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AN INVESTIGATION OF THE ANNUAL CYCLE OF MALARIA IN AN AREA OF UGANDA

by

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1. INTRODUCTION

In the course of the malaria pre-eradication programme in Uganda, extensive malariometric and entomological surveys have already been carried out in the Eastern, Western and part of the Northern regions of Uganda, with a view to gaining more knowledge on the distribution of the disease and its vectors, and they will be gradually extended to cover the whole country.

At the same time observations on the annual cycle of malaria have been undertaken in the Busoga district of central-eastern Uganda, in order to obtain more detailed information with regard to seasonal fluctuations of the disease and the results of these observations are discussed in the present paper.

These studies, together with the results of work carried out in recent years in Uganda (de Zulueta et al., 1961, 1963 and 1964) will provide base line data for the future planning of a malaria eradication programme.

The Busoga district lies 0°-1° 30' North and 33°-34° East in the western part of the Eastern Region of Uganda. On its southern shores lies Lake Victoria, west and east are the Nile and Mpologoma rivers respectively and north the swampy

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Lake Kyoga (Fig. 1). The surface is approximately 6876 square miles (11 065 km^2) of which 3709 (5969 km^2) are of land and swamp and 3167 (5096 km^2) of open water including the territorial waters of Lake Victoria. Busoga is the most densely populated district of the Eastern Region with a census population in 1959 of 660 507 inhabitants (estimated in 1964 to be 747 304) mainly of the Bantu stock.

Topographically the area is characterized by flat-topped hills of uniform height (about 4300 ft (1010 m)) with swamp inlets in the vicinity of the two lakes which are often floored with extensive papyrus growth. In the north the vegetation is mainly wooded savannah, becoming thicker southwards (forest/savannah mosaic) until it changes to medium altitude moist semi-deciduous forest near Lake Victoria.

The climate of the area shows comparatively small seasonal variations of temperature, humidity and winds throughout the year. There is a relatively dry season between December and March and another in June and July, but both are frequently broken by thunderstorms. Consequently rainfall is well distributed throughout the year with a principal peak in March, April, May and a smaller one in October, November.

During the period of the present observations the mean maximum and minimum temperatures were 84.4°F (29.1°C) and 60°F (16°C) respectively and relative humidity 85% at 09.00 hours and 62% at 15.00 hours with little variation from month to month. On the lake shores the rainfall amounts to 60" to 70" (1525 mm to 1780 mm) per annum and occurs on an average of 160 to 170 days each year. There is a marked gradient of annual rainfall amounting approximately to one inch (25 mm) decrease per mile (1.6 km) inland.

The soil in Busoga is very fertile and the main activity of the people is agriculture. The main crops are cotton, coffee, ground-nuts, maize, sugar and timber; cattle-raising in the north is another steady source of income.

In the south, especially around Jinja which is the capital of the district and the most important industrial town of Uganda, considerable development has recently taken place.

Field operations for the study of the duration of and fluctuation in the transmission season of malaria in Busoga were initiated in February 1964 and continued until the end of February 1965. They consisted of malariometric and entomological surveys carried out at regular intervals in selected localities of the district and of monthly infant and fever surveys.

2. METHODS

Malariometric surveys. In January 1964 preliminary malariometric surveys were carried out in some localities of the district in order to gain more knowledge on the distribution of the disease. From the results of these preliminary surveys 10 localities were finally selected on a geophysical and epidemiological basis in order to assure a fair coverage of the area under investigation (Fig. 1). Kidera and Nawaikoke are situated on the shores of Lake Kyoga, with a vegetation of the wooded savannah type and with breeding-places in permanent swamps. Kaiti is also in a wooded savannah area but far from the lake and with seasonal swamps as breeding-places. Kamuli (Mbulamuti), Kiyunga, Bugiri, Iganga and Mafubira are in the territory which extends between Lake Victoria and Lake Kyoga with a forest/savannah mosaic vegetation and with permanent and temporary swamps (Kamuli, Kiyunga) or seasonal pools (Mafubira), or a permanent river with swampy inlets (Bugiri and Iganga) as breeding-places. Kaluba and Rwangosha are in the southern section of the district, in a medium altitude semi-deciduous forest environment with vestor breeding taking place in permanent swamps and seasonal pools. School surveys were carried out regularly in these localities at approximately three monthly intervals, whilst general mass population surveys were conducted in eight of the same localities at six month intervals. School surveys were always carried out in the same selected schools and many children were regularly followed up. On the other hand detailed records were not kept nor were accurate serial parasite rates carried out among schoolchildren. In the mass surveys, people were examined at random at the time of the two surveys. It is extremely difficult to measure a parasite rate in an entire village community in Uganda and follow this up as habitations are so widely scattered and co-operation is often poor, so that even a proper random selection of the group is not easy.

Thin and thick blood films were taken from all persons examined ans spleens were palpated with the patient placed in a recumbent position and with knees flexed except in the case of infants in whom spleen enlargement was not recorded. 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 thin films only in case of doubts as to species.

Monthly infant and fever surveys. Arrangements had been made for the collection of blood films from all infants and fever cases attending the medical units existing in Busoga district (Fig. I). Films were taken by the medical assistant in charge of the unit and collected at fortnightly intervals by the project staff for examination at the central haematological laboratory at Jinjo.

Entomological studies. Eight indicators districts were selected in Busoga for carrying out entomological activities at monthly intervals. The selection was based on malariometric findings and consequently the indicator districts were situated in areas where malariometric surveys had been made so that the studies would be run in parallel (Fig. I). The localities selected were : Nawaikoke and Kidera in the vicinity of Lake Kyoga shores, Mbulamuti, Kiyunga and Bugiri in central Busoga, Lugala and Kityerera on the shores of Lake Victoria and finally Kazinga, a locality 11 miles (18 km) from Jinja on the banks of the river Nile.

The techniques used during the observation period were: (a) day-time spray catches once a month in eight fixed houses of different types of structure in each indicator district; (b) all-night catches on man and animals indoors and outdoors for two consecutive nights monthly in four (northern Busoga) of the eight indicator districts; (c) window-trap observations, utilizing local premises in each of the four indicator districts which had been selected for night-catches: collections from traps were made in two consecutive days and at monthly intervals; (d) identification of blood digestion stages and salivary gland dissections from samples collected on spray-catches; (e) identification of blood meals from samples collected in different type of structures. The blood samples from mosquitos were forwarded to the Lister Institute, England, for their identification.

Regular night-catches and window-trap observations were introduced only in September and November 1964 respectively. However, few mosquitos were collected by the use of these techniques, a finding which was contrary to the high incidence of malaria found in the area. The paucity of the results might have been partly due to technical faults, i.e. wrong selection of houses, the location of houses too far from the breeding-places etc. Only recently the introduction of bed-traps in night-catches has shown promising results, whereas the failures to collect vectors from window-traps and in natural shelters are still a matter for further investigations.

3. EPIDEMIOLOGICAL AND ENTOMOLOGICAL RESULTS

Malariometric surveys. The results of the two general mass population surveys and the four school surveys are represented in detail in Tables 1 and 2 and Table 3 shows the distribution of malaria by age-groups as found in February-March and September-October 1964 in schools and mass surveys (Fig. 2). The total number of persons examined for spleen enlargement was 8715 and 3375 presented with an enlarged spleen (38.7%). The total number of slides taken was 9204 of which 3301 were positive for malaria parasites (35.9%).

Following the classification formulated at the Malaria Conference in Equatorial Africa in 1950 it will be noticed that malaria endemicity in Busoga can be classified as hyperendemic and mesoendemic. Hyperendemic conditions prevailed along the Lake Victoria and Lake Kyoga shores, whereas mesoendemic malaria was encountered in that part of the district which extends between the two lakes. What this is due to is difficult to say as metereological conditions are similar throughout the district, breeding-places for vectors can be found all over and human habits do not differ from place to place. If malaria endemicity is correlated to ecological conditions it would appear that highest indices were found in areas predominantly of the wooded savannah type - northern Busoga - and along the Lake Victoria shores where the vegetation is represented mostly by a medium altitude moist semi-deciduous forest. Another possible contributing factor is that medical facilities such as health centres and dispensaries are well distributed in central Busoga and almost non-existent along the lake shores.

The distribution of malaria in different age-groups is shown in Table 3. It will be noticed that the highest parasite rates were found in the two to four years group when surveys were carried out in February-March 1964 and in the 10-14 years group when the same were done in September-October 1964 (Fig. 2). In both instances the parasite rates in infants and one-year-old babies were rather low, and this is in agreement with the results obtained by other workers in another part of East Africa (Pringle, 1964).

The relative prevalence of infections, based on the examination of 39 789 blood films which had been collected in Busoga district during the year in the course of malariometric surveys and infants and fever case surveys, shows that Plasmodism falciparum was the most prevalent species (95.9%) followed by P. malariae (4.04%) and P. ovale (0.05%). P. malariae and P. ovale infections seem to have the tendency to decrease more rapidly than that of P. falciparum with the advancement of age and this is in agreement with other findings in Africa (Wilson, 1936; Davidson & Draper, 1953; Davidson, 1955; Draper & Smith, 1957; Price & Lewthwaite, 1963; de Zulueta et al., 1963).

Malaria incidence did not show great variations during the year. Conditions for malaria transmission seemed to have reached their optimum during the long rainy season, when the highest spleen and parasite rates were obtained in our malariometric surveys and the highest vector densities were also recorded. However, conditions seem to be favourable for perennial transmission as it will be better shown by the results of our monthly infant and fever surveys.

Infant surveys. The results of monthly infant parasite surveys are summarized in Table 4. From February 1964 to February 1965, 8019 blood films were taken and 1221 were found positive (15.2%). Malaria transmission appears to have occurred throughout the observation period and no great fluctuations were noted from month to month (Fig. 3). The highest parasite rate was found in March 1964 (27.9%) and the lowest in January 1965 (8.1%), whereas in the remaining months malaria rates varied between 19.7% in June 1964 and 11.6% in August 1964. The high incidence of malaria in March may be related to the heavy rainfall experienced in February which was also accompanied by high vector densities (13.4%) and sporozoite rates (1.2%), whereas the low figure for January might be explained with the dry weather of the second fortnight of December and the entire month of January, which accounted for low vector densities (5.1% and 6.6%) and low sporozoite rates (0.7% and 0.0%) respectively for December 1964 and January 1965. It might be argued that our investigation was carried out among a special selected sample of the infant population. This is only partially true as blood films were taken from ill babies and from those who were regularly attending the child welfare clinics without being apparently sick. The evidence that every month there were malaria cases among infants, especially in the 0-2 month old babies (Fig. 4) seems to be strongly indicative that malaria transmission in Busoga is perennial.

Fever surveys. Table 5 presents the results of fever surveys (oral temperature over 99°F (37.2°C)) which were carried out in Busoga district from February 1964 to February 1965. The total number of slides taken during the period was 22 566 of which 4145 showed malaria parasites (18.4%). Here again there was no marked seasonal trend and the incidence of malaria among fever cases showed very little fluctuation from month to month. If the monthly parasite rates obtained in the 0-2 month old babies and those obtained among fever cases are expressed graphically, the similarity of the two curves is rather striking (Fig. 3).

Another interesting finding was that parasite rate among fever surveys (18.4%) was lower than the over-all parasite rate found in general mass population and school-children surveys (35.9%). This seems to support the findings of de Zulueta et al., 1963 who came across with the same unexpected finding in Masaka district in Uganda; that is when malaria reaches a certain level of endemicity, immunity is comparatively strong, overt attacks of malaria become rare and as a consequence the positivity in fever cases is no higher than in a cross-section of the population. The over-all parasite rate found in Busoga in general mass population and school surveys (35.9%) was higher than the parasite rate found in Masaka among the same unselected sample of the population (24.0%).

Entomological results. A total of 2553 female Anopheles gambiae and 3951 female A. funestus were obtained in day-time spray-catches by flitting and carried out monthly from February 1964 to February 1965 in 64 fixed catching stations in Busoga district, combined densities per hut varying from 16.6 in May 1964 to 4.1 in July 1964. Other Anophelines caught during these entomological surveys, were A. coustani, A. hancocki, A. moucheti, A. marshalli, A. pharoensis, A. squamosus, A. wellcomei but none were found infected with sporozoites. Of these Anophelines only A. hancocki and A. moucheti seem to deserve some special consideration. A. hancocki was reported for the first time in Uganda in 1932 (Gibbins, 1932) and at that time in 1014 dissections 2.7% mosquitos had infected glands. In 1946-1947, in the course of spraying experiments carried out by the Pesticide Research unit (Hocking, Personal Communication) around a military camp at Jinja, 22 A. moucheti were found infected out of 9293 dissections (0.23%). In our investigation in Busoga we found only one specimen of A. hancocki with infected glands in January 1964 and no gland infections were detected among 1008 dissections of A. moucheti. These data seem to indicate that the potentiality of these two species as vectors of malaria is now very little; however we feel that further investigations should be carried out to provide adequate information on the infection rates, contact with man and age composition of A. hancocki and A. moucheti before their importance in malaria transmission in Busoga can be ruled out.

The results expressed graphically in Fig. 4 show that apparently there were marked seasonal variations in the densities of A. gambiae and A. funestus. Whenever A. gambiae density increased the density of A. funestus decreased and vice versa. This seemed to be clearly related to variations in rainfall; in fact increases of A. gambiae densities almost always occurred after a peak of rainfall in the preceeding month, whereas increases of A. funestus densities coincided with periods of dry weather.

The two different seasonal trends are also evident when A. gambiae and A. funestus densities are recorded in accordance with place of collection. It will be remembered that the selection of the indicator districts was based on the results of malariometric findings and were representative of different geographical conditions. Table 7 shows the A. gambiae and A. funestus densities as found in indicator districts situated along the Lake Kyoga shores (A), the savannah and forested areas of the interior of Busoga (B) and along the Lake Victoria Shores (C). Comparing these data it will be noticed that not only A. gambiae and A. funestus showed opposite seasonal fluctuations, but also that A. funestus was more prevalent and probably the main vector along the Lake Victoria shores, whereas A. gambiae was the predominant species in the territory which extends between the two lakes and even more along the Lake Kyoga shores.

The results of A. gambiae and A. funestus salivary gland dissections are summarized in Table 6. With the exception of the month of January 1965 sporozoite infections were found during the whole period. For what reason in January 1965 no gland infections were found is difficult to say as the malariometric findings did not point to any interruption of transmission. The sporozoite rates detected in Busoga during the period of observations have been always low, especially if compared with Equatorial Africa.

Finally the results of the identification of blood meals, carried out at the Lister Institute on specimens caught in different types of structures of Busoga district, show that A. gambiae (90.5%), A. funestus (98.3%), A. hancocki (88.9%) and A. moucheti (100.0%) feed readily on man.

4. CONCLUSIONS

From the results of the present study it would appear that malaria in Busoga district of Uganda is hyperendemic in the northern and southern areas of the district, in the vicinity of Lake Kyoga and Lake Victoria; mesoendemicity prevails in the central part of the district.

Malariometric surveys carried out among schoolchildren at about three month intervals and among general mass population at six month intervals, monthly parasite rates among infants and fever cases, show that malaria transmission is perennial, without marked seasonal fluctuations.

From the examination of 39 789 films, which had been collected in the course of malariometric, infant and fever surveys, it would appear that P. falciparum was the most prevalent species found in the district, followed by P. malariae and P. ovale. The relative prevalence of the three infections were respectively 95.9%, 4.04% and 0.05%.

Clear seasonal trends were observed in the densities of A. gambiae and A. funestus, the two main vectors found in Busoga district. A. gambiae densities usually increased after periods of rainfall, whilst A. funestus densities coincided with periods of dry weather. The increase in number of one species was compensated by the decrease of the other, so that there was always a sufficient number of vectors to maintain malaria transmission.

In the past decades A. hancocki and A. moucheti, especially the former, have been found with infected glands on different occasions, thus suggesting that they might play a role in malaria transmission in Busoga. Our investigation did not provide sufficient evidence to support such possibility, but further studies are recommended.

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RESUME

Au cours du programme de pré-éradication du paludisme en Ouganda, des observations relatives au cycle annuel de cette maladie ont été entreprises, de février 1964 à février 1965, dans le district de Busoga, situé dans la partie centre-ouest du pays, afin d'obtenir des renseignements plus détaillés sur les fluctuations saisonnières de la maladie.

Après enquête préliminaire, dix localités ont été choisies sur la base de considérations géophysiques et épidémiologiques de manière à disposer d'un bon échantillonnage de la zone étudiée. Dans chacune de ces localités des enquêtes scolaires ont été régulièrement menées à intervalles de trois mois, tandis que dans huit des dix localités, des enquêtes portant sur la population générale étaient effectuées à intervalles de six mois. De plus, les services médicaux du district ont recueilli des lames de sang chez tous les nourrissons et tous les malades fébriles (température buccale supérieure à 37,2°C). Huit stations entomologiques de capture ont également été installées le long de la zone où les enquêtes scolaires ont eu lieu. Les résultats de la présente étude semblent indiquer que le paludisme est hyperendémique dans la région septentrionale et la région méridionale du district de Busoga, ainsi qu'à proximité des lacs Kyoga et Victoria. Dans la partie centrale du district règne un état de méso-endémicité.

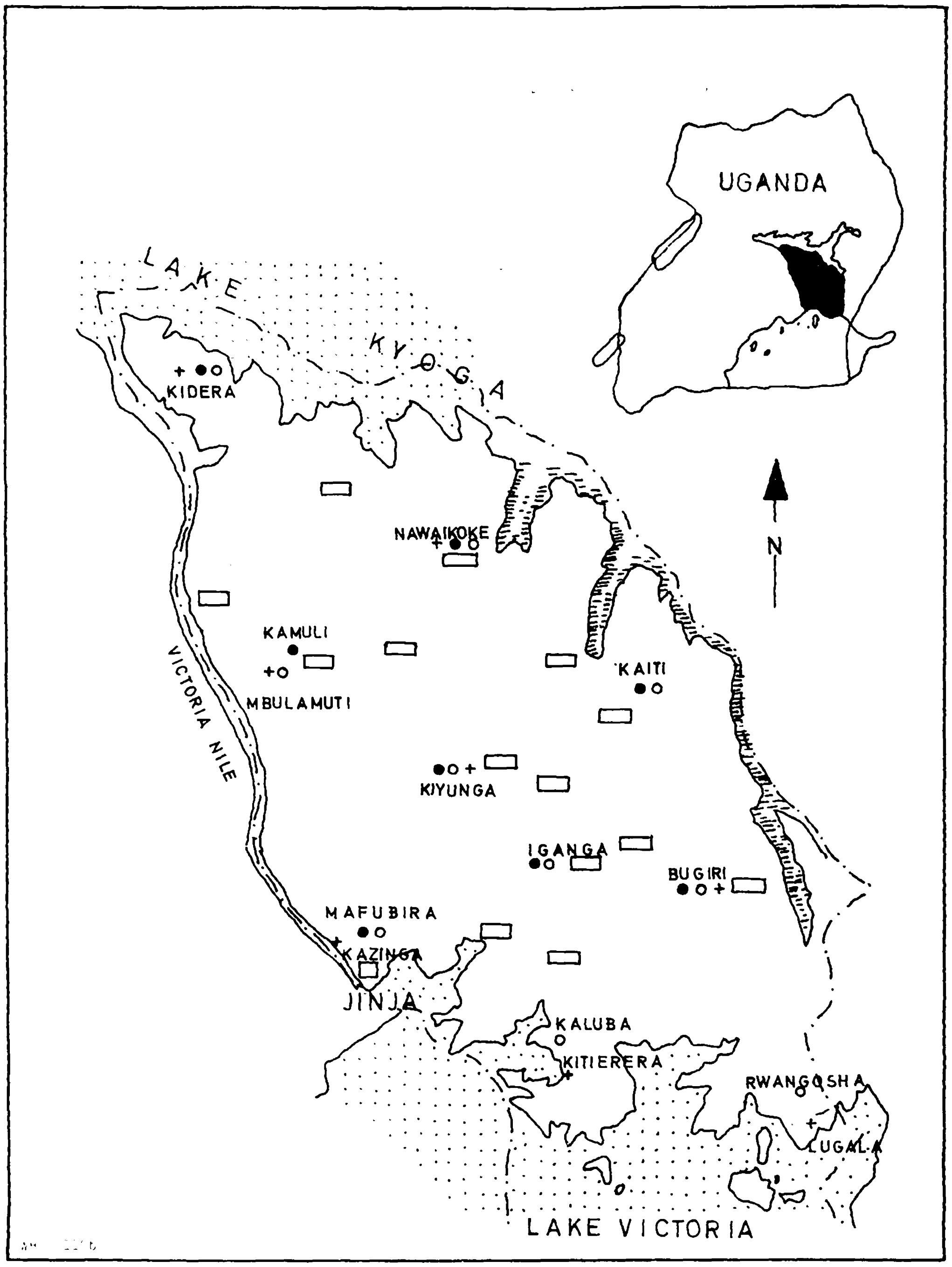
Les données paludométriques fournies par les enquêtes scolaires, ainsi que l'indice plasmodique mensuel des nourrissons et des malades, indiquent que la transmission du paludisme est perpétuelle et ne présente aucune fluctuation saisonnière marquée.

A la suite de l'examen de 39 789 lames de sang recueillies au cours des enquêtes paludométriques et des enquêtes sur les nourrissons et les malades, il apparaît que Plasmodium falciparum est l'espèce la plus répandue dans le district, suivi par P. malariae et P. ovale. La prévalence relative des trois infections est respectivement de 95,9 %, 4,04 % et 0,05 %.

De nettes tendances saisonnières ont été observées dans les densités de Anopheles gambiae et A. funestus, qui sont les deux principaux vecteurs du district de Busoga. Les densités de A. gambiae ont coïncidé avec les périodes sèches. L'augmentation du nombre de représentants d'une espèce a été compensée par la diminution de ceux de l'autre, de telle sorte qu'il y a toujours eu un nombre suffisant de vecteurs pour entretenir la transmission du paludisme.

Au cours des dernières décennies, A. hancocki et A. moucheti - le premier plus particulièrement - ont été trouvés à différentes reprises porteurs de glandes infectées, ce qui porte à croire qu'ils pourraient intervenir dans la transmission du paludisme au Busoga. Notre enquête n'a pas produit suffisamment de faits à l'appui de cette possibilité, mais nous recommandons la poursuite des études.

FIG. 1 SHOWING THE STUDY AREA - BUSOGA DISTRICT, UGANDA



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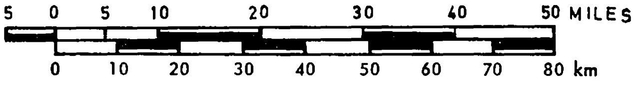

● MASS BLOOD EXAMINATION

o SCHOOL CHILDREN BLOOD EXAMINATION

+ MOSQUITO INDICATOR DISTRICT

▭ MEDICAL UNITS

FIG 2 SHOWING THE DISTRIBUTION OF MALARIA BY AGE GROUPS IN BUSOGA DISTRICT, UGANDA, AS PER MALARIOMETRIC SURVEYS CARRIED OUT IN FEB. MARCH (A) AND SEPT. OCT 1964 (B) AMONG SCHOOL CHILDREN AND DIFFERENT SAMPLES OF POPULATION

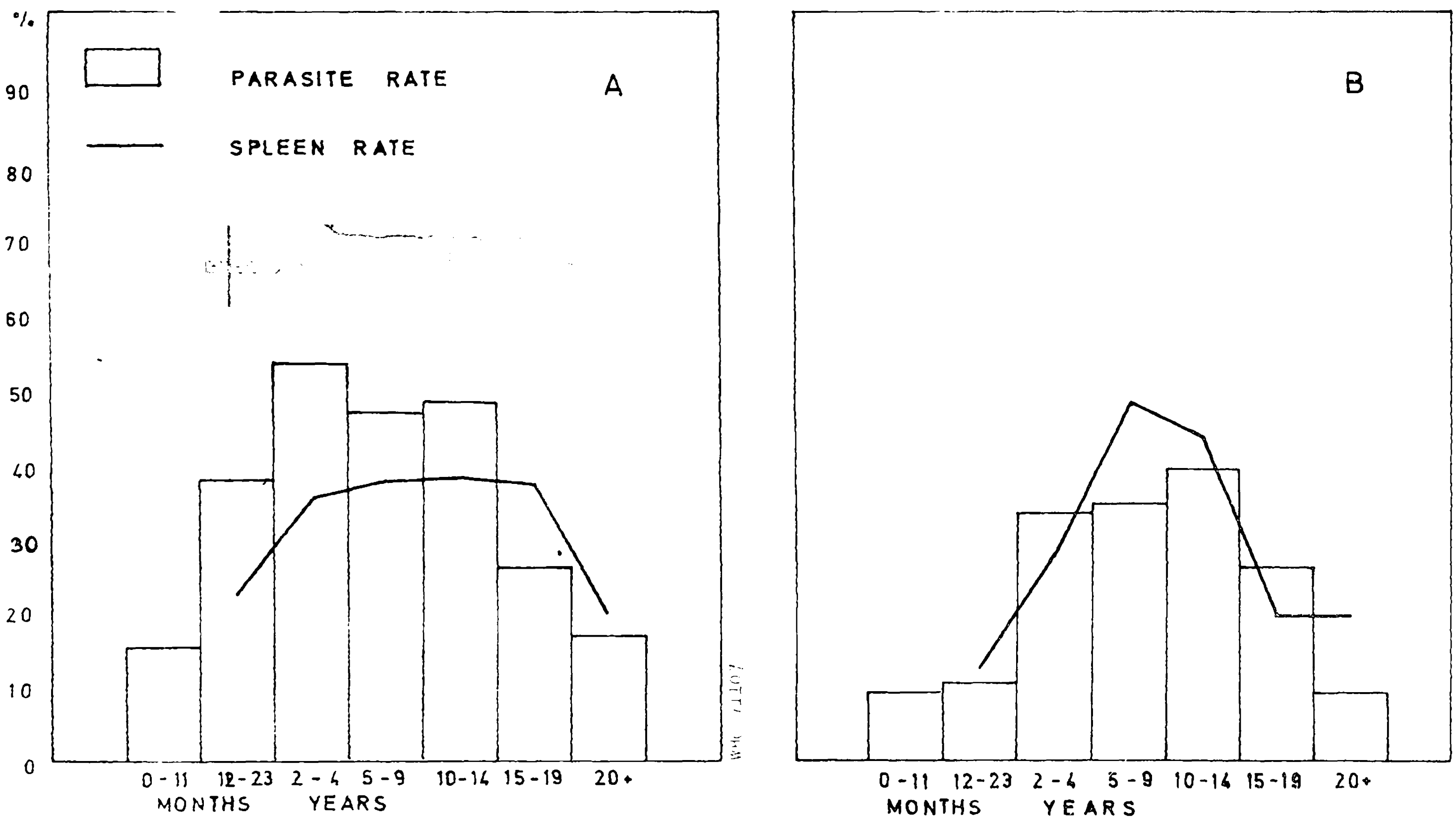

FIG. 3 SHOWING THE MONTLY PARASITE RATES IN BUSOGA DISTRICT, UGANDA, IN 0 2 MONTH OLD BABIES AND FEVER CASES FROM FEBRUARY 1964 TO FEBRUARY 1965

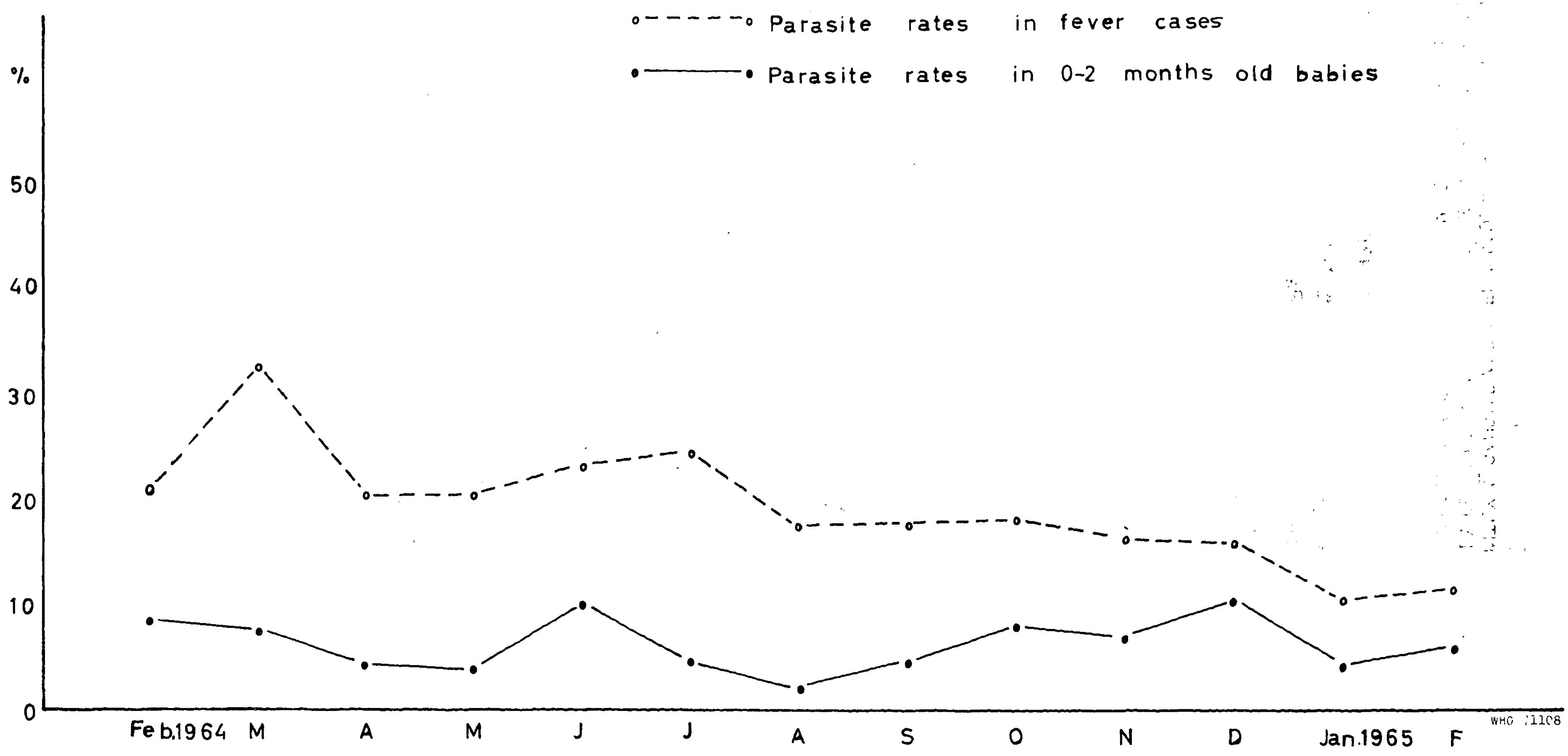

FIG 4 RESULTS OF MONTLY *A. GAMBIAE* AND *A. FUNESTUS* AVERAGE DENSITIES PER HUT OBTAINED BY FLITTING IN 64 CATCHING STATIONS IN BUSOGA DISTRICT, UGANDA, AND RAINFALL RECORDED AT JINJA FROM FEB. 1964 TO FEB. 1965

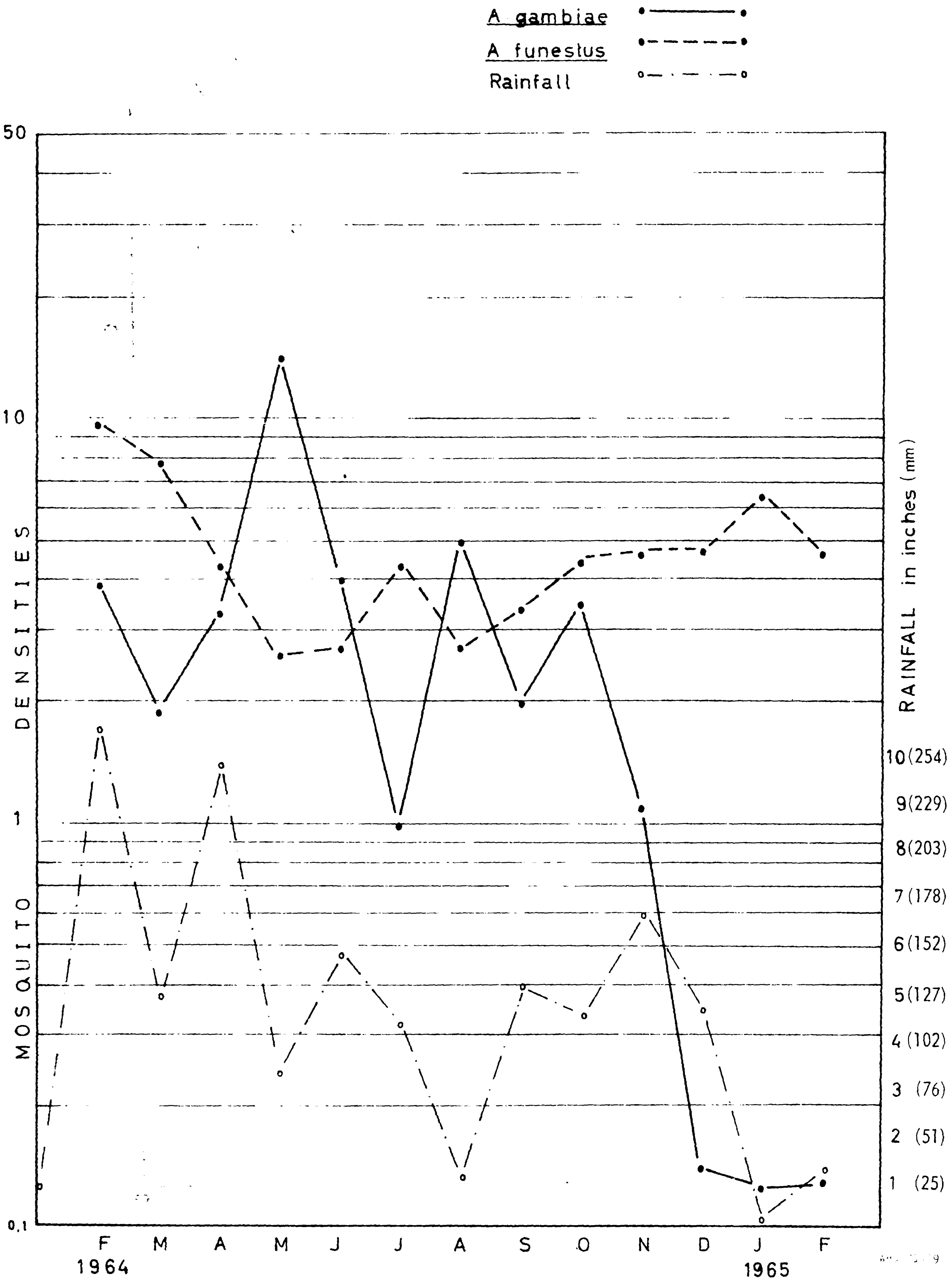

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TABLE 1. RESULTS OF MALARIOMETRIC SURVEYS CARRIED OUT AMONG DIFFERENT SAMPLES OF POPULATION IN BUSOGA DISTRICT, UGANDA

Locality	February/March 1964						September/October 1964					
	Spleens			Parasites			Spleens			Parasites		
	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
Mafubira	297	9.4	1.6	315	2.2	15.0	298	15.4	1.4	340	3.8	10.3
Iganga	291	23.0	1.6	320	2.8	17.2	279	24.4	1.2	316	4.4	18.0
Bugiri	254	41.7	1.6	324	4.3	40.7	258	27.5	1.3	279	6.8	24.7
Kidera	208	50.2	1.8	224	3.4	59.8	187	50.8	1.6	200	17.0	49.5
Kaiti	162	40.7	1.8	226	5.7	43.4	290	7.9	1.4	336	4.8	22.6
Nawaikoke	148	49.9	1.7	175	16.0	68.0	136	38.2	1.5	148	14.2	50.7
Kiyunga	201	38.3	1.8	248	11.3	37.2	271	36.5	1.4	310	8.4	25.2
Kamuli	-	-	-	-	-	-	202	30.7	1.3	210	13.3	28.6
Total	1 561	33.4	1.7	1 832	7.0	37.2	1 921	29.9	1.4	2 130	7.1	25.7

* A.E.S. - Average enlarged spleen.

TABLE 2. RESULTS OF MALARIOMETRIC SURVEYS CARRIED OUT AMONG SCHOOLCHILDREN AGED 5-15 IN BUSOGA DISTRICT, UGANDA, AT APPROXIMATELY THREE MONTH INTERVALS

Locality	First survey (February/March 1964)			Second survey (June 1964)			Third survey (September/October 1964)			Fourth survey (January/February 1965)		
	Number examined	Spleen rate	Parasite rate	Number examined	Spleen rate	Parasite rate	Number examined	Spleen rate	Parasite rate	Number examined	Spleen rate	Parasite rate
Mafubira	112	13.9	18.7	115	19.1	7.8	120	20.0	7.5	120	15.8	5.8
Iganga	195	13.3	5.1	200	29.5	27.0	180	38.3	39.9	160	33.1	25.6
Kamuli	105	37.1	67.6	120	59.2	64.2	120	50.0	37.5	118	48.3	43.2
Kidera	74	58.1	56.8	112	67.0	71.4	100	77.0	62.0	100	63.0	76.0
Kaiti	110	32.7	40.9	113	54.9	75.2	110	41.8	24.5	140	44.3	22.9
Bugiri	120	40.8	42.5	180	45.0	41.7	133	54.1	49.6	112	57.1	52.7
Nawaikoke	179	50.9	64.2	172	60.5	50.6	165	44.2	26.1	150	50.7	24.7
Kiyunga	87	33.3	35.6	213	41.8	26.3	100	48.0	43.0	190	31.1	21.6
Rwangosha	186	35.4	62.9	190	60.0	45.3	109	57.8	74.8	110	62.7	41.8
Kaluba	-	-	-	103	57.3	57.3	100	40.0	25.0	110	50.0	32.7
Total	1 168	33.7	43.1	1 518	48.5	44.0	1 237	46.2	38.2	1 310	44.0	32.5

TABLE 3. DISTRIBUTION OF MALARIA BY AGE-GROUP IN BUSOGA DISTRICT, UGANDA

AGE-GROUPS	February/March 1964						September/October 1964					
	Spleens			Parasites			Spleens			Parasites		
	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
0-11 months	-	-	-	271	3.7	15.1	-	-	-	218	4.6	9.6
12-23 months	146	21.9	1.9	146	7.5	37.7	183	12.0	1.4	183	4.9	10.4
2-4 years	350	35.1	1.8	350	13.1	52.9	437	27.2	1.7	437	1.3	33.6
5-9 years	1 332	37.5	1.3	1 332	9.7	46.5	987	48.1	1.3	987	8.0	34.7
10-14 years	403	37.7	1.7	403	4.5	47.9	955	43.5	1.3	955	7.9	39.3
15-19 years	70	37.1	1.5	70	4.3	25.9	254	19.3	1.2	254	5.1	25.9
20+ years	428	19.4	1.6	428	2.8	17.1	342	19.6	1.4	342	2.0	9.4
Total	2 729	33.5	1.7	3 000	7.6	39.5	3 158	36.3	1.3	3 376	7.4	30.3

TABLE 4. RESULTS OF MONTHLY INFANT PARASITE RATES IN BUSOGA DISTRICT, FEBRUARY 1964/FEBRUARY 1965

Time of survey	0-2 Months			3-5 Months			6-8 Months			9-11 Months			Total		
	No. ex.	+ve	%	No. ex.	+vc	%	No. ex.	+ve	%	No. ex.	+ve	%	No. ex.	+ve	%
February 1964	103	9	8.7	170	42	24.7	205	42	20.5	121	21	17.4	599	114	19.0
March	102	8	7.8	140	39	27.8	185	69	37.3	78	25	32.1	505	141	27.9
April	154	7	4.5	236	31	13.1	266	54	20.3	145	28	19.3	801	120	14.0
May	97	4	4.1	154	19	12.3	159	21	13.2	85	17	20.0	495	61	12.3
June	98	10	10.2	158	36	22.8	174	42	24.1	104	17	16.3	534	105	19.7
July	163	8	4.9	229	42	18.3	333	79	23.7	164	31	18.9	889	160	18.0
August	42	1	2.4	91	11	12.1	121	17	14.0	56	7	12.5	310	36	11.6
September	168	8	4.8	247	32	12.9	353	48	13.6	163	24	14.7	931	112	12.0
October	88	7	8.0	146	26	17.8	184	30	16.3	118	26	22.0	536	89	16.6
November	141	10	7.1	231	29	12.6	254	38	15.0	133	17	12.0	759	94	12.4
December	86	9	10.5	129	25	19.4	170	33	18.4	86	10	11.6	480	77	16.0
January 1965	88	4	4.5	103	10	9.7	151	14	9.3	90	7	7.8	432	35	8.1
February	118	7	5.9	229	31	13.5	255	30	11.8	146	9	6.2	748	77	11.8

TABLE 5. RESULTS OF MONTHLY FEVER CASES OF ALL AGES EXCLUDING INFANTS IN BUSOGA DISTRICT, UGANDA. FEBRUARY 1964/FEBRUARY 1965

	February 1964	March	April	May	June	July	August	September	October	November	December	January 1965	February
Number examined	1 344	1 135	1 457	1 188	1 204	1 806	1 260	2 746	1 619	2 280	1 612	1 944	2 971
Number positives	294	390	295	244	278	440	219	485	292	373	258	206	371
Per cent. positives	21.9	34.4	20.3	20.5	23.1	24.4	17.4	17.7	18.0	16.4	16.0	10.6	12.5

TABLE 6. SPOROZOITE RATES IN *A. GAMBIAE* AND *A. FUNESTUS* COLLECTED MONTHLY BY DAY-TIME SPRAY-CAPTURES IN 64 CATCHING STATIONS (EIGHT INDICATOR DISTRICTS) OF BUSOGA DISTRICT

Year	Month	*A. gambiae*			*A. funestus*			Combined sporozoite rate
		Total dissected	Positive	Sporozoite rate	Total dissected	Positive	Sporozoite rate	
1964	February	229	5	2.2	282	1	.4	1.2
	March	119	2	1.7	334	0	0	.4
	April	206	1	.5	253	0	0	.2
	May	288	3	1.0	135	1	.7	.9
	June	138	2	1.5	146	0	0	.7
	July	63	1	1.6	206	1	.5	.7
	August	177	3	1.7	170	0	0	.9
	September	122	1	.8	199	3	1.5	1.3
	October	218	3	1.4	202	1	.5	1.0
	November	67	1	1.5	186	2	1.1	1.2
	December	21	0	0	249	2	.8	.7
1965	January	11	0	0	216	0	.0	.0
	February	13	2	15.4	233	1	.4	1.2

TABLE 7. *A. GAMBIAE* AND *A. FUNESTUS* DENSITIES PER HUT, AS FOUND IN INDICATOR DISTRICT SITUATED ALONG THE LAKE KYOGA SHORES, CENTRAL BUSOGA AND LAKE VICTORIA SHORES

Month	Lake Kyoga shores		Central Busoga		Lake Victoria shores	
	A. gambiae	*A. funestus*	*A. gambiae*	*A. funestus*	*A. gambiae*	*A. funestus*
February 1964	5.5	4.3	4.4	.03	.9	34.3
March	.4	4.8	2.0	.06	2.9	26.2
April	6.3	3.3	3.1	0.0	.4	13.7
May	52.9	2.2	1.3	.15	.7	7.6
June	14.1	2.6	.6	0.0	.4	7.8
July	2.5	2.3	.7	.8	.06	12.4
August	17.3	5.7	1.2	.3	.1	4.3
September	5.0	4.7	1.3	.13	.06	8.3
October	10.6	3.5	1.5	.06	.06	14.0
November	3.2	5.2	.5	.06	0.0	13.0
December	.4	4.3	.4	.06	0.0	14.5
January 1965	.2	4.6	.3	.06	0.0	21.0
February	0.0	3.9	.4	.03	0.0	14.6
Average	9.9	4.3	1.4	.2	.5	16.0

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(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;

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