24. Seasonal Livestock population in the Maliki Herders Association at Amataltal	40
25. Seasonal Livestock population in the Maliki Herders Association at Tchín Taborak	41
26. Wet Seasons pastoral populations in the NRL Study Area, Niger	42

LIST OF FIGURES

	Page
1. Location of Study Area in Niger	6
2. Aerial Survey grid pattern	7
3. Wet season distribution of Bororo cattle	43
4. Wet season distribution of Azawak cattle	44
5. Wet season distribution of sheep and goats	45
6. Wet season distribution of camels	46
7. Wet season distribution of donkeys	47
8. The Land Management Strata and Units	48
9. The Herders Association regions proposed by Maliki	49
10. Wet Season distribution of Wodaabe/Peuhl camps	50
11. Wet Season distribution of tented Twareg camps	51
12. Wet Season distribution of matted Twareg camps	52
13. Wet Season distribution of grass cover	53
14. Wet season distribution of Mares	54
15. Distribution of total well sites	55

1. SUMMARY

(1) This Final Report describes the September 1982 wet season distribution of people, livestock and environmental conditions in the 81,555 km² Niger Range and Livestock Project Area situated in a central region of the Pastoral Zone of Niger. The information was collected by systematic low altitude aerial survey, carried out by the Aerial Survey Unit of the International Livestock Centre for Africa (ILCA) at the request of the United States Agency for International Development (USAID) and the Government of Niger.

(2) This survey was a direct follow on from two surveys carried out by the same team over the same area during May and October 1981.

(3) The total cattle population was estimated at about 331,000, or 25 hectares per head. This total is not significantly different to that estimated for October 1981. Although estimates for the Azawak cattle breed were similar during the three survey periods, the Bororo breed increased from 13% more abundant than Azawak during May, to 38% during September to 90% during October. The total sheep and goat population, of about 800,000, was between that estimated for May and October.

(4) The most marked difference detected during September was a camel immigration into the northern areas, particularly the Ighazer Flood Plains between Ingal and Agadez. The estimated camel population, of about 156,000 head, was almost 100% greater than the May and October estimates.

(5) These overall livestock populations are described as separate estimates for the four Land Management Strata and ten Land Management Units proposed by the 1981 flights. In addition, the livestock populations recorded during the total three flight periods have been re-analysed to fit into a new initial stratification of the Project Area into eight Herders Association regions.

(6) The total Twareg and Wodaabe/Peuhl populations during September were similar to May and October, though a reduction in tented Twareg camps appears to be compensated by an increase in sedentary Twareg camps. The distribution of the two main ethnic groups was distinct, reflected that of May and October, and corresponded to the distribution of the two cattle breeds.

(7) The distribution of grass cover and surface water showed a general western concentration. However, despite seasonal environmental differences, the overall human and livestock numbers and distribution (with the exception of camels) suggested a situation similar to May and October and thus the hypothesis that general wet season conditions could prevail for a longer period than had previously been assumed. An additional flight, during the mid-dry season period of February/March would be useful.

2. INTRODUCTION

During May and October 1981, low altitude aerial surveys were carried out over the 81, 555 km² Niger Range and Livestock Project Area (NRL) of central Niger. These surveys were carried out by the Aerial Survey Unit of the International Livestock Centre for Africa (ILCA) at the request of the United States Agency for International Development (USAID) and the Government of Niger.

The surveys provided about a 9% count of the livestock and human populations of the area and related their distribution patterns to seasonal range and water conditions. The entire area was divided into ten principal Land Management Units, based upon recorded variations in Landscape and Geomorphology, and populations were described within each of these Units. The results of these two surveys (Milligan, 1982) were presented to USAID, Niger in March 1982.

The initial concept of these 1981 surveys was to study conditions during the end of the dry season and during the wet season. However, the 1981 rains stopped during August in Agadez and September in Tahoua and thus the two survey periods were thought to more accurately represent late dry and early dry conditions respectively.

USAID thus requested the services of ILCA's Aerial Survey Unit to repeat their successful 1981 survey design, with data collection during the wet season of 1982.

This report is therefore a direct follow on from the report of the 1981 surveys, with the entire NRL project area (figure 1) flown during a two week period of mid-September 1982.

3. METHODS

A) Flight and Sample Procedures

The spacing of adjacent flight lines and grid intervals were identical to that used for the two 1981 surveys. A total of 990 grids (figure 2) were covered at an average flying altitude of 810 feet above ground level which resulted in an overall sample of about 8.8%.

B) Survey Team

The survey team was:

- | | |
|--|--|
| - Captain Jacques Meunier (ILCA)
B P 60, Bamako, Mali | - pilot |
| - Dr Kevin Milligan (ILCA)
P M B 2248, Kaduna, Nigeria | - Survey co-ordinator
recording land conditions |
| - Mr Ibrahim Touraoua (NRL)
Assistant d'elevage
Projet Gestion des Paturages et
Elevages
B P 85, Tahoua, Niger | - recording livestock |
| - Mr Omar Alpha (NRL)
Assistant d'elevage
Projet Gestion des Paturages et
Elevages
B P 85, Tahoua, Niger | - recording livestock |

Analysis of data was carried out by Dr Milligan, with assistance from:

- | | |
|--|------------------------------------|
| - Mr Jeff Durkin (ILCA)
P O Box 5689,
Addis Ababa, Ethiopia | - programming, computer operations |
| - Ms Eta Kontrohr (ILCA)
P O Box 5689,
Addis Ababa, Ethiopia | - programming, computer operations |

C) Analysis and Presentation of Results

The methods used to analyse the results of the September 1982 survey were the same as those used for the 1981 flight data. To retain an ecological

basis for comparing results, full analysis of the livestock populations within each of the Land Management Units have been calculated.

As part of the research and development activities of the NRL project, pilot herders' association regions are being organised around traditional mutual aid structures composed of small groups of herders that share natural resources in the same area. Conceptually, these herders associations would provide institutional mechanisms to facilitate Nigerien herders active participation in their own development (White and Maliki, pers. comm.). A preliminary and tentative division of the NRL project area into 8 principal herders association areas has been proposed by Maliki (pers. comm.) and this report provides an analysis of the livestock populations within each of these regions for the total three flights of 1981 and 1982. The implication of these seasonal population totals within each region are not discussed in detail in this report, as it is felt that such information can be best interpreted by complementary data presently being compiled by the active ground work of the socio-economic unit of the NRL project team.

Although a certain amount of cross-referencing to the report of the 1981 flights was inevitable to highlight the implications of differences detected during September, this has been kept to a minimum to reduce wasteful replication. This report should thus not be viewed in isolation, but as a natural progression, composed simply of an additional flight, to the 1981 results.

Figure 1. Location of Study Area in Niger.

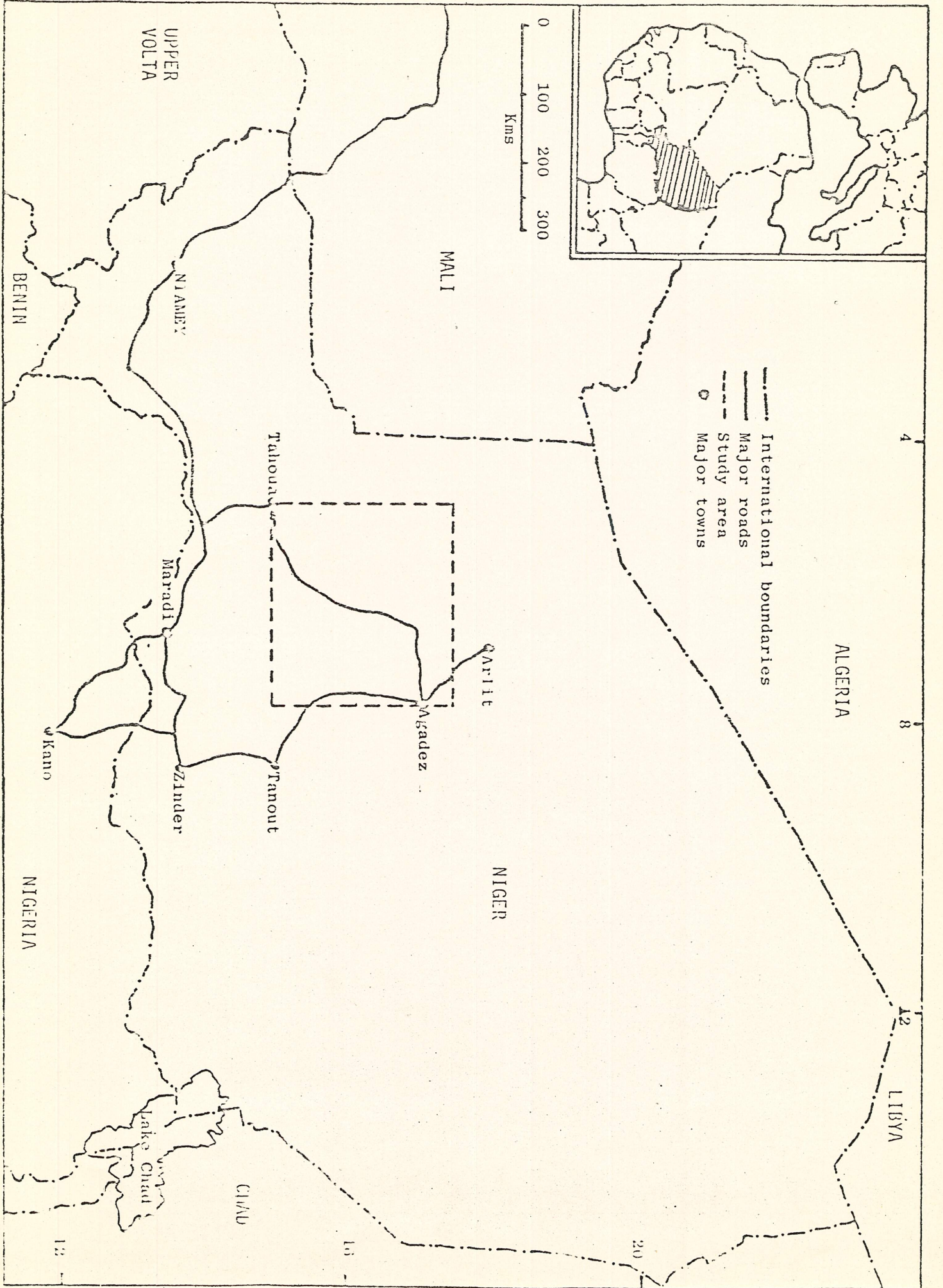
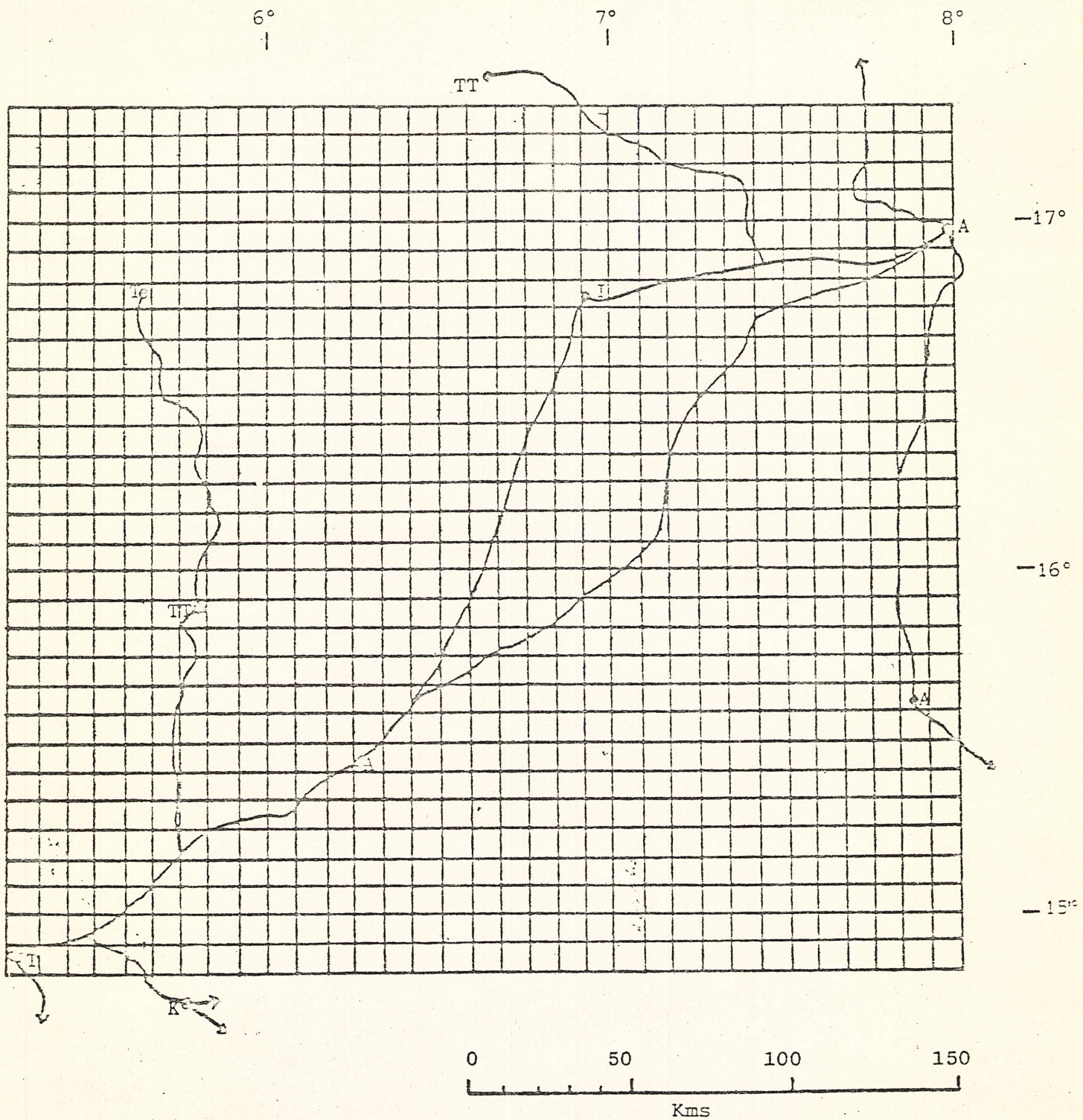


Figure 2. Aerial Survey Grid Pattern.



4. RESULTS

A) Livestock Populations - Numbers and Distribution

(i) The NRL Project Area

Table 1 provides overall population totals for cattle, sheep and goats, camels and donkeys for the entire 81,555 km² area of the NRL Project. The total cattle population, of about 331,000 was not significantly different from that estimated for October 1981. These figures thus suggest an overall wet season stocking of about 20 - 25 hectares per head.

Total Azawak cattle population estimates were not significantly different between the three surveys, varying from about 129,000 to 139,000 or 63 to 53 hectares per head. Bororo cattle, in proportion to Azawak cattle, increased markedly, from 13% greater in May to 38% and 90% greater in September and October respectively. These results suggest a continued immigration of Bororo cattle into the area as the wet season progresses, with a departure that is delayed until surface water sources are reduced or dry.

The sheep and goat population estimates for the three periods show a gradual increase from May through till October, varying between $\frac{3}{4}$ million to over 1 million, or 10 to 7 hectares per head.

A most marked difference was recorded for the camel populations. The May and October figures of about 70,000 and 90,000 respectively were considerably less than the 156,000 recorded in September. This difference is mostly due to a herd size change with the May and October sizes of 5.4 and 5.6 increasing to 19.8 during September.

The donkey population estimates showed a similar trend to that of camels. However, the September totals were not significantly different to those of October, while the May totals are likely to be under estimates (Milligan, 1982). The more interesting difference is in herd sizes, with the September herds almost twice as large as those of May and October.

Figures 3, 4, 5, 6 and 7 map the September distribution of Bororo cattle, Azawak cattle, sheep and goats, camels and donkeys respectively. General distribution zones for the two cattle breeds were similar to those observed during

May and October. The Bororo breed occupied a central to south-easterly zone, with a general spread from Aderbissinat, through Abalak towards Tchin Tabaradene. Concentrations further north towards Ingal were also conspicuous. The Azawak breed, although occurring at lower numbers and less concentrated within their zones of distribution, were more widely scattered than the Bororo. As in May and October, the greatest concentrations were found in the general Tchin Tabaradene area, though they spread down to also occupy the area between Abalak and Aderbissinat. Interestingly, Azawak were also relatively common in the drier areas between Ingal and Teguidda-n-Tessoumt.

As in May and October, the numerous sheep and goats were encountered throughout the study area, with the exception of north-western regions. Camels conversely, showed a very marked concentration towards the most northern areas. Greatest numbers were between Agadez, Ingal and Teguidda-n-Tessoumt. Donkey populations were also relatively abundant in the northern areas, with two main concentrations: between Agadez and Ingal; and between Tassara and Tchin Tabaradene.

With the exception of the marked camel immigration, the general numbers and distribution patterns of livestock during September were not particularly different to either May or October. It is thus tempting to suggest that, while at the outset of the survey May and October were considered dry, they may in fact more accurately represent wet season stocking conditions. This suggestion would be more realistic if supporting ground data were to show that livestock, particularly cattle, move into the zone just before the rains begin and delay their departure until just after the rains have finished. If this possibility proves plausible, the NRL project could benefit from a more clear cut dry season survey, perhaps during February. The situation of considerable camel immigration and their marked zone of concentration suggests a study area of particular interest and importance to the understanding of what must be essentially a camel economy.

(ii) The Land Management Strata

Table 2 gives the numbers of grids and areas of the four Land Management Strata (LMS) whose locations are indicated in figure 8. The basis for selection of these strata and their general ecological characteristics are discussed

in the Final Report of the 1981 surveys.

Population totals for the four strata are given in table 4 to 7.

Greatest cattle stocking rates were recorded in LMS 3, the Sanddune Grasslands. This stocking of about 17 hectares per head was however similar to the value of 21 hectares per head recorded in LMS 2, the Central Savannas. Overall cattle herd sizes in these two strata were identical at 44. The two breeds showed a more marked difference. Although both breeds stocked at about 35 hectares per head in the Sanddune Grasslands, the Bororo breed was almost 2.5 times more abundant than Azawak in the Central Savannas. A comparison to the May and October results suggests that the Sanddune Grasslands always support greatest cattle numbers. Low Azawak totals in the Central Savannas during October suggest that they move out soon after wet season conditions decline, while the Bororo breed appears to continue its immigration, especially up towards the Sanddune Grasslands.

The two other strata: the Northern Ighazer Flood Plains and the Tahoua Uplands support only 14% and 41% respectively of the population density of the Sanddune Grasslands. For the three survey periods, the Northern Ighazer Flood Plains support similar Azawak numbers, of about 190 - 200 hectares per head, while the Bororo breed were most common during the May, late dry season, period and would appear to decrease thereafter till October. The Tahoua Uplands had their lowest cattle numbers during September and this would suggest that many cattle enter and depart from the project area via Tahoua, presumably relying upon available resources in the Tahoua Uplands at times when conditions elsewhere in the project area are less favourable.

The greatest total number of sheep and goats, of over 300,000 head, were recorded in the Central Savannas. However, the Tahoua Uplands, that are only 18% the size of the Central Savannas, supported twice the density of sheep and goats, at about 20 head per km² or only 5 hectares per head.

The greatest camel concentrations were in the Northern Ighazer Flood Plains, where about 110,000 head were estimated stocking at 17 hectares per head. This September total is about 94,000 head more than recorded during either May or October. As an initial interpretation of the September results,

this camel immigration concentration within the project area represents a striking finding.

Donkeys were also more abundant during September in the northern Ighazer Flood Plains, a result contrasting to the May and October figures and suggesting donkey populations linked to the camel owners.

iii) The Land Management Units

Table 2 gives the number of grids and areas of the ten Land Management Units (LMU) whose locations are indicated in figure 8. These LMUs are designed to give a further, and more refined, breakdown of the Land Management Strata based primarily upon varying ecological conditions.

Population totals for the ten LMUs are given in tables 8 to 17.

Greatest cattle densities were recorded in LMU's 2.2, 2.3 and 3.1 being the Central River Drained Plains, the Plains with Mares and the Tchín Tabaradene Dunes respectively, which each support populations at about 16 hectares per head. Although the Bororo breed dominated each of these three Units, the greatest difference was in the Plains with Mares where Bororo outnumbered Azawak by about 3 to 1. Azawak cattle only dominated in the two Units of the Northern Ighazer Flood Plains, with no Bororo at all seen in the Air Mountains and Savanna Unit; the Abalak to Dakoro Dunes and in the two Units of the Tahoua Uplands Strata.

The sheep and goat population was high, at 10 hectares per head, in LMU 1.1, the Ighazer Plains, while the other two Units of the Northern Ighazer Flood Plain Strata contained only half this density. Within the Central Savannas, the Central River Drained Plains supported small stock at 7 hectares per head. Both Units of the Tahoua Upland Strata were stocked at about 5 hectares per head.

The marked increase in camel populations of the Northern Ighazer Flood Plain Strata was concentrated within the Ighazer Plains, where total number were about 80,000, or 8 times that recorded during the May and October flights. This change in numbers is principally reflected in the herd size change which was about 5 times greater, averaging 33 head.

Donkey populations within the Ighazer Plains during September were about 3 to 5 times that recorded for May and October, with a 3 times greater average herd sizes, at 16.

iv) The Maliki Strata

Table 3 gives the number of grids and areas of the eight herders association regions proposed by Maliki, whose locations are given in figure 9.

Population totals for these eight regions, for the total three surveys of May, October and September are given in tables 18 to 25.

The region at Abalak supported similar overall cattle populations during the three seasons, dominated by the Bororo breed. The Azawak breed was most abundant during the wet season period of September, when they were about twice as common as during May. The sheep and goat populations remained similar during the three periods, at about twice that of cattle.

The populations of cattle, sheep and goats in the region of Bermon were similar during May and September, but increased about two fold during October. The increase was however not reflected in the Azawak cattle numbers.

The region at Tofamenir is clearly a wet season concentration area, with the October and September cattle totals being twice that of May. This situation is however totally explained by a Bororo cattle immigration as Azawak cattle are in fact less during the wet season. During October, when Bororo cattle numbers are less than during September, herd sizes averaged over 100, or twice that recorded during the two other periods. The region also supports large sheep and goat numbers that were most abundant, at over 100, 000, during May.

Cattle populations in the region of Tchín Tabaradene remained similar during the three flight periods, though were highest during the September wet season period due to an influx of Bororo cattle. The sheep and goat population numbers during this September period was almost identical to the cattle population numbers, though during May and October they outnumbered cattle by about 2 to 1.

The cattle populations at Tassara during May and September were almost identical, though dropped to about $\frac{1}{3}$ of these totals during October. This October

low was due to an almost total lack of Bororo. Camel populations were relatively high in the Tassara area during both May and September.

The Ingal region, which contains a large proportion of Ighazer Plains, supported a similar cattle number during both May and September with only half this number during October. This difference was largely due to the Bororo breed. Sheep and goat numbers were similar throughout, while camel numbers during September were about four times that recorded during May and October.

The Amatal region had similar overall cattle numbers during the three seasons, with greatest Bororo numbers being during the September and October period. Sheep and goat numbers were about seven times that of cattle. Of all these herders' association regions, the greatest camel density, of about 3.8 per km², was recorded in this region during September. Throughout the three flight periods, over 10,000 camels occurred in this region.

B) Pastoral Populations - Numbers and Distribution

Table 26 provides population estimates for the Twareg and Wodaabe/Peuhl peoples during September. The Twareg populations are divided into : a tented group, a matted group and a sedentary group, as for the May and October flights. Distribution maps for the Wodaabe/Peuhl, the tented Twaregs and the matted Twaregs are given in figures 10, 11 and 12 respectively; the sedentary Twaregs being always restricted to the extreme south-western cultivated areas near Tahoua.

The total estimated Twareg population during September was about 164,000, predominated by the sedentary group. This total is almost identical to that estimated during both May and October. However, while the matted Twaregs remained similar throughout the three survey periods, showing only a slight progressive decrease from May through October, the tented population was substantially less during September, being almost half that of May. This tented drop seems to correspond well to an increase in the sedentary population, which leads to the tentative hypothesis that many of the May and October tented camps were out-reaches from the sedentary population. As the sedentary population are involved in cultivation, such a September re-grouping would be logical. The

overall distribution of the tented group was similar to that observed during May and October, with greatest concentrations being to the west, particularly between Abalak, Tchin Tabanadene and towards Tassara. Scattered, and less numerous, camps occur in a north-easterly direction towards Agadez. The matted group showed a distinctly easterly distribution, as in May and October, but two clear concentration areas could be identified : one in the Agadez area; the other in the Aderbissinat area.

The estimated Wodaabe/Peuhl numbers of September were similar to those of May and October, though at their highest at about 29, 000 people. The distribution map confirms the May and October findings of a generally south-easterly concentration, though suggests that during the wet season there is a movement more into the central areas between Abalak and Ingal and also towards Tchin Tabaradene.

The similarity of the population totals between the three flight periods supports the contention, based from livestock figures, that the September wet season situation exists over the May to October period. The September results also confirm the May and October finding that there is a close distributional link between Azawak and Twareg in the more western regions, with Bororo and Wodaabe in the central to south-eastern regions.

C) Environmental Conditions

The report of the 1981 flights provided 19 different maps of the distribution of various environmental and ecological conditions. The September flights thus concentrated on the seasonal changes in grass cover and water availability.

Figure 13 provides a map of the September grass cover, which indicates high levels throughout the Sanddune Grasslands, stretching from north of Tchin Tabaradene in a south-easterly direction towards Dakoro. Areas of lowest cover were between Aderbissinat and Ingal, north of Tassara, and throughout most of the Northern Ighazer Flood Plains. This situation is similar to that of May and October though, as expected, levels were generally higher due to the rains.

Figure 14 indicates the distribution of surface water in Mares. As expected from the ecological breakdown into Land Management Strata and Units, most of these sources were in the Plains with Mares and in the Sanddune Grasslands especially those of Tchín Tabaradene. The main area of Mares starts just south of Tassara, is particularly marked just north of Tchín Tabaradene, then spreads down past Abalak towards Dakoro. Another conspicuous band lies between Aderbissinat and Tassara passing south of Ingal.

The 1981 survey report described the distribution of wells, either traditional or cement, as detected during flight. Figure 15 indicates what may be the total "well resource", in that it combines those observed during flight with those marked on the IGN maps. A very clear concentration of wells occurs in the south-eastern regions, particularly between Aderbissinat and Dakoro. This concentration continues, though more scattered, in a north-westerly direction towards Ingal and Tassara. The area between Tchín Tabaradene and Tahoua has apparently also an abundant supply of wells.

5. REFERENCES

Milligan, K. (1982). Aerial survey of human, livestock and environmental conditions in a central region of the Pastoral Zone of Niger. Final Report 105 pp. presented to USAID, Niamey, Niger.

Table 1. Wet Season Livestock Populations (\pm %SE) in the NRL Study Area, Niger (81,555 sq.km)

	HEAD		HERDS				
	TOTAL NOS	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS	DENSITY (NOS/KM) ²	MEAN SIZE	
1. Cattle	331,135 (13)	4.06	25 24.6	7,852 (11)	0.10	42	48.1
Bororo	191,994 (18)	2.35	42	3,948 (16)	0.05	49	27.9
Azawak	139,141 (14)	1.71	53	3,903 (11)	0.05	36	20.2
2. Shoats	829,610 (8)	10.17	10 9.8	10,701 (7)	0.13	77	17.2
3. Camels	155,708 (32)	1.91	52 52.4	7,829 (13)	0.10	20	32.3
4. Donkeys	23,375 (12)	0.29	345 346.9	2,086 (9)	0.03	11	2.4

WSD

7c.1.

Table 2. Land Management Strata and Units in NRL Study Area*

	Grids	Area (km ²)	% Total
1. <u>Northern Ighazer Flood Plains</u>	<u>227</u>	<u>18,627</u>	<u>22.9</u>
1.1 The Ighazer Plains	153	12,554	15.5
1.2 The North-Western Plains	44	3,613	4.4
1.3 Air Mountains and Savanna	30	2,460	3.0
2. <u>Central Savannas</u>	<u>391</u>	<u>32,219</u>	<u>39.5</u>
2.1 The Northern Fringe Plains	146	12,002	14.7
2.2 The Central River-drained Plains	152	12,551	15.4
2.3 The Plains with Mares	93	7,666	9.4
3. <u>Sand-dune Grasslands</u>	<u>307</u>	<u>25,331</u>	<u>31.0</u>
3.1 The Tchín-Tabaradene Dunes	179	14,739	18.1
3.2 The Abalak to Dakoro Dunes	128	10,592	12.9
4. <u>Tahoua Uplands</u>	<u>65</u>	<u>5,738</u>	<u>6.6</u>
4.1 The Tahoua Hills	25	2,069	2.6
4.2 The Tahoua Runoff and Lowlands	40	3,309	4.0

*for the locations of these Strata Units see figure 8.

Table 3. The Herders Association Regions proposed by Maliki*

	Region	Grids	Area (km ²)	% Total
1.	Abalak	71	5,868	7.2
2.	Bermon	66	5,461	6.7
3.	Tofamanir	87	7,415	9.1
4.	Tchin Tabaradene	119	9,813	12.0
5.	Tassara	103	8,456	10.4
6.	Ingal	109	8,946	11.0
7.	Amataltal	87	7,154	8.8
8.	Tchin Taborak	92	7,591	9.3
9.	Excluded Areas	256	20,851	25.6

* for the locations of these regions see figure 9.

Table 4. Wet Season Livestock Population (\pm %SE)
 in Land Management Strata 1.
 (18,627 sq.km)

	HEAD			HERDS		
	TOTAL NOS	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS	DENSITY (NOS/KM) ²	MEAN SIZE
1. Cattle	14,705(26)	0.79	127	460(22)	0.02	32
Bororo	5,081(52)	0.27	370	123(48)	0.01	41
Azawak	9,624(24)	0.52	192	337(24)	0.02	29
2. Shoats	163,393(14)	8.72	11	1,907(12)	0.10	85
3. Camels	108,890(35)	5.85	17	3,780(14)	0.20	29
4. Donkeys	8,794(19)	0.47	213	594(19)	0.03	15

Table 5. Wet Season Livestock Populations (\pm %SE) in Land
Management Strata 2
(32,219 sq. km)

	HEAD			HERDS		
	TOTAL NOS.	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS.	DENSITY (NOS/KM) ²	MEAN SIZE
1. Cattle	157,032(15)	4.87	21	3,589(14)	0.11	44
Bororo	110,494(19)	3.43	29	2,288(17)	0.07	48
Azawak	46,537(19)	1.44	69	1,301(15)	0.04	36
2. Shoats	329,542(10)	10.23	10	4,318(10)	0.13	76
3. Camels	26,157(17)	0.81	123	2,255(12)	0.07	12
4. Donkeys	7,156(17)	0.22	455	729(13)	0.02	10

Table 6. Wet Season Livestock Population (\pm %SE) in Land
 Management Strata 3.
 (25,331 sq.km)

	HEAD			HERD		
	TOTAL NOS	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS	DENSITY (NOS/KM) ²	MEAN SIZE
1. Cattle	146,645(15)	5.79	17	3,331(10)	0.13	44
BORORO	73,637(20)	2.91	34	1,458(16)	0.06	51
AZAWAK	73,009(16)	2.88	35	1,873(12)	0.07	39
2. Sheep	228,403(15)	9.02	11	3,219 (9)	0.13	71
3. Camels	18,844(20)	0.74	12	1,537(16)	0.06	12
4. Donkeys	6,932(23)	0.27	370	628(15)	0.02	11

Table 7. Wet Season Livestock Populations (\pm %SE) in the Land Management Strata 4.

	HEAD				HERDS			
	TOTAL NOS	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS	DENSITY (NOS/KM) ²	MEAN SIZE		
1. Cattle	12,753(15)	2.37	42	471(14)	0.09	27		
Bororo	2,782(45)	0.52	192	79(43)	0.01	35		
Azawak	9,972(23)	1.85	54	393(18)	0.07	25		
2. Snoats	109,272(14)	20.32	5	1,256(12)	0.23	87		
3. Camels	1,817(28)	0.34	294	258(14)	0.05	7		
4. Donkeys	494(40)	0.09	1,111	135(28)	0.03	4		

Table 8. Wet Season Livestock Population (\pm %SE) in the Land Management Unit 1.1 The Ighazer Plains
(12,554 sq.km)

	HEAD			HERDS		
	TOTAL NOS	DENSITY ² (NOS/KM)	STOCKING (HA/HD)	TOTAL NOS	DENSITY ² (NOS/KM)	MEAN SIZE
1. Cattle	8,884(20)	0.71	141	280(20)	0.20	35
Bororo	3,129(49)	0.25	403	90(40)	0.01	35
Azawak	5,754(25)	0.46	217	190(26)	0.02	30
2. Snoats	125,754(14)	10.20	13	1,335(14)	0.11	94
3. Camels	95,812(35)	7.63	13	2,894(17)	0.23	33
4. Donkeys	7,347(23)	0.59	169	449(24)	0.04	16

Table 9. Wet Season Livestock Population (\pm %SE) in the Land Management Unit 1,2

The North-Western Plains
(5,613 sq.km)

	HEAD				HERDS			
	TOTAL NOS	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS	DENSITY (NOS/KM) ²	MEAN SIZE		
1. Cattle	5,361(53)	1.48	67	168(37)	0.05	32		
Bororo	1,952(91)	0.54	185	34(91)	0.01	57		
Azawak	3,410(41)	0.95	105	135(33)	0.04	25		
2. Shoats	23,308(35)	6.45	15	377(23)	0.09	69		
3. Camels	10,880(51)	3.01	33	538(37)	0.15	20		
4. Donkeys	919(50)	0.25	400	67(61)	0.02	14		

Table 10. Wet Season Livestock Population (\pm %SE) in the Land Management Unit 1.3

The Air Mountains and Savanna
(2,460 sq.km)

	HEAD			HERDS		
	TOTAL NOS	DENSITY ² (NOS/KM)	STOCKING (HA/HD)	TOTAL NOS	DENSITY ² (NOS/KM)	MEAN SIZE
1. Cattle	460(85)	0.19	526	11(85)	0.00	42
Bororo	0	0	0	0	0	0
Azawak	460(85)	0.19	526	11(85)	0.00	42
2. Shoats	13,258(27)	5.39	19	236(26)	0.10	56
3. Camels	2,198(33)	0.39	112	343(30)	0.14	6
4. Donkeys	527(49)	0.21	476	79(33)	0.05	7

Table 11. Wet Season Livestock Populations (\pm %SE) in the Land
Management Unit 2.1
The Northern Fringe Plains
(12,002 sq.km)

	HEAD		HERDS			
	TOTAL NOS	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS		
				DENSITY (NOS/KM) ²	MEAN SIZE	
1. Cattle	25,450(35)	2.12	47	651(25)	0.05	40
Bororo	17,632(50)	1.47	68	337(41)	0.03	52
Azawak	7,818(30)	0.65	154	314(29)	0.03	25
2. Shoats	65,235(26)	5.44	18	897(21)	0.07	73
3. Camels	15,972(18)	1.33	75	1,110(14)	0.09	14
4. Donkeys	2,131(29)	0.18	555	213(27)	0.02	10

Table 12. Wet Season Livestock Population (\pm %SE) in the Land
Management Unit 2.2.
(12,551 sq.km)

	HEAD				HERDS			
	TOTAL NOS	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS	DENSITY (NOS/KM) ²	MEAN SIZE		
1. Cattle	83,956(13)	6.69	15	2053(13)	0.16	41		
Bororo	57,350(20)	4.57	22	1,324(16)	0.11	43		
Azawak	26,606(23)	2.12	47	729(18)	0.06	36		
2. Shoats	187,642(10)	14.95	6.68	2,580(9)	0.21	73		
3. Camels	4,475(30)	0.36	278	684(26)	0.05	6		
4. Donkeys	3,443(21)	0.27	370	370(16)	0.03	9		

Table 13. Wet Season Livestock Populations (\pm %SE) in the Land Management Unit 2.5

(7,656 sq.km)

	HEAD		HERDS			
	TOTAL	DENSITY ² (NOS/KM)	TOTAL	DENSITY ² (NOS/KM)		
	NOS		NOS	MEAN SIZE		
1. Cattle	47,625(26)	6.21	16	886(23)	0.12	54
Bororo	35,512(26)	4.63	21	628(25)	0.08	65
Azawak	12,114(31)	1.53	53	258(27)	0.03	47
2. Shoats	76,665(17)	10.00	10	841(15)	0.11	91
3. Camels	5,709(34)	0.75	133	460(19)	0.06	12
4. Donkeys	1,582(44)	0.21	476	146(38)	0.02	11

Table 14. Wet Season Livestock Population (\pm %SE) in the Land Management Unit 3.1

The Tchin-Tabaradene Dunes
(14,739 sq.km)

	HEAD				HERDS			
	TOTAL	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS	DENSITY (NOS/KM) ²	MEAN SIZE		
1. Cattle	92,828(20)	6.30	16	2,030(14)	0.14	45		
Bororo	55,600(22)	3.77	26	1,032(18)	0.07	54		
Azawak	37,228(23)	2.53	39	998(18)	0.07	37		
2. Shoats	100,321(13)	6.81	15	1,638(12)	0.11	61		
3. Camels	1,535(20)	1.05	95	1,211(15)	0.08	13		
4. Donkeys	5,339(26)	0.36	278	460(18)	0.03	12		

Table 15. Wet Season Livestock Population (\pm %SE) in the Land
Management Unit 3.2
The Abalak to Dakoro Dunes
(10,592 sq.km)

	HEAD			HERDS		
	TOTAL NOS	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS	DENSITY (NOS/KM) ²	MEAN SIZE
1. Cattle	53,817(20)	5.08	20	1,301(13)	0.12	41
Bororo	18,036(34)	1.70	59	426(25)	0.04	42
Azawak	35,781(22)	3.38	95	875(13)	0.08	41
2. Shoats	128,082(23)	12.09	8	1,582(11)	0.15	81
3. Camels	3,309(42)	0.31	322	325(24)	0.03	10
4. Donkeys	1,593(35)	0.15	667	168(13)	0.02	9

Table 15. Wet Season Livestock Population (± %SE) in the Land Management Unit 4.1

The Tanoua Hills
(2,069 sq.km)

	HEAD				HERDS			
	TOTAL	DENSITY ² (NOS/KM)	STOCKING (HA/HD)	TOTAL NOS	DENSITY ² (NOS/KM)	MEAN SIZE		
1. CATTLE	6,865(18)	3.32	30	236(20)	0.11	30		
90RORO	1,694(72)	0.82	122	45(76)	0.02	38		
AZAWAK	5,171(31)	2.50	122	191(26)	0.09	28		
2. SHOATS	46,964(20)	22.70	4	381(14)	0.18	132		
3. CAMELS	1,088(49)	0.53	189	101(30)	0.05	11		
4. DONKEYS	157(32)	0.08	1250	56(21)	0.03	3		

Table 17. Wet Season Livestock Population (± %SE) in the Land Management Unit 4.2

The Tahoua Runoff and Lowlands
(3,309 sq.km)

	HEAD			HERDS		
	TOTAL NOS	DENSITY (NOS/KM) ²	STOCKING (HA/HD)	TOTAL NOS	DENSITY (NOS/KM) ²	MEAN SIZE
1. Cattle	5,839(25)	1.78	56	236(20)	0.07	25
Sororo	1,088(69)	0.33	303	34(45)	0.01	32
AZAWAK	4,801(28)	1.45	69	202(21)	0.06	24
2. Shoats	52,308(22)	13.83	5	875(15)	0.26	71
3. Camels	729(19)	0.22	454	157(12)	0.05	5
4. Donkeys	337(53)	0.10	100	79(41)	0.02	4

Table 18. Seasonal Livestock Population (+ %SE) in the Malakl Herders Association at Abatax (5,858 sq.km)

	HEAD				HERDS							
	TOTAL NOS.		DENSITY(NOS/KM) ²		TOTAL NOS.		MEAN SIZE					
	MAY 81	OCT 81	SEPT 82	MAY 81	OCT 81	SEPT 82	MAY 81	OCT 81	SEPT 82			
1. Cattle	32,308(26)	33,318 (9)	39,460(26)	5.51	5.69	6.72	700(14)	969(10)	753(19)	46	41	52
Bororo	23,482(32)	22,036(14)	20,324(27)	4.00	3.75	3.46	394(17)	518(15)	391(29)	59	42	53
Azawak	3,820(16)	11,283(18)	19,135(29)	1.50	1.92	3.26	306(12)	451(17)	331(13)	29	25	50
2. Shoats	63,413(20)	77,085(11)	58,892(18)	10.81	13.14	11.74	1,378(11)	1,499(10)	852(11)	46	51	81
3. Camel	4,440(12)	8,814(13)	2,127(36)	0.76	1.50	0.36	842(12)	1,837 (9)	359(16)	5	2	6
4. Donkey	295(52)	5,557(18)	1,077(26)	0.05	0.92	0.18	33(47)	271(20)	292(20)	9	20	4

Table 19. Seasonal Livestock Population (± XSE)
 in the Malaki Herders Association at Bermon
 (5,461 sq.km)

	TOTAL NOS.			DENSITY(NOS/KM) ²			TOTAL NOS.			MEAN SIZE		
	MAY 81	OCT 81	SEPT 82	MAY 81	OCT 81	SEPT 82	MAY 81	OCT 81	SEPT 82	MAY 81	OCT 81	SEPT 82
1. Cattle	28,896(16)	57,676(10)	29,623(17)	5.29	10.56	5.42	995(14)	2,401(36)	651(16)	29	24	45
30oro	17,718(26)	47,622(11)	11,407(38)	3.24	8.72	2.09	623(20)	1,161(10)	247(33)	28	41	46
Azawak	11,178(23)	10,054(26)	18,216(30)	2.05	1.84	3.34	372(27)	1,240(73)	404(28)	30	8	45
2. Shoats	50,256(15)	99,538(10)	42,354(19)	9.20	18.23	7.76	1,400(11)	1,544 (9)	561(20)	36	64	75
3. Camel	2,483(23)	5,444(26)	1,447(47)	0.45	1.00	0.26	1,568(13)	1,206(17)	146(37)	1	4	10
4. Donkey	22(95)	2,694(32)	796(53)	0.00	0.49	0.15	11(95)	169(22)	191(30)	2	16	4

Table 20. Seasonal Livestock Populations (\pm XSE) in the Malaki Herders Association at Tofamahir (7,415 sq.km)

	HEAD				HERDS						
	TOTAL NOS.		DENSITY(NOS/KM) ²		TOTAL NOS.		MEAN SIZE				
	MAY 81	OCT 81	MAY 81	OCT 81	MAY 81	OCT 81	MAY 81	OCT 81			
1. Cattle	28,272(20)	41,129(19)	3.81	5.55	7.48	809(11)	1,037(15)	1,122(23)	35	40	49
Bororo	12,632(29)	31,481(24)	1.70	4.25	6.45	295(16)	597(17)	920(22)	43	107	52
Azawak	15,640(23)	9,648(15)	2.11	1.30	1.03	514(15)	440(14)	202(31)	30	22	38
2. Goat	107,534(34)	97,892(15)	14.50	13.20	10.45	1,816(21)	1,499(14)	1,038(12)	59	65	71
3. Camels	9,865(18)	12,004(11)	1.33	1.62	0.72	1,859(14)	2,220(8)	432(21)	5	5	2
4. Donkey	2,166(38)	2,570(22)	0.29	0.35	0.31	295(22)	304(17)	393(18)	7	8	6

Table 21. Seasonal Livestock Populations (\pm %SE)
 in the Malaki Herders Association at Tchin Tabaradene
 (9,813 sq.km)

	HEAD				HERDS							
	TOTAL NOS.		DENSITY (NOS/KM) ²		TOTAL NOS.		MEAN SIZE					
	MAY 81	OCT 81	SEPT 82	MAY 81	OCT 81	SEPT 82	MAY 81	OCT 81	SEPT 82			
1. Cattle	58,798(11)	59,000(15)	62,531(23)	6.99	6.01	7.09	1,936 (7)	1,702(11)	1,402(18)	30	35	49
Bororo	25,724(20)	29,204(28)	40,828(26)	2.62	2.98	4.16	558(12)	564(25)	707(24)	46	52	58
Azawak	33,074(13)	29,802(18)	23,703(27)	3.37	3.04	2.92	1,378(11)	1,138(12)	695(21)	24	26	41
2. Sheep	112,729 (9)	177,385(22)	70,339(16)	11.49	19.13	7.17	2,887 (9)	2,333 (9)	1,167(14)	39	76	60
3. Camels	13,321(21)	14,587(18)	8,726(30)	1.36	1.50	0.89	2,494(14)	2,623 (9)	841(17)	5	5	10
4. Donkey	3,413(24)	9,795(29)	3,051(20)	0.35	1.00	0.31	514(16)	518(26)	482(19)	7	19	6

Table 22. Seasonal Livestock Populations (± KSE)
in the Malaki Herders Association at Tassara
(8,456 sq.km)

	TOTAL NOS.				DENSITY(NOS/KM) ²				TOTAL NOS				MEAN SIZE			
	MAY 81	OCT 81	SEPT 82		MAY 81	OCT 81	SEPT 82		MAY 81	OCT 81	SEPT 82		MAY 81	OCT 81	SEPT 82	
1. Cattle	15,465(20)	5,850(35)	16,713(29)	1.83	0.69	1.93		645(18)	282(37)	482(22)	24	21	35			
Bororo	5,950(31)	11(94)	7,280(49)	0.70	0.00	0.86		306(35)	11(94)	112(44)	19	1	65			
Azawak	9,515(32)	5,839(35)	9,433(32)	1.13	0.69	1.12		339(26)	271(36)	370(25)	28	21	25			
2. Shoats	65,896(22)	57,642(31)	37,250(25)	7.79	6.82	4.41		1,127(19)	699(25)	551(22)	58	82	66			
3. Camels	14,896(12)	6,504(22)	12,271(20)	1.76	0.77	1.45		1,827(16)	1,307(18)	998(18)	8	5	12			
4. Donkey	2,636(22)	1,454(42)	1,884(47)	0.31	0.17	0.22		262(16)	192(33)	135(46)	10	7	14			

Table 23. Seasonal Livestock Populations (± MSE) in the Malaki Herders Association at Ingal (8,946 sq.km)

	HEAD						HERDS					
	TOTAL NOS		DENSITY(NOS/KM.) ²		TOTAL NOS.		MEAN SIZE					
	MAY 81	OCT 81	MAY 81	OCT 81	MAY 81	OCT 81	MAY 81	OCT 81				
1. Cattle	12,775(42)	5,996(44)	11,138(57)	1.43	0.67	1.25	295(37)	225(29)	247(42)	43	27	45
Bororo	7,951(46)	2,301(92)	6,921(39)	0.89	0.26	0.77	153(46)	45(72)	112(86)	52	51	62
Azawak	4,823(42)	3,686(28)	4,217(31)	0.54	0.41	0.47	142(35)	180(30)	135(23)	34	20	31
2. Goat	52,028(23)	50,417(25)	46,515(20)	5.82	5.64	5.20	984(25)	631(19)	437(18)	53	80	106
3. Camels	7,404(19)	6,834(32)	24,329(16)	0.93	0.97	2.72	1,203(13)	1,240(21)	1,333 (8)	6	5	21
4. Donkey	1,280(30)	1,431(34)	3,152(32)	0.14	0.16	0.35	197(23)	169(29)	179(25)	6	8	18

Table 24. Seasonal Livestock Populations (\pm % SE) in the Malakki Herders Association at Anataltal (7,154 Sq.km)

	HEAD				HERD						
	TOTAL NOS		DENSITY(NOS/KM) ²		TOTAL NOS		MEAN SIZE				
	MAY 81	OCT 81	MAY 81	OCT 81	MAY 81	OCT 81	MAY 81	OCT 81			
1. Cattle	7,022(47)	8,995(23)	0.93	1.26	1.23	197(39)	316(25)	222(17)	36	28	31
Bororo	3,609(43)	6,932(37)	0.50	0.97	0.91	98(48)	203(37)	158(26)	37	34	39
Azawak	3,412(54)	2,063(32)	0.43	0.29	0.37	98(51)	113(17)	123(32)	35	18	22
2. Sheep	50,519(22)	53,393(25)	7.06	7.46	10.65	1,094(18)	879(20)	942(15)	46	61	81
3. Camels	10,161(14)	13,559(17)	1.42	1.90	3.80	1,772(11)	2,266(19)	1,840(19)	6	6	15
4. Donkeys	1,230(17)	2,531(25)	0.13	0.36	0.53	252(27)	259(19)	337(21)	5	10	12

Table 25. Seasonal Livestock Populations (% SE)
 In the Malaki Herders Association at Tchin Taborak
 (7,591 sq.km)

	HEAD			HERD								
	TOTAL NOS			TOTAL NOS.								
	MAY 81	OCT 81	SEPT 82	MAY 81	OCT 81	SEPT 32						
1. Cattle	20,824(16)	41,411(31)	36,801(21)	2.74	5.46	4.85	777(13)	992(26)	1,021(17)	27	42	36
Bororo	13,037(25)	37,342(35)	26,247(25)	1.72	4.92	3.46	459(17)	812(30)	652(19)	28	46	40
Azawak	7,787(21)	4,069(30)	10,555(25)	1.03	0.54	1.39	317(21)	180(21)	359(21)	24	25	29
2. Shoat	75,532(15)	128,494(15)	109,058(19)	9.95	16.93	14.37	1,826(15)	1,837(14)	1,391(15)	41	70	78
3. Camels	7,197(24)	12,624(10)	4,565(22)	0.95	1.66	0.60	1,662(18)	2,888(5)	673(20)	4	5	7
4. Donkey	984(34)	2,119(22)	1,817(21)	0.13	0.28	0.24	197(28)	338(18)	359(17)	5	6	5

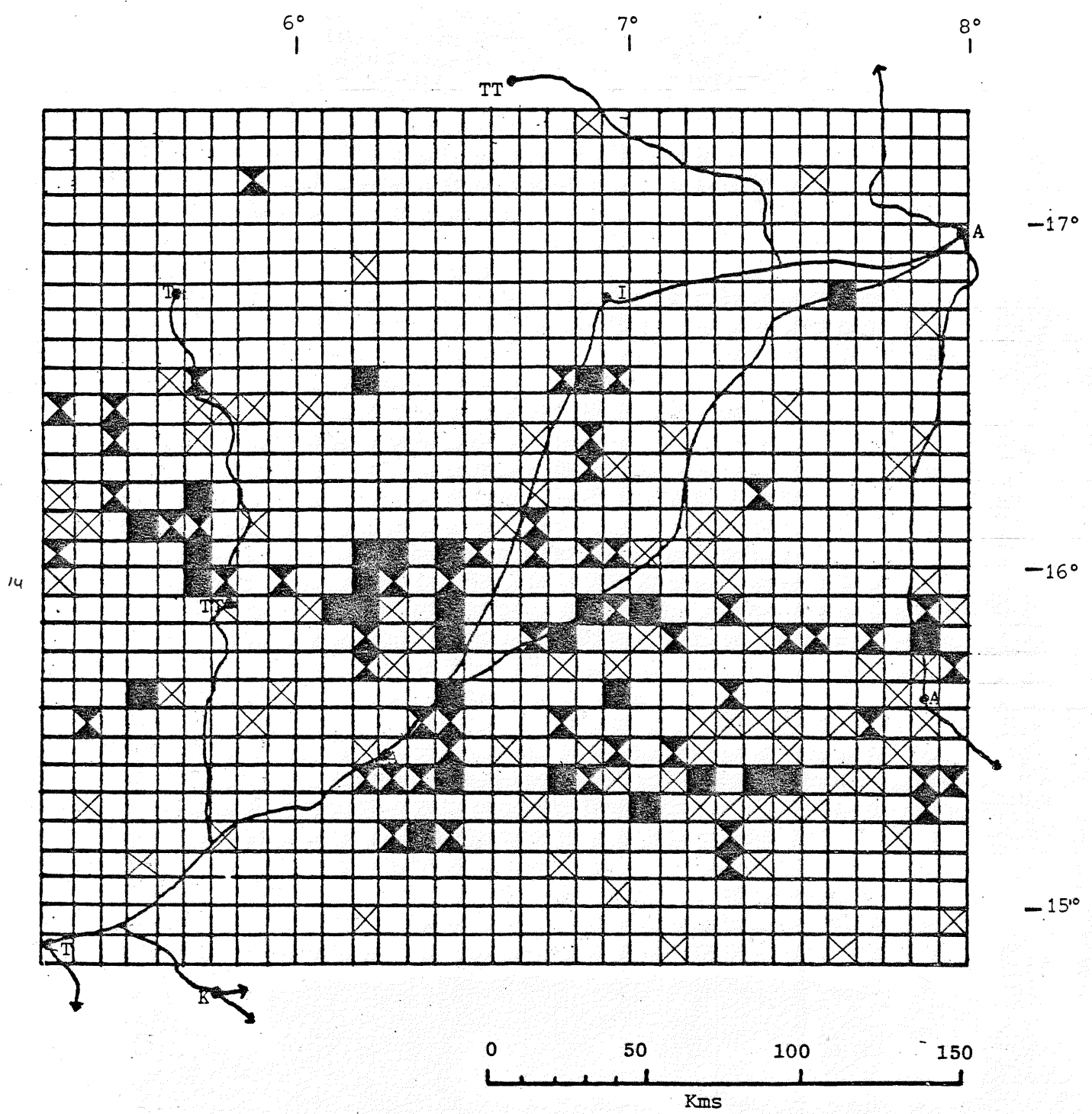
Table 26. Wet Season Pastoral Population* (± XSE) in the
 NRL Study Area, Niger
 (81,555 sq.km)

	DWELLINGS		CAMPS			
	TOTAL	DENSITY 2	TOTAL	DENSITY 2	MEAN SIZE	
	NOS	(NOS/KM) 2	NOS	(NOS/KM) 2	POPULATION**	
1. Twareg						
1. Tented	7,201(24)	0.09	1,682(21)	0.02	4.28	36,005
2. Matted	6,550(19)	0.08	1,638(16)	0.02	3.99	32,750
3. Sedentary	19,001(31)	0.23	1,705(29)	0.02	11.14	95,005
2. Wodaabe/Peul	6,954(25)	0.09	1,490(20)	0.03	2.79	29,206

* This Table includes only pastoral camps of grass, mat or tent and does not include mud houses, towns or villages.

** The estimated population is based upon an assumed 5 people per dwelling/ except for Wodaabe/Peul assumed at 4.2 (Swift, pers comm.)

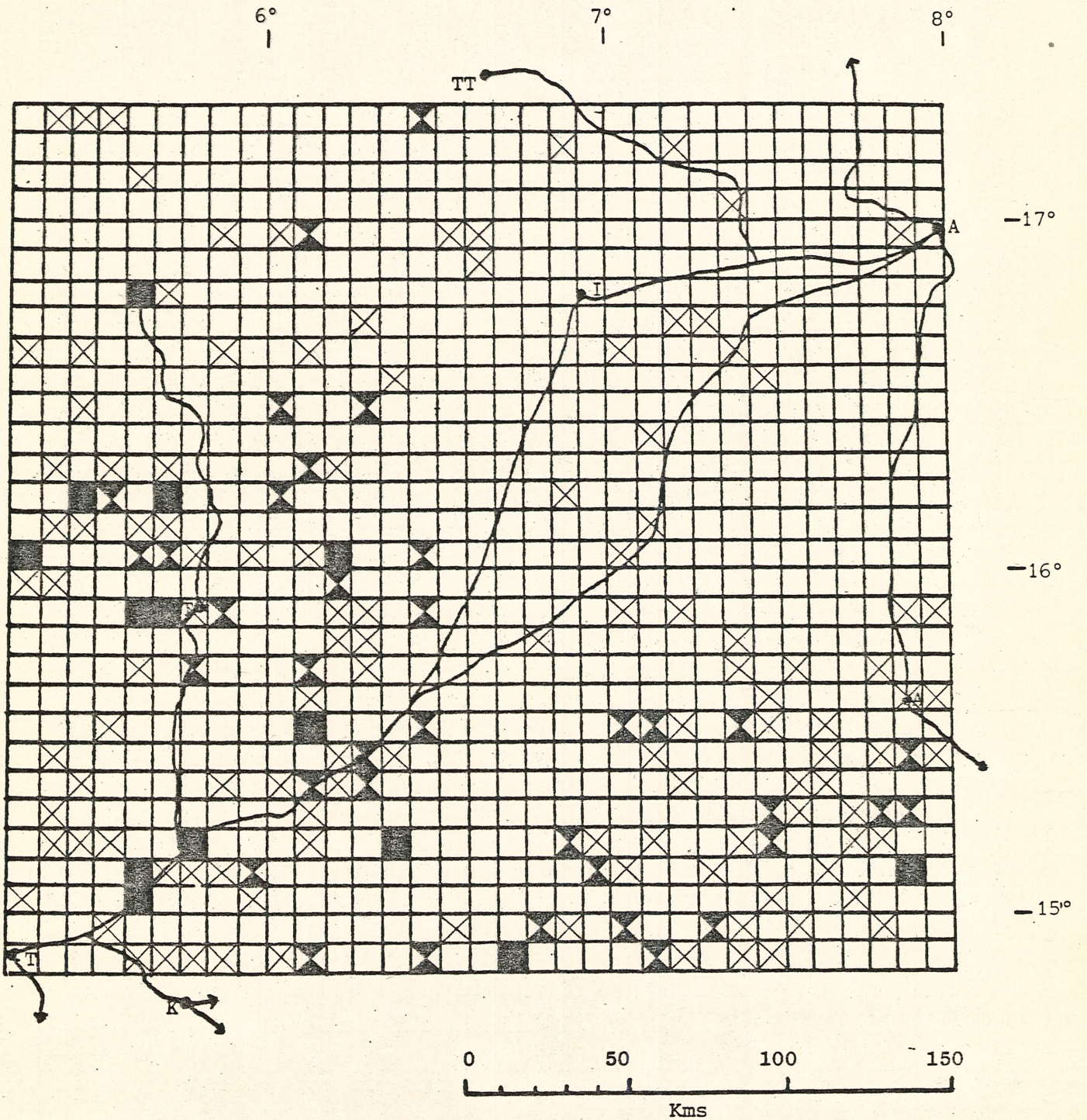
Figure 3. Wet season distribution of Bororo cattle



Stocking rate
(hectares/head)

- > 50
- ⊗ 10 - 50
- ▣ 5 - 10
- < 5

Figure 4. Wet season distribution of Azawak cattle

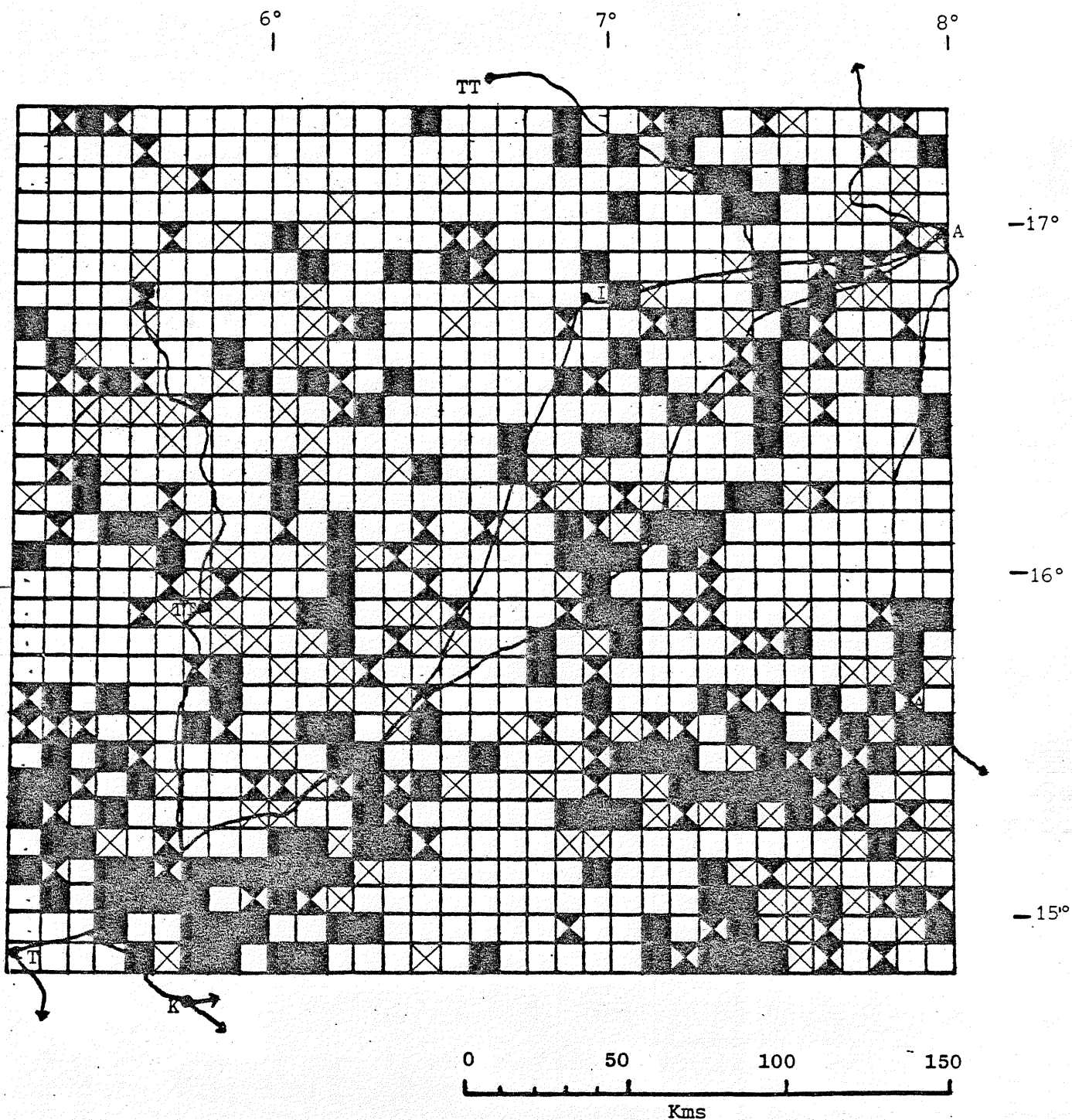


Stocking rate

(hectares/head)

- > 50
- ⊗ 10 - 50
- ▤ 5 - 10
- < 5

Figure 5. Wet season distribution of sheep and goats

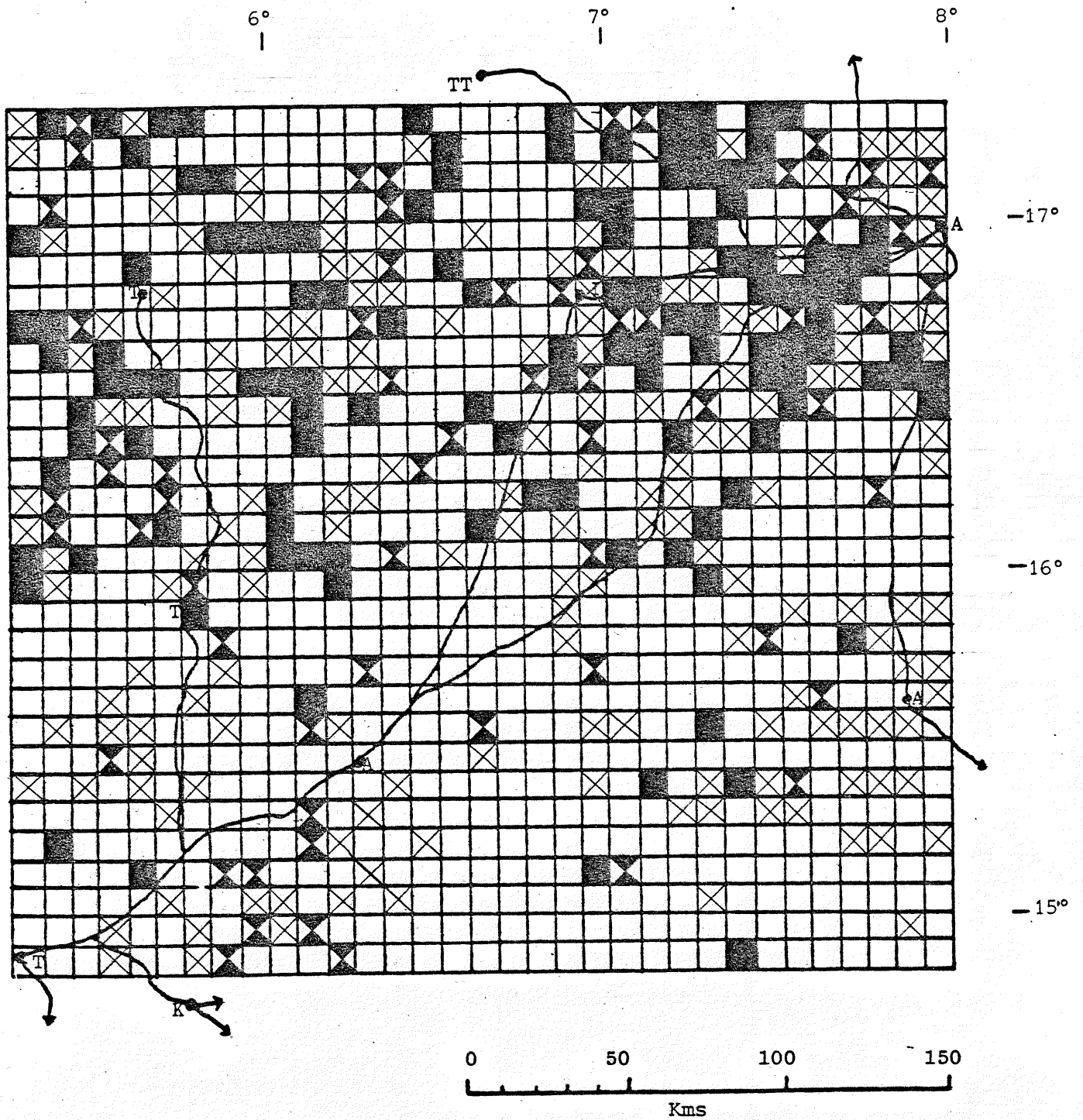


Stocking rate

(hectares/head)

- > 50
- ⊗ 10 - 50
- ⊠ 5 - 10
- < 5

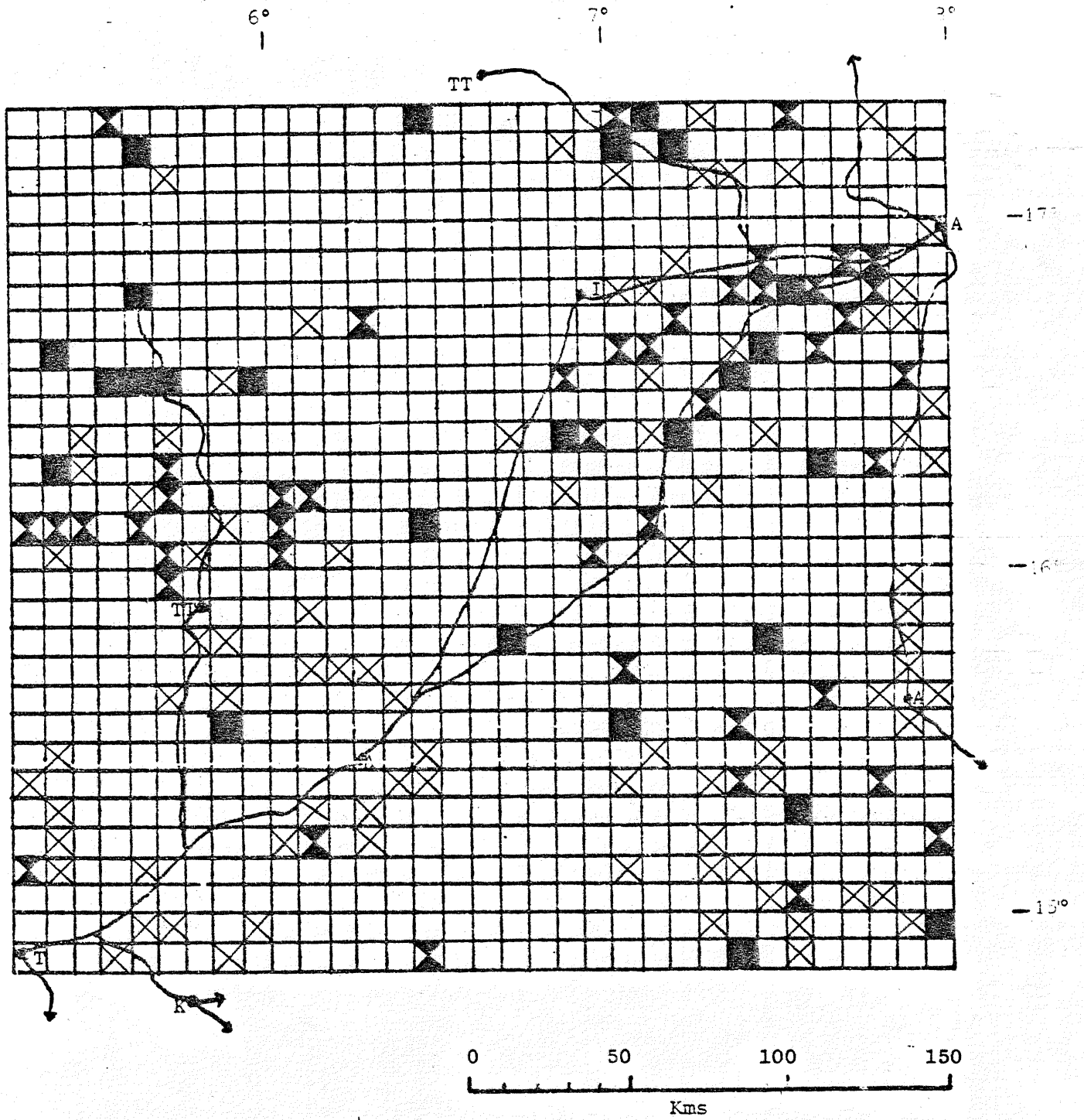
Figure 6. Wet season distribution of camels



Animals seen per grid

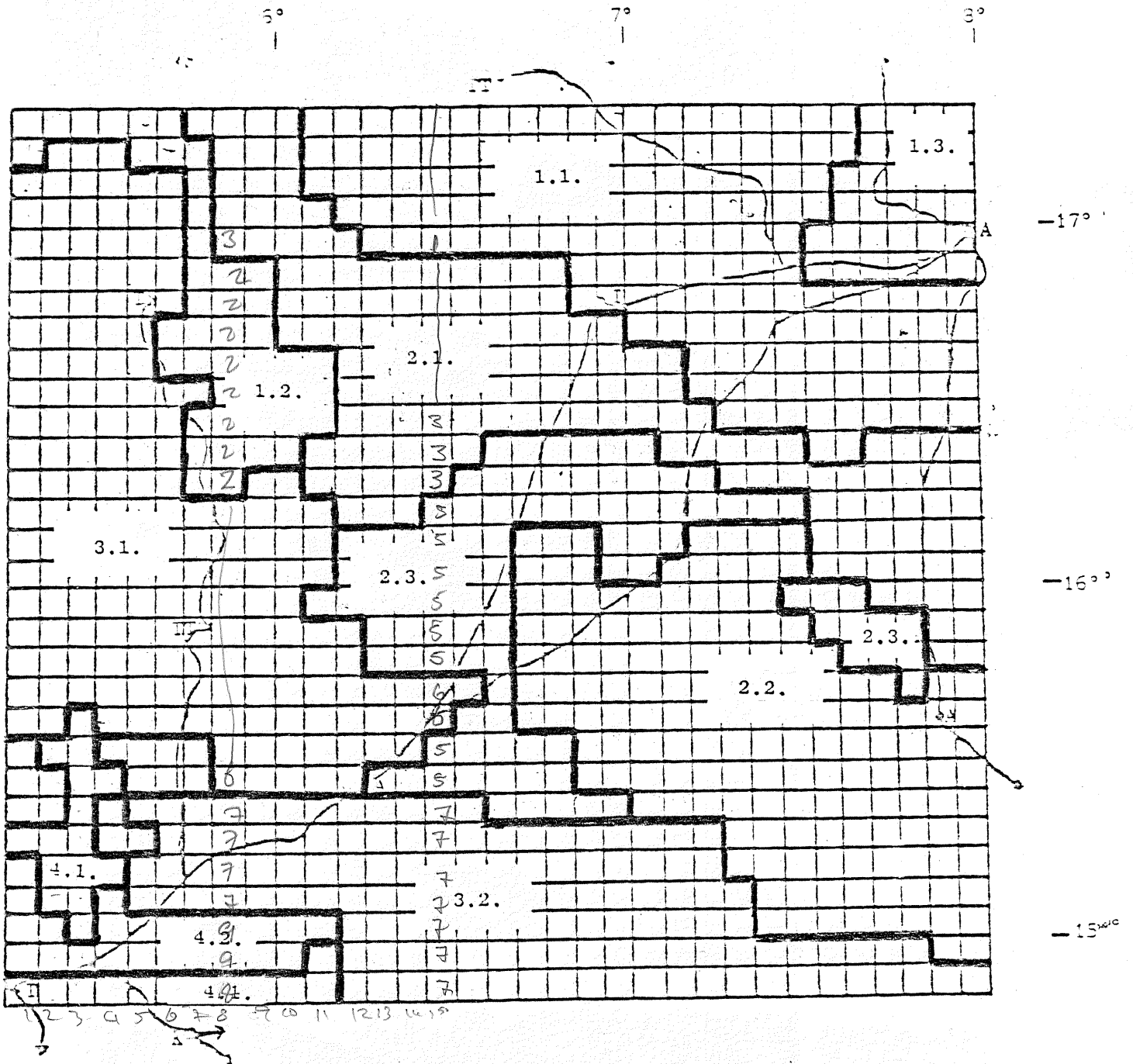
- 0
- ⊗ 1 - 10
- ▤ 11 - 20
- > 20

Figure 7. Wet season distribution of donkeys.



Animals seen per grid

- 0
- ⊗ 1 - 10
- ▤ 11 - 20
- > 20



THE LAND MANAGEMENT UNITS

- 1.1.1 The Ighazer Plains
- 1.2.2 The North-Western Plains
- 1.3.7 The Air Mountains and Savannas

- 2.1.4 The Northern Fringe Plains
- 2.2.5 The Central River Drained Plains
- 2.3.6 The Plains with Mares

- 3.1.7 The Tchin Taboradene Dunes
- 3.2.8 The Abalik or Bokoko Dunes

- 4.1.9 The Tiboua
- 4.2.10 The

Figure 9. The Herders Association regions proposed by Maliki

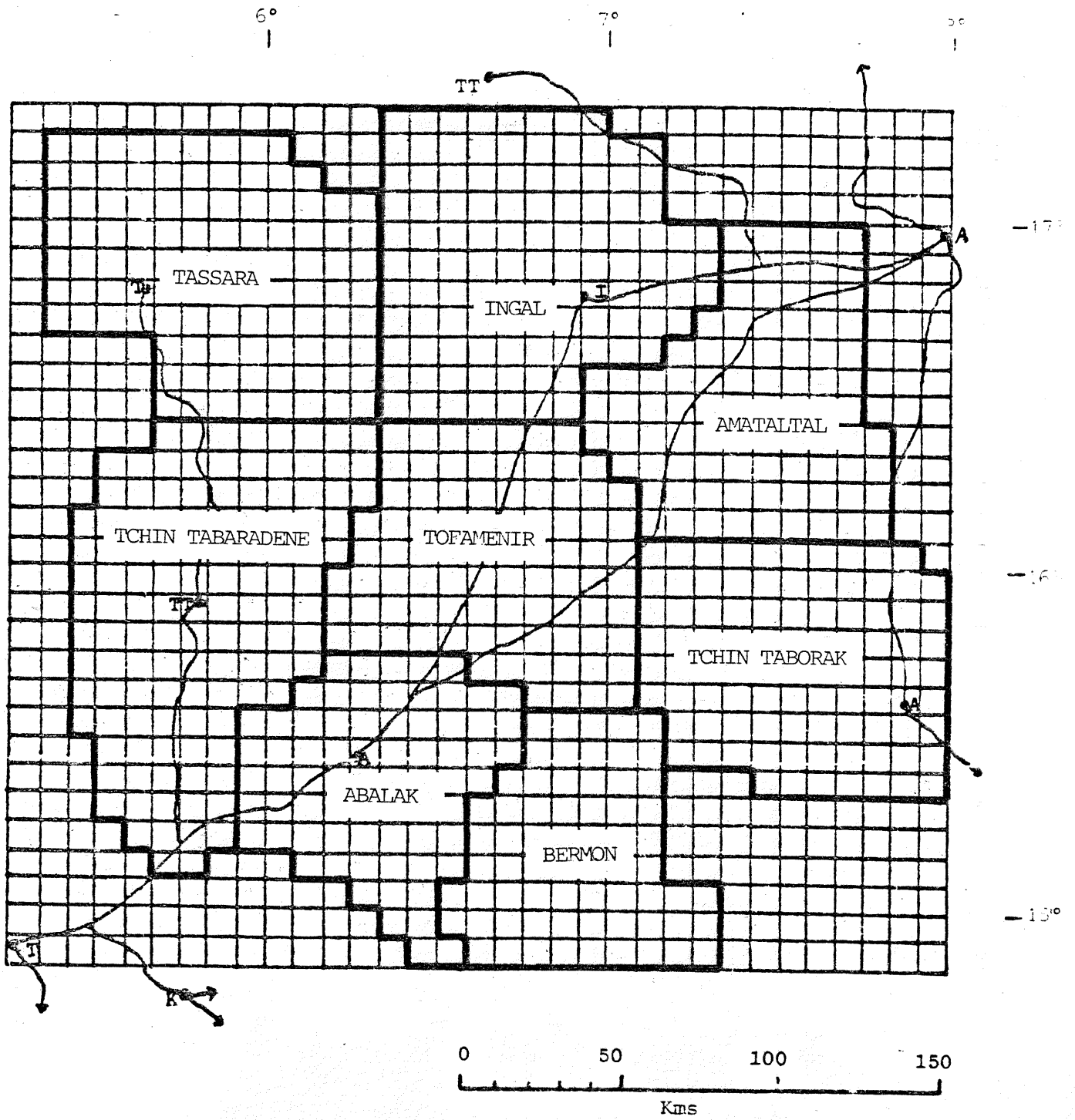
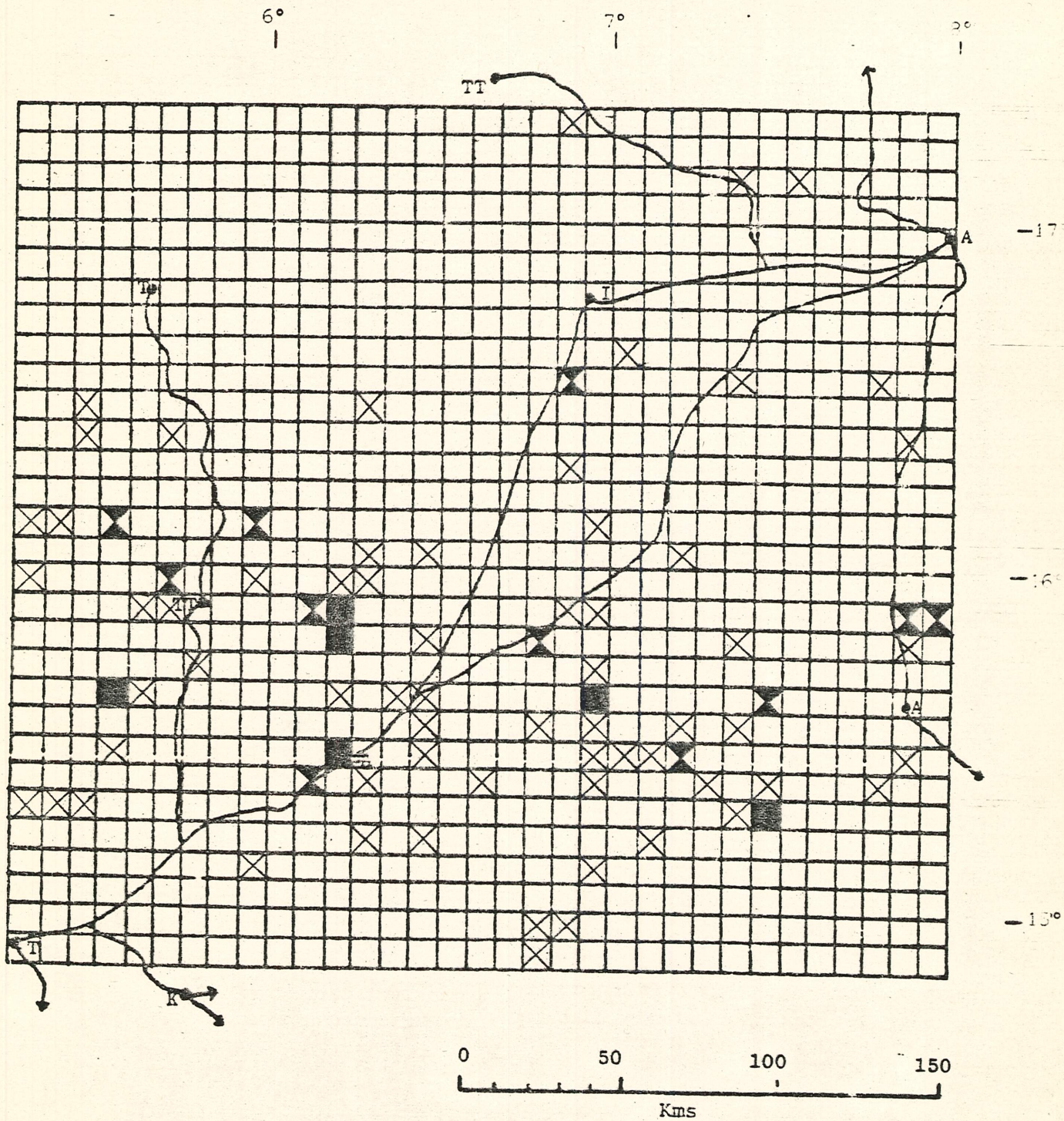


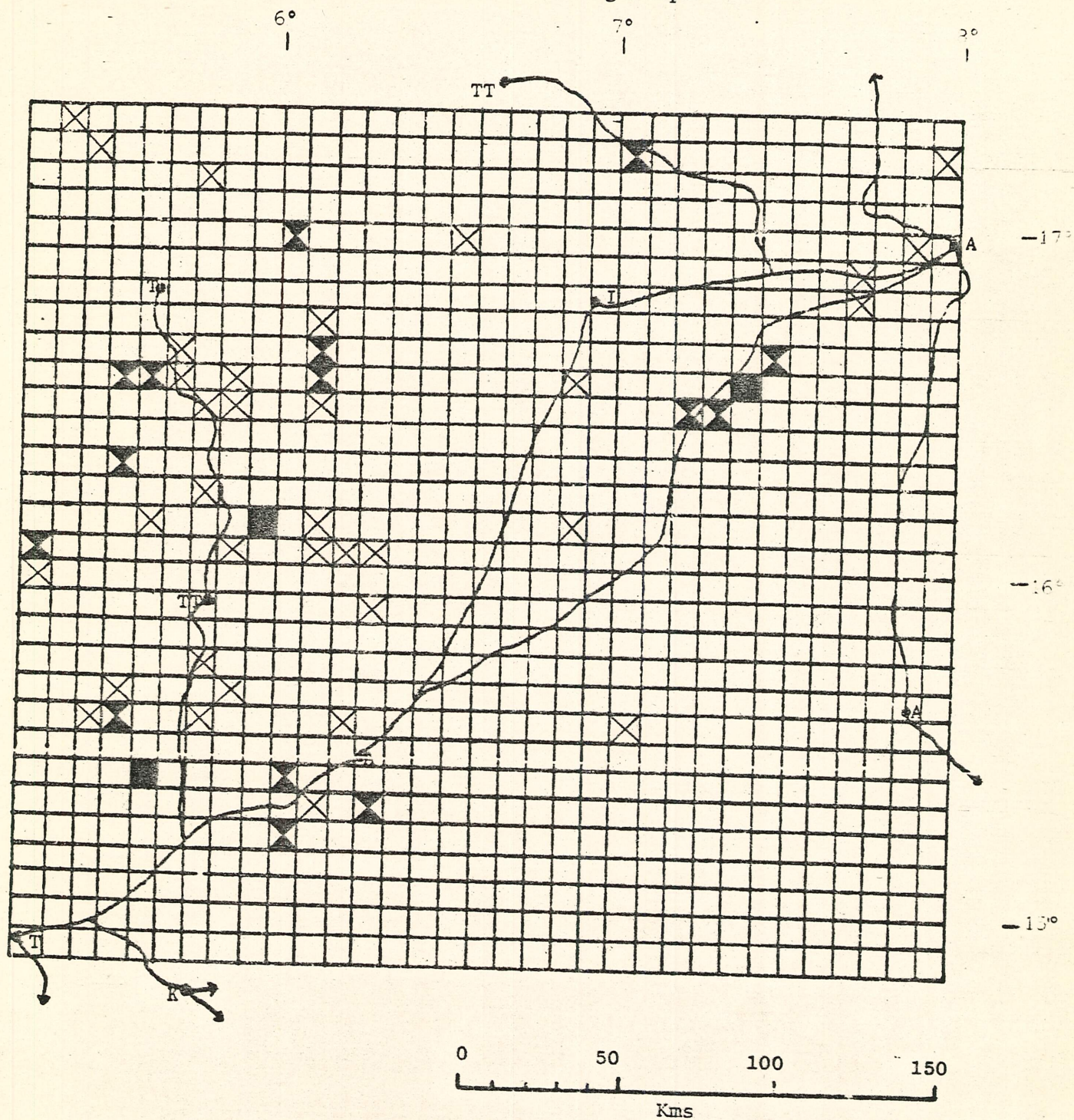
Figure 10. Wet Season distribution of Wodaabe/Peuhl camps



Camps seen per grid

- 0
- ⊠ 1
- ◩ 2
- 3+

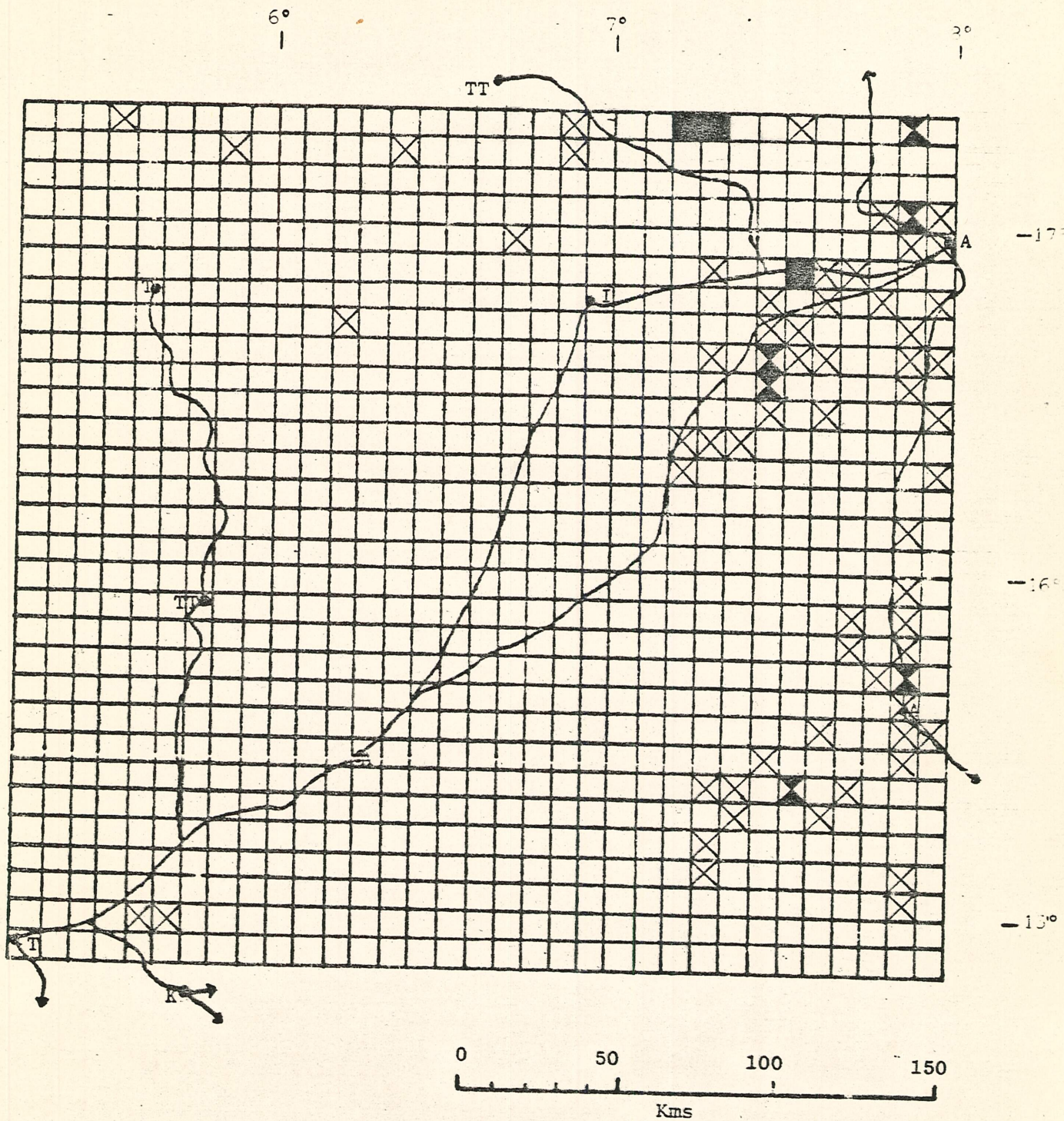
Figure 11. Wet Season distribution of tented Twareg camps



Camps seen per grid

- 0
- ⊠ 1
- ⊞ 2
- 3+

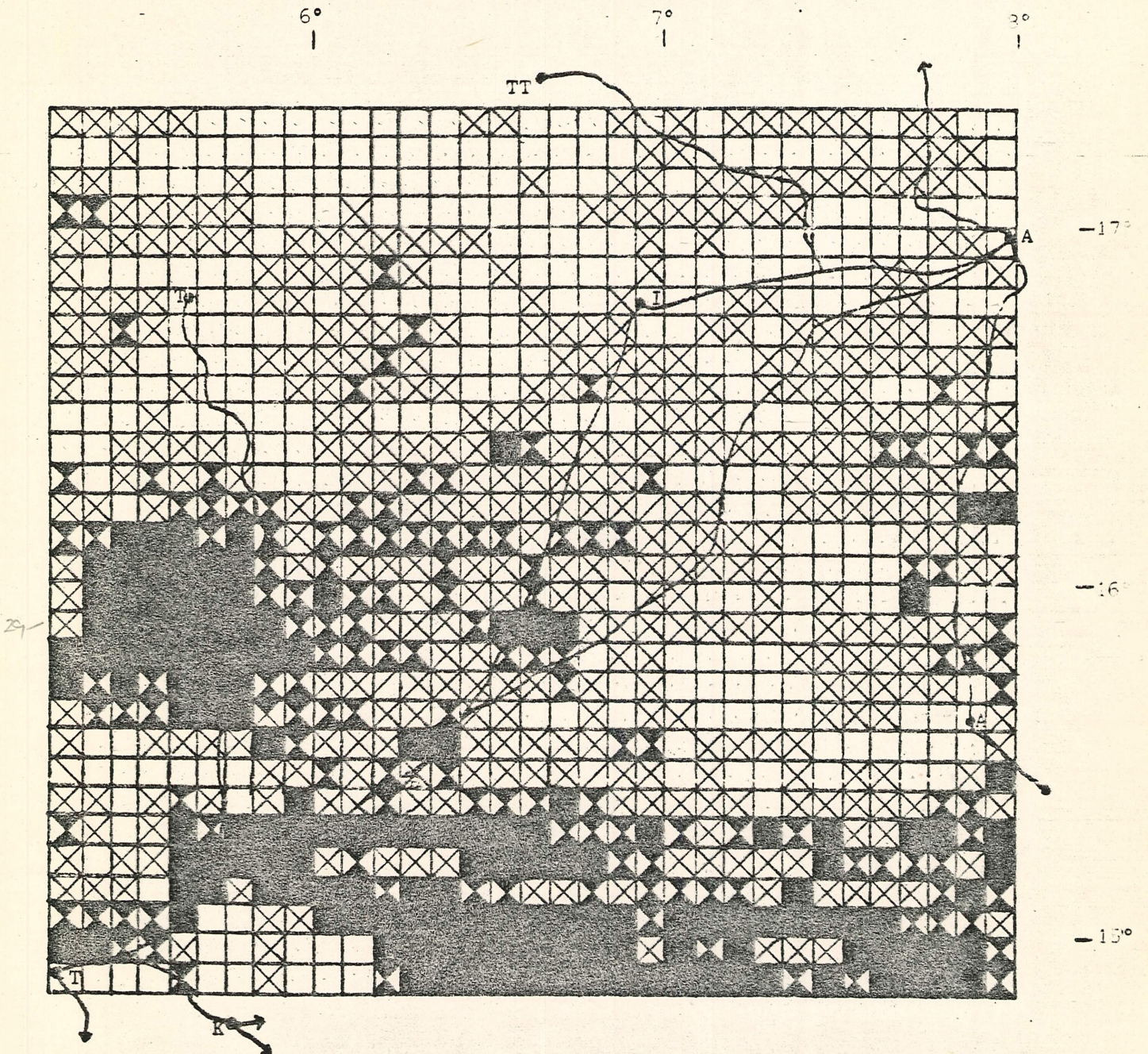
Figure 12. Wet Season distribution of matted Twareg camps.



Camps seen per grid

- 0
- ⊗ 1
- ◻ 2
- 3+

Figure 13. Wet Season distribution of grass cover



% cover

- 0 - 10 - 380
- ⊗ 11 - 30
- ◐ 31 - 50 - 129
- 51+ - 148

990

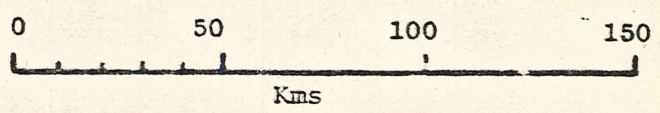
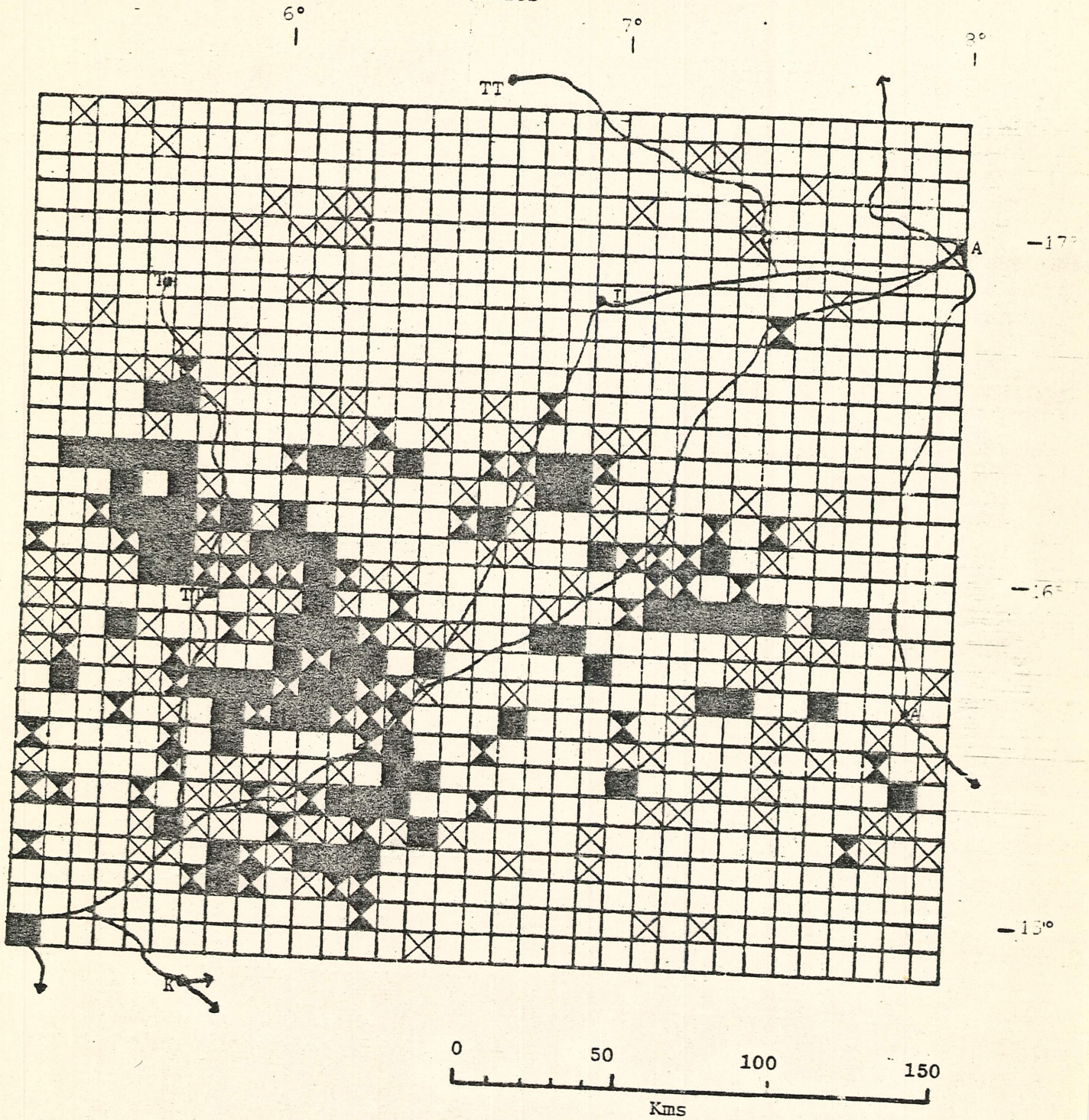


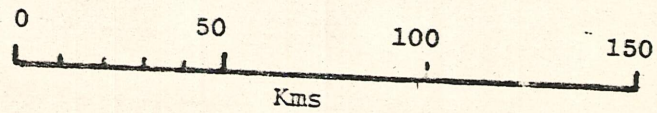
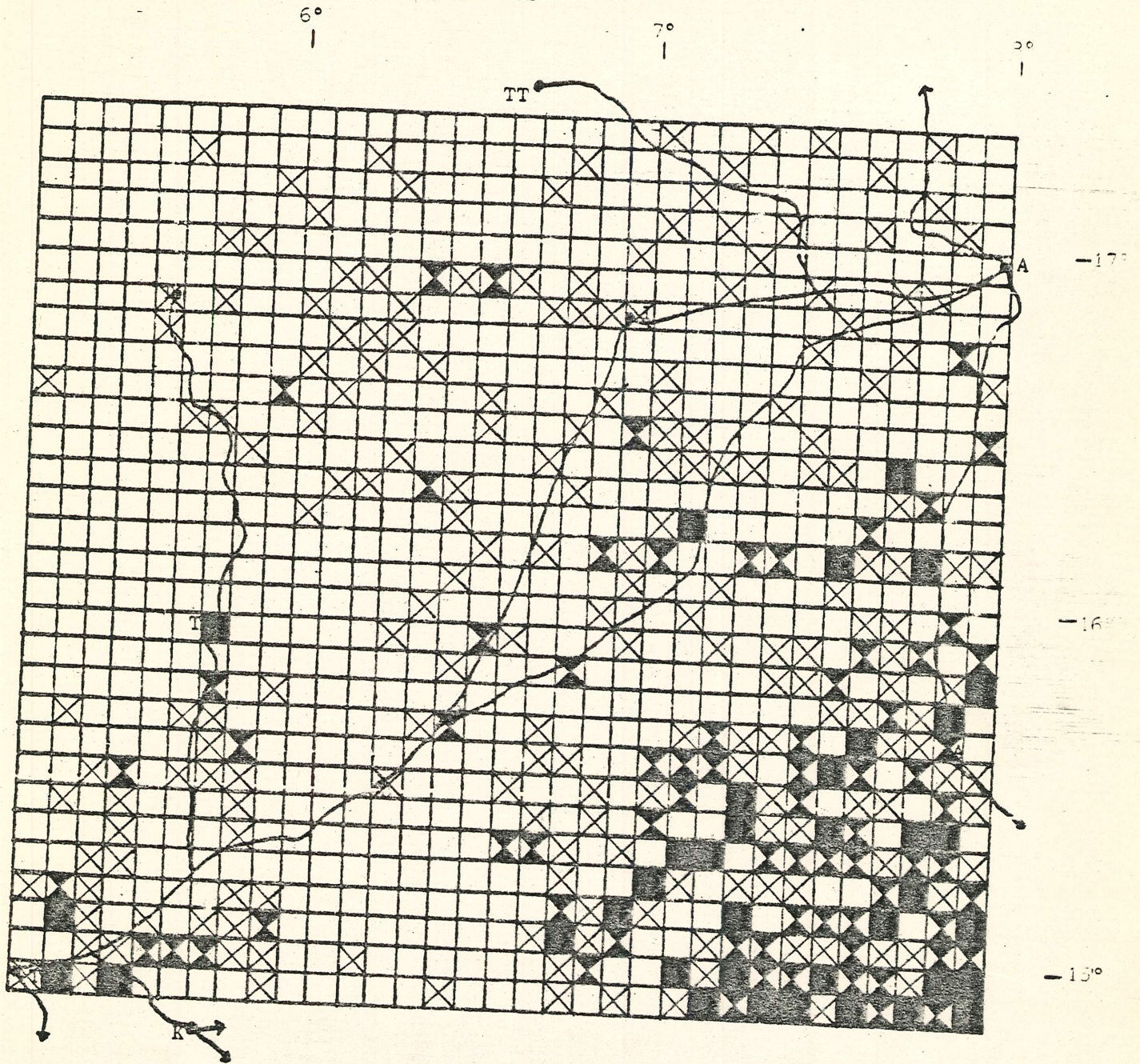
Figure 14. Wet season distribution of Mares



% cover

- 0 - 10
- ⊗ 11 - 30
- ▧ 31 - 50
- 51+

Figure 15. Distribution of total well sites



Well per grid

- 0
- ⊗ 1
- ⊗ 2
- 3+