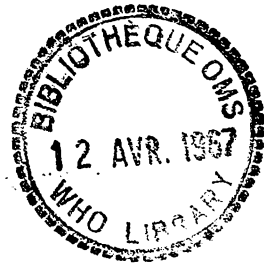


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MALARIA IN KARAMOJA DISTRICT, UGANDA

by

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One of the objectives of the malaria pre-eradication programme in Uganda is the assessment of the malaria situation and the study of epidemiological conditions existing in the country.

Sustained observations on the annual cycle of malaria have been carried out in Masaka District in south-western Uganda (Zulueta et al., 1963) and in Busoga District in central-eastern Uganda (Onori & Benthein, in press). At the same time country-wide malariometric surveys have been carried out in the Eastern, Western and Northern Regions of the country with a view to gaining more knowledge on the distribution of the disease and its vectors.

Usually malariometric surveys are carried out during the rainy season when malaria transmission is likely to be relatively high, but in Karamoja District which differs so much from the rest of the country, ecologically and geophysically, surveys were made during the wet (May-July 1965) and the dry season (February 1966). The results of these observations are presented and discussed in this paper.

KARAMOJA DISTRICT

Karamoja District lies between 1° 30' to 4° 06' N and 33° 30' to 35° E, forming the north-eastern part of Uganda. It is bounded on the north by the Republic of Sudan, on the east by the Republic of Kenya, on the south by Sebei District and on

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the west, from south to north, by Teso and Acholi Districts (Map 1). The district is a large plateau at 3500 ft (1050 m) to 5000 ft (1500 m) above sea level interrupted by a number of isolated peaks which rise to 8000 ft (2400 m) to 10 000 ft (3000 m). It covers an area of 11 363 square miles (29 430 km²). In the east, running from north to south, is a rocky watershed whilst to the west lies an area of flat plains; the so-called "riverine area" lies in between.

Life is a constant hardship as the district is dry and barren. Survival depends on the availability of water, both for human and animal populations. The rainy season is April to November, with a marked minimum in June and marked peaks in May to July; December and January are the driest months. The annual rainfall is approximately 25 in (635 mm) in the plains and 35 in (890 mm) at higher altitudes, but variations and irregularities of rainfall are a feature of Karamoja.

The "rivers" - which are usually only dry beds - are filled during the rainy season. They flow to the west from the steep mountain slopes, on which they leave occasional rock pools. As the water flows over the dry river beds, it seeps into the ground from where it is later recovered by digging shallow wells. From the narrow, steep-sided river beds, the water flows into more open waterways until it reaches the black clay plains and becomes the permanent swampland of Teso District. Semi-permanent waterholes occur on the plains.

Deciduous woodland and perennial grasses cover the rocky highlands in the east. The riverine (central) area supports the greatest number of inhabitants (200 000) and here are found the permanent dwellings and plots of cultivated land on which sorghum, interplanted with cucumber, beans, maize and finger millet, is usually grown. In this area most of the grasses have been destroyed by over-grazing and the growth of acacia trees hindered by grazing goats and chopping for firewood. Settlements are usually built in the vicinity of water-bearing places. The dwelling houses are built in a series of compounds with adjoining yards, huts and granaries all enclosed by a strong wooden fence. Fig and tamarind trees are usually found near the dry river beds.

The Karamojong are a cattle-raising people and an average herd is calculated to contain about 200 beasts; about 30 persons are usually supported by such a herd. As 95% of the land is uncultivated, the livestock provides the population with a means of livelihood. The animals, accompanied by the herdsman, lead a "transhumant" existence (Prothero, 1960 and 1965), moving to the grass plains during the dry season and returning to their homes at the beginning of the rainy season (Map 2). Whilst leading this mobile existence, the cattle exploit the grazing grounds and the herdsman live mainly on milk and blood from their cattle. The women and children stay behind in their homes and they are left with goats and sheep to provide them with milk.

The Karamojong are a "Nilo-hamitic" tribe. Their very existence revolves around their cattle on which they depend for their nutritional, psychological and cultural existence. Cattle are their wealth, bride-price and source of food.

OBSERVATIONS AND RESULTS

Malariometric surveys were carried out during the rainy season in May-July 1965 in seven different localities of the district among different age-groups of the population. As the main objective of the survey was the study of the local epidemiological malaria situation, surveys were also carried out among schoolchildren in 15 different schools at the same time. Localities and schools were selected in the most populated permanent settlements in order to have a fair coverage of the whole district (Map 1). In February 1966 malariometric surveys were repeated among different age-groups of the population in the seven localities where spleen and blood examinations had been carried out during the previous rainy season. This investigation was conducted at the end of the dry season, after two and a half months of almost complete lack of rain (Table 1) to find out whether seasonal fluctuations of malaria transmission occur in the district and whether variations of Plasmodium malariae prevalence rate might be found under different ecological conditions.

Thin and thick blood films were taken from all people examined and spleens were palpated, except in the case of infants, with the patients placed in a recumbent position and with knees flexed; the degree of spleen enlargement was noted following Hackett's classification. The blood films were stained with Giemsa. The thick films were examined for five minutes and the thin films only in case of doubts as to species. All films were cross-examined and a diagnosis other than P. falciparum confirmed by the writer.

The results of the two general mass population surveys are presented in Table 2. The spleen rates, the average enlarged spleen and the parasite rates were 49.4%, 1.6%, 42.3% in May-July 1965 and in February 1966 38.6%, 1.6%, 26.6% respectively.

Table 3 shows the results of school surveys which were carried out in May-July 1965; the over-all spleen rate was 64.0%, the average enlarged spleen 1.6% and the crude parasite rate 51.5%, but there were marked differences from one locality to another.

Table 4 shows the distribution of Plasmodium species by different age-groups as encountered during the rainy and dry season surveys. It will be noticed that in all age-groups and during both surveys P. falciparum was the most prevalent species accounting for 85.3% and 79.9% of all infections during the wet and dry season surveys respectively. P. malariae came second with 14.4% and 19.8%, followed by P. vivax with 0.2% and 0.3% and P. ovale with 0.1% and 0.0%.

Entomological observations. Single daytime spray-catches by pyrethrum were carried out in 10 houses in each of the seven localities selected for mass examinations in the two different seasons and in a few localities where school surveys were carried out during the rainy season. In February 1966, as mosquitos were very few, the number of houses sprayed was increased to 15 or 20 in five of the seven localities.

The flitting catches were carried out to study: (a) the anopheline fauna, (b) the anopheline densities in houses, (c) the sporozoite rates, (d) the blood-fed/gravid ratios and (e) the identification of blood meals from samples collected in different types of structures. The meal samples were forwarded to the Lister Institute, England, for their identification. Egg-batches of Anopheles gambiae from samples collected in natural shelters in a locality (Acholichor) of southern Karamoja were sent to the London School of Hygiene and Tropical Medicine for genetical studies.

Table 5 shows the results of the single daytime spray-catches carried out in the seven different localities of Karamoja District in June-August 1965 and February 1966. From the table it would appear that A. gambiae is the main vector in the district. It was found resting in houses in all the localities which were surveyed during the

rainy season and it was also found, though in very scanty numbers, in Karita, Amudat, Kangole, Kaabong and Morulem during the dry weather. A. funestus was found only in Karita (three), Kotido (three), Namalu (2030), Morulem (two) and Karenga (one) during the wet season.

A. gambiae with infected glands were found at Karita (1.0%), Kotido (3.0%) and Morulem (30.0%) during the wet season and no gland infections were detected during the dry season; in Morulem only 10 mosquitos were dissected during the rainy season. Of the A. funestus found during the wet season 69 were dissected but all proved to be negative.

The fed/gravid ratio for A. gambiae which were collected in June-August 1965 was 6:4, which is an indication of endophilic tendency. The identification of blood meals showed that A. gambiae feed readily on man (60.4%) and bovid (33.3%) difference being made up by dog (5.7%) and horse (1.04%). However, it must be admitted that the number of blood meals investigated was not very high.

Finally the eggs of one of the A. gambiae families which were caught when resting in natural shelters at Acholichor were identified as species B. A few adults were tested on 0.4% dieldrin for one hour and all died, indicating susceptibility to this insecticide.

DISCUSSION

Malaria endemicity is at present recorded following either the classification formulated at the Malaria Conference in Equatorial Africa held in Kampala in 1950 (WHO, 1951), based on the spleen rates in different age-groups or that proposed by Matselaar and Van Thiel (1959) based on the results of blood examinations only. In Karamoja District it is felt that preference be given to the Matselaar and Van Thiel's classification for, as it will be discussed later, other diseases than malaria might contribute to spleen enlargement.

Following this classification it would appear that malaria endemicity in Karamoja, based on malarionetric surveys carried out during the wet season, can be mesoendemic, hyperendemic or holoendemic. Mesoendemic conditions prevailed in the eastern rocky highlands and valleys which run from north to south through the district and which

are covered by deciduous woodland and perennial grasses. Hyperendemicity was found in the remaining part of the district, the so-called "riverine area" or the main area of habitation, and where the vegetation is mainly of the dry acacia savannah type. An exception to this were the high indices of spleen and parasite rates found in Labwor county - Morulem and its surroundings - among the two to nine years old age-group, strongly indicating that here malaria reaches the holoendemic level.

Comparing the results of the two different seasonal surveys it is evident that during the dry season the parasite rates dropped considerably in almost all the localities visited. This might be considered as an indication of seasonal fluctuation of malaria transmission. However, there are reasons to believe that the transmission of the disease continues even during the dry season in most parts of the district, though at a very low level. During the surveys carried out in February 1966 few babies of the age of two months were found to be infected - three in Amudat, two in Nabilatuk, one in Kangole, one in Kaabong and two at Morulem. At the very end of the dry season transmission might cease; if it does, it lasts for a very short period and provided that no rains fall during the dry months, a possibility which should not be overlooked in Karamoja.

Morulem should be considered apart because Labwor county, of which Morulem is the centre, is much wetter than the rest of Karamoja and there are therefore possibilities for vector breeding throughout the year. In fact, at the end of February 1966, two infants aged one month were found positive for P. falciparum infection; an indication that at Morulem transmission is perennial.

The parasitological findings were confirmed by the entomological investigations. In February 1966, in dry weather conditions, few A. gambiae were still found at Karita (anopheline density index (a.d.i.) = 3.1), Amudat (a.d.i. = 5.2), Kangole (a.d.i. = 0.05), Kaabong (a.d.i. = 0.07) and Morulem (a.d.i. = 0.07). Once the rains start the high endemicity levels are reached in a very short time. The herds-men returning home with their cattle from the distant grassland and water sources, where they had spent a period of time, usually ranging from November to March (Map 2), bring with them a good reservoir of infection. With the mosquito population reaching its highest level and a good availability of gametocyte carriers, it is a question of a few weeks before malaria comes back to hyperendemicity.

P. falciparum was the most prevalent species; it accounted for 85.3% of all infections during the rainy season and 79.9% in dry weather. P. malariae prevalence rate was 14.4% in the wet and 19.8% in the dry season. P. vivax was recorded in 0.2% of all infections in May-July 1965 and in 0.3% in February 1966. P. ovale was found only on two occasions during the rains (0.1%), one case at Loro and one case at Morulem. The distribution and prevalence of Plasmodium species, as shown by the results of the present study, were not at variance with the findings of Wilson & Wilson (1962). These authors carried out malarimetric surveys in four localities of Karamoja District in April-May 1960; the parasite rates varied between 28.0% and 59.6% with a P. malariae incidence of 4.0% to 15.3%. P. malariae prevalence rate, according to our results, was significantly higher during the dry season than during the rainy season. In fact, by using the method of combining fourfold contingency tables given by Cochran (1954) it appears that P. malariae was more prevalent during the dry season (two-sided significance level of 2%). However, it is worth while noting here that on no occasion were we able to detect such a high prevalence rate of the magnitude of 92.2% which had been recorded at Moroto in January 1962 among children aged 0 to four years (Jelliffe & Jelliffe, 1963). In February 1966, 160 children aged 0 to four were examined at Moroto by the malaria pre-eradication team and only 22 (13.8%) exhibited malaria parasites in their blood. Of these, 18 had P. falciparum infection (75.0%) and only six (25.0%) were infected with P. malariae. The discrepancy between our and Jelliffe's findings cannot be explained by the assumption (Jelliffe, personal communication) that in January 1962 the investigation was conducted under exceptionally dry weather conditions. In 1961 in fact, the rainfall in inches recorded at Moroto amounted to 55.42 in, of which 2.66, 10.75 and 3.75 in fell in October, November and December respectively.

Wilks (personal communication) also found a high prevalence rate of P. malariae (80.4%) in January 1962 examining 194 blood films taken from children and adults at Kaabong and Amudat, but was unable to confirm these findings in successive surveys. The only possible explanation might be that both Jelliffe and Wilks met with very exceptional foci of P. malariae in January 1962; a situation that successive investigations could not confirm and which would therefore suggest that their findings were exceptional and of limited epidemiological significance.

In malarionetric surveys carried out during the rainy and dry seasons, spleen rates were found to be higher than the parasite rates, though the average enlarged spleen was identical on both occasions. Brucellosis, kala-azar and idiopathic splenomegaly were considered as possible contributing factors to the enlargement of the spleens. Although very little is known about the distribution and endemicity of kala-azar, our knowledge has recently improved regarding the problem of brucellosis. Cox (1966) has published the results of a survey carried out in Amudat, southern Karamoja. He found that among 139 patients with large spleens and 54 patients with musco-skeletal symptoms, 27% of the patients with splenomegaly and 38% of the patients with musco-skeletal troubles had titres for Brucellae greater than 1:240.

The idiopathic splenomegaly is a syndrome consisting of splenomegaly with dilation and lymphocytic infiltration of the liver sinusoids (Fawdry, 1955; Chaudhuri & Chaudhuri, 1956; Leather, 1961) and an unusually high malaria antibody titre (Gebbi et al., 1964) in the absence of any known etiology. The suggestion that the syndrome may be due to an abnormal immune response to chronic infection with P. malariae (Marsden et al., 1965) seemed to find support on the high prevalence of P. malariae reported by Jelliffe & Jelliffe (1963) and Jelliffe et al. (1964), in Karamoja and the relatively high number of idiopathic splenomegalies found at Moroto (Hamilton et al., 1965). Although we were unable to confirm the high prevalence rate of P. malariae infection found by previous authors in Karamoja District, the 19.8% prevalence rate of this Plasmodium, detected during the 1966 dry season in Karamoja, is one of the highest encountered in Uganda in the course of country-wide malarionetric surveys.

SUMMARY

Karamoja District, in north-eastern Uganda, differs markedly in ecological, geophysical and cultural aspects from the rest of the country. The results of malarionetric surveys carried out in this special environment during the rainy (May-July 1965) and dry seasons (February 1966) are presented. It would appear that malaria endemicity can be classified as mesoendemic and hyperendemic respectively in the eastern and central parts of the district when the results of the wet season survey are taken into consideration. At this time malaria endemicity in Labwor county reaches the holoendemic level.

Seasonal fluctuations of malaria transmission were evident with malaria indices dropping significantly during the dry season. However, malaria transmission seemed to persist under unfavourable meteorological conditions, though at a very low level, in most parts of the district. At the beginning of the rainy season an important role in restoring and maintaining the transmission of the disease is played by the herdsmen who return, often with malaria infections, to the settled communities.

P. falciparum was the most prevalent species (85.3% and 79.9% during the wet and dry seasons respectively), followed by P. malariae (14.4% and 19.8%). P. vivax (0.2% and 0.3%) and P. ovale (0.1% in the wet season) had a very scanty and patchy distribution. P. malariae prevalence rate was significantly higher during the dry season, though confirmation was not obtained of the very high malariae rate previously reported in the area.

A. gambiae was the main vector found in the district; A. funestus was far less numerous and patchy in distribution. Genetical studies carried out on A. gambiae collected at Acholichor, south Karamoja, identified this mosquito as species B.

The high spleen rates found in both surveys with an average enlarged spleen showing no variations suggest that other diseases than malaria may be responsible for the splenomegaly. The role of brucellosis has recently been recognized, whereas the epidemiological significance of kala-azar and idiopathic splenomegaly is still a matter for further investigations.

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Finally we would like to thank the staff of the malaria pre-eradication programme who participated in the present investigation.

RESUME

Les auteurs rapportent les résultats d'enquêtes paludométriques effectuées dans le district de Karamoja, dans le nord-est de l'Ouganda. Ils considèrent qu'une transmission de faible degré se poursuit tout au long de l'année dans la plus grande partie du district, et qu'il se produit au début de la saison des pluies une importation considérable de cas due aux mouvements de population.

Si Plasmodium malariae est responsable de près de 20 % des cas, avec un taux de prévalence de 25 % dans un secteur, il s'en faut de beaucoup que le taux très élevé de 92,2 %, observé en 1962, soit atteint. Il semble en conséquence qu'il se soit agi d'un phénomène exceptionnel n'ayant donc qu'une faible portée épidémiologique.

L'indice splénique élevé observé dans les deux enquêtes et les faibles variations de la splénomégalie moyenne donnent à penser que cette dernière est imputable à d'autres causes que le paludisme.

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TABLE 1. RAINFALL AS RECORDED AT MOROTO AND KAABONG
KARAMOJA DISTRICT, UGANDA, JANUARY 1964 TO FEBRUARY 1966

Year	Month	Moroto		Kaabong	
		Inches	mm	Inches	mm
1965	January	1.30(.17)*	33(3)*	0.38(Nil)	10(Nil)
	February	0.15(0.92)	4(23)	Nil(0.05)	Nil(1)
	March	2.26(2.90)	57(74)	2.97(1.10)	75(28)
	April	6.01(4.84)	153(123)	4.40(0.86)	112(22)
	May	1.73(2.61)	44(66)	1.80(0.86)	46(22)
	June	0.41(2.85)	10(72)	0.44(4.32)	11(110)
	July	2.05(10.13)	52(257)	3.71(3.76)	94(96)
	August	0.90(2.66)	23(67)	1.08(3.61)	27(92)
	September	0.96(5.89)	24(150)	Nil(3.25)	Nil(83)
	October	3.19(Nil)	81(Nil)	1.75(1.17)	44(30)
	November	2.80(Nil)	71(Nil)	1.38(Nil)	35(Nil)
	December	0.87(0.47)	22(12)	0.47(1.21)	12(31)
1966	January	Nil	Nil	Nil	Nil
	February**	5.79	147	1.62	41

* Figures in brackets refer to 1964.

** Heavy rainfalls in February 1966 were experienced towards the end of the month, during or after malarionetric and entomological surveys were carried out. The results of February surveys reflect, therefore, the malaria situation as it was at the end of the dry season.

TABLE 2. RESULTS OF TWO MALARIOMETRIC SURVEYS CARRIED OUT AMONG DIFFERENT AGE-GROUPS IN KARAMOJA DISTRICT, UGANDA

Locality	May-July 1965						February 1966					
	Spleen examination			Parasite examination			Spleen examination			Parasite examination		
	Number examined	Spleen rate	A.E.S.	Number examined	Gametocyte rate	Parasite rate	Number examined	Spleen rate	A.E.S.	Number examined	Gametocyte rate	Parasite rate
Amudat	296	30.1	1.3	319	3.2	12.2	295	30.2	1.5	338	8.9	14.8
Karita	194	57.7	1.5	211	3.3	19.9	215	56.7	1.8	238	15.1	28.2
Nabilatuk	297	60.6	1.6	328	9.8	50.0	298	51.3	1.5	346	15.3	33.2
Kangole	209	54.5	1.4	218	5.0	31.7	290	39.3	1.6	340	10.6	22.6
Morulem	311	60.5	1.8	350	36.9	66.9	300	50.7	1.5	348	21.6	47.1
Kotido	246	58.1	1.6	276	27.1	56.9	310	31.0	1.5	352	10.8	29.0
Kaabong	258	26.4	1.7	290	10.0	30.0	301	15.6	1.3	348	5.2	11.5
Total	1 811	49.4	1.6	1 992	14.6	42.3	2 009	38.6	1.6	2 310	12.4	26.6

TABLE 3. RESULTS OF MALARIOMETRIC SURVEYS CARRIED OUT AMONG SCHOOLCHILDREN, AGED 5-15, IN KARAMOJA DISTRICT, UGANDA, MAY-JULY 1965

Locality	Spleen examination			Parasite examination		
	No. examined	Spleen rate	A.E.S.	No. examined	Gametocyte rate	Parasite rate
Moruita	78	57.7	1.4	78	9.0	38.5
Loro	90	32.2	1.5	90	1.1	10.0
Namalu	102	68.6	1.6	102	18.6	71.6
Lolachat	70	73.0	1.9	70	1.4	50.0
Lorengedwat	78	79.5	1.8	78	14.1	53.0
Moroto	160	45.0	1.5	160	5.0	20.6
Nyakwei	85	85.0	1.5	85	34.1	94.1
Atunga	72	62.5	1.6	72	27.8	70.8
Alerek	52	90.4	1.7	52	48.1	94.2
Panyangara	90	70.0	1.6	90	21.1	50.0
Kapelimoro	66	66.7	1.6	66	25.8	72.7
Kacheri	35	94.3	1.6	35	28.6	74.3
Karenga	200	76.0	1.7	200	19.5	60.0
Nalakas	58	62.1	1.5	58	12.1	44.8
Loyoro	64	21.9	1.4	64	3.1	15.6
Total	1 300	64.0	1.6	1 300	16.5	51.5

TABLE 4. PREVALENCE RATES OF INFECTIONS BY DIFFERENT AGE-GROUPS OBTAINED IN KAROMOJA DISTRICT, UGANDA, DURING THE RAINY AND DRY SEASON SURVEYS (MAY-JULY 1965 AND FEBRUARY 1966)

Age-groups	May-July 1965										February 1966									
	No. examined	P. falciparum		P. malariae		P. ovale		P. vivax		No. examined	P. falciparum		P. malariae		P. ovale		P. vivax			
		Positive	P. rate	Positive	P. rate	Positive	P. rate	Positive	P. rate		Positive	P. rate	Positive	P. rate	Positive	P. rate	Positive	P. rate	Positive	P. rate
0-11 months	181	53	93.0	4	7.0	0	0.0	0	0.0	301	42	93.3	3	6.7	0	0.0	0	0.0		
12-23 months	140	57	80.1	12	17.1	1	1.4	1	1.4	298	90	78.9	22	19.3	0	0.0	2	1.8		
2-4 years	309	136	76.0	43	24.0	0	0.0	0	0.0	350	99	67.3	48	32.7	0	0.0	0	0.0		
5-9 years	873	419	84.0	78	15.6	1	0.2	1	0.2	345	122	78.2	34	21.8	0	0.0	0	0.0		
10-14 years	1 147	484	87.2	70	12.6	0	0.0	1	0.2	341	82	83.7	16	16.3	0	0.0	0	0.0		
15-19 years	297	92	89.3	11	10.7	0	0.0	0	0.0	330	57	95.0	3	5.0	0	0.0	0	0.0		
20+ years	345	34	94.4	5	5.6	0	0.0	0	0.0	345	42	87.5	6	12.5	0	0.0	0	0.0		
Total	3 292	1 325	85.3	223	14.4	2	0.1	3	0.1	2 310	534	79.9	132	19.8	0	0.0	2	0.3		

TABLE 5. RESULTS OF SINGLE DAY TIME SPRAY-CATCHES CARRIED OUT IN SEVEN DIFFERENT LOCALITIES OF KARAMOJA DISTRICT, UGANDA (JUNE-AUGUST 1965 AND FEBRUARY 1966)

Locality	Time of survey	Number of houses examined	<i>A. gambiae</i>				<i>A. funestus</i>			
			Index ♀	Blood fed / gravid	Glands		Index ♀	Blood fed / gravid	Glands	
					Ex.	% + ve			Ex.	% + ve
Karita	June 1965	10	28.7	55/45	100	1.0	0.3	67/33	3	0.0
	February 1966	10	3.1	71/29	31	0.0	0.1	0/100	1	0.0
Amudat	June 1965	10	29.0	80/20	160	0.0	0.0	-	-	-
	February 1966	10	5.2	48/42	52	0.0	0.0	-	-	-
Nabilatuk	June 1965	10	2.0	95/5	20	0.0	0.0	-	-	-
	February 1966	20	0.0	-	-	-	0.0	-	-	-
Kangole	June 1965	10	13.2	53/47	100	0.0	0.0	-	-	-
	February 1966	20	0.05	100/0	1	0.0	0.0	-	-	-
Kotido	August 1965	10	6.5	56/44	65	3.0	0.3	67/33	3	0.0
	February 1966	15	0.0	-	-	-	0.0	-	-	-
Kaabong	August 1965	10	0.2	100/0	2	0.0	0.0	-	-	-
	February 1966	15	0.07	100/0	1	0.0	0.0	-	-	-
Morulem	August 1965	10	1.0	70/30	10	30.0	0.2	0/100	2	0.0
	February 1966	15	0.07	0/100	1	0.0	0.0	-	-	-

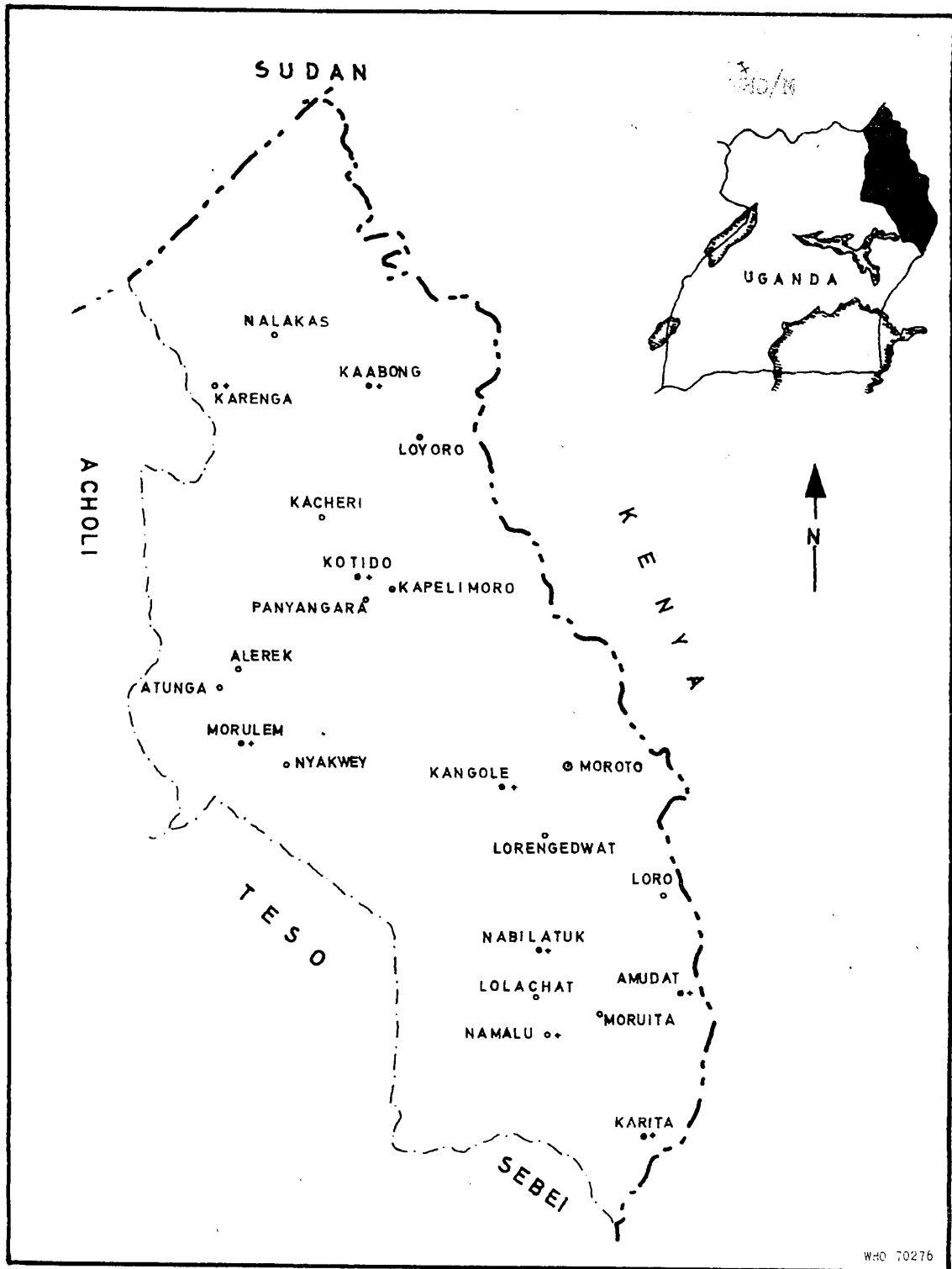
The purpose of the WHO/Mal series of documents is threefold:

- (a) to acquaint WHO staff, national institutes and individual research or public health workers with the changing trends of malaria research and the progress of malaria eradication by means of summaries of some relevant problems;
- (b) to distribute to the groups mentioned above those field reports and other communications which are of particular interest but which would not normally be printed in any WHO publications;
- (c) to make available to interested readers some papers which will eventually appear in print but which, on account of their immediate interest or importance, deserve to be known without undue delay.

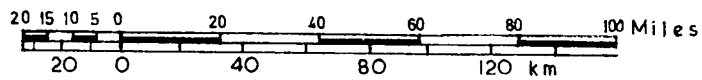
It should be noted that the summaries of unpublished work often represent preliminary reports of investigations and therefore such findings are subject to possible revision at a later date.

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Map 1. SHOWING THE STUDY AREA - KARAMOJA DISTRICT - UGANDA.



REFERENCE



- MASS SURVEY
- SCHOOL SURVEY
- * SINGLE SPRAY CATCH

Map 2. MOVEMENTS OF KARAMOJONG TOWARDS AND AWAY FROM THE WESTERN PART OF THE DISTRICT WITH THE ALTERNATION OF DRY AND WET SEASONS

