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THE WINTER ACTIVITIES OF A. GAMBIAE AT HIGH ALTITUDES IN SOUTHERN RHODESIA

by

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In his detailed survey in Shamva and in the Mazoe Valley in north-east Southern Rhodesia, 1926-1928, Leeson (1931) found that A. gambiae disappears completely from the plateau in the winter months - June to August - and in the succeeding hot dry months of September and October. Descending the Mazoe Valley in the middle of the winter season - July - he was not able to find any adults above the 2000 feet level, and no larvae at a higher level than 1680 feet. Adults were first detected at an altitude of 1900 feet at a point about 65 miles east in a direct line from Shamva (see map). Further down the river, from 1680 feet downwards, adults and larvae were both recorded in increasing numbers. At the junction of the Mazoe and the Nyaderi Rivers (1550 feet) A. gambiae was breeding intensively and there were very high adult densities at that time.

From these findings Leeson concluded that A. gambiae disappears completely from the plateau each winter for a period of five to six months, and that at the beginning of the hot weather and the rainy season from November onwards there is an annual re-invasion of the high plateau from these perennial breeding grounds in the lower Mazoe.

The present malaria control scheme in Southern Rhodesia was originally influenced by this finding, the controlled 'barrier' areas at low altitudes being designed to prevent or delay this seasonal invasion (Alves & Blair, 1955).

Investigations carried out by the WHO team in Shamva (altitude 3000-3200 feet) in 1957-1958 showed that the behaviour of A. gambiae in relation to feeding and resting in untreated human habitations differed so much from that observed by Leeson and later by Meeser (unpublished) as to suggest that some radical change in the

composition of the A. gambiae population had occurred as a result of the intensive and prolonged BHC treatment of houses in this and surrounding areas. It seemed very unlikely that such a marked alteration in the population could have occurred if the A. gambiae population of the plateau died out each year and was completely replaced annually by an invasion from the low-lying untreated areas beyond the barrier zone. Leeson's working hypothesis obviously needed re-investigation in the light of these developments, and with the aid of more modern techniques.[1]

The field unit's first assignment was to find out the extent of winter breeding of malaria vector species - A. gambiae in particular - along the lower Mazoe in Pungwi reserve (treated annually with LHC). This was the precise area covered by Leeson in his 1926-1928 survey and the same month (July) of the winter season. However, in a survey from 17-27 July 1958 the field unit could find no evidence of dense breeding or high populations of adult A. gambiae in this same area, anophelines of all kinds being relatively scarce. Whatever the reasons - regular treatment of reserves bounding the lower Mazoe, or the altered density of the human and cattle population - this area no longer appears to be of first importance as a perennial breeding ground of A. gambiae.

While this unit was working in the lower Mazoe, adult A. gambiae were found by the WHO entomologist on several occasions at Kondo in Uzumba reserve further up the Mazoe at an altitude of 2700-2800 feet, and about 15 miles in a direct line from Shamva. In view of this recovery of A. gambiae at higher altitudes in winter and of the disappointing results in the lower Mazoe, it was decided to move the field unit to Chitengu - two miles from Kondo - and to combine our effort towards the elucidation of this persistence of A. gambiae - and other potential malaria vectors - at this altitude during the dry winter season.

Experience gained prior to this survey had shown that the artificial pit shelter provided the most sensitive technique available for detecting outdoor resting A. gambiae at very low densities, and this was the method of choice in studying the

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[1] In order to do justice to this important problem it was found necessary to enlist the aid of additional entomological staff from the Federal Ministry of Health, in the form of a field unit, under Mr R. Woods, Technical Assistant Entomologist, composed of two junior European Technicians and a number of African assistants. Thanks are due to the authorities of the Federal Ministry of Health, Government of Southern Rhodesia for their ready assistance and co-operation.

winter activities at high altitudes, with about 30 pit shelters being searched regularly. These collections were made either by visits from Salisbury once or twice a week, or by daily collections from the field camp set up in the experimental area. All larval collections were carried out personally by the author of this note.

In the typical breeding place of A. gambiae several additional species such as A. rufipes, A. pretoriensis and A. maculipalpis are liable to occur in this part of Southern Rhodesia. Instead of identifying the batches of larvae when they were collected it was found more convenient to breed out all larvae in the laboratory and to base identifications on the much more distinctive adult character of these species. This method not only established the identity of pupae and full grown larvae, but also that of the earlier stages in which larval characters are less clearly defined. This was found particularly valuable in detecting the presence of the occasional A. gambiae larva among large numbers of larvae A. rufipes and A. pretoriensis of all stages.

The results of adult and larval collections are shown in Tables 1 and 2.

These combined results in the Mazoe river section of Uzumba reserve show that adult A. gambiae were recorded in each of the four to five months of long dry winter and hot season. There was no indication of winter conditions inducing hibernation at this altitude, as many of the female A. gambiae recovered were engorged. Small numbers of larvae were recorded along the Mazoe river in this area each month from July to October.

The month of November, which usually heralds the first showers of the rainy season, proved to be unusually dry in 1958. Instead of the expected increase in A. gambiae breeding, potential breeding places were at their lowest level, and no larvae were recorded in that month. However, larvae appeared at the beginning of December, and one can conclude from this, and from the records of the previous year (1957) that this month normally marks a sharp increase in A. gambiae breeding.

It should be noted that it required the combined efforts of the two teams (one working continuously from the beginning of July and the other from the beginning of August onwards) to demonstrate convincingly the continuity of A. gambiae feeding and breeding throughout this entire adverse period on the fringe of the Southern

Rhodesian plateau. Although the numbers of adults and larvae recovered were small, it must be remembered that the sample area is only a minute part of the whole valley area, and that it is therefore quite possible that A. gambiae persists over winter in undetectable numbers at even higher altitudes (compare the rapid appearance of A. gambiae adults at Shamva 3200 feet, within a week of the first heavy rains in 1958).

These findings indicate strongly that there is a resident population of A. gambiae at high altitudes within the barrier, and that it is very likely that this local scanty population initiates the seasonal increase in A. gambiae breeding with the advent of the hot weather and the rainy season.

TABLE 1. UZUMBA RESERVE, MAZOE RIVER SECTION. SUMMARY OF THE OBSERVATIONS ON THE PERSISTENCE OF ANOPHELES GAMBIAE OVER WINTER AT HIGH ALTITUDES (KONDO AND CHITENGU VILLAGES, ALTITUDE 2700-2800 ft) JULY - DECEMBER 1958

Date	Kondo (WHO Team) (12 pit shelters operating from 3 July onwards)	Chitengu (Mr R. Woods' team) (Observations from 31 July onwards, with a number of pit shelters increasing to a maximum of 18 from 8 September)
3 July 1958	2 blood-fed females	
7	1 blood-fed, 1 gravid	
16	1 blood-fed female, 7 larvae	
28	1 blood-fed female	
18 August	1 blood-fed female	
14		1 male, 1 larva
20		1 gravid female
23		1 male
25		1 gravid female
29		1 female (gambiae eggs laid by unidentified batch)
4 September		1 blood-fed female
6		1 half-fed female
10		1 blood-fed female
29	2 larvae	
1 October		1 half-gravid female
2	3 larvae (in different sections of river from 29/9)	
15		1 gravid female
17	1 larva	
19 November		1 male
3 December	13 larvae	
17		1 female
22	(Larvae and adult A. gambiae at Shamva)	

(December 1957, 82 larvae on 6th, 10th and 20th from Uzumba reserve, Mazoe river section)

TABLE 2. UZUMBA RESERVE, MAZOE RIVER SECTION. LARVAE COLLECTED IN POOLS ALONG THE MAZOE RIVER IN THE WINTER AND DRY SEASON, JULY-DECEMBER 1958 (AND IN DECEMBER 1957)

	1958		1957
	July-September	October-December	December
A. gambiae	7	16	82
A. rufipes	71	12	26
A. pretoriensis	78	163	114
A. rhodesiensis	11	0	
A. coustani) A. maculipalpis) A. longipalpis)	11	2	

Summary

Work on the winter bionomics of Anopheles gambiae in Southern Rhodesia has revealed the persistence of this species feeding and breeding throughout the adverse winter and dry season at high altitudes (2800 ft). The implications of this finding are discussed in relation to the system of "barrier control" which aims at protecting the main plateau, 3000-5000 ft, by regular house-treatment of a ring of native reserves at lower altitudes.

REFERENCES

Alves, W. & Blair, D. M. (1955) J. Trop. Med. Hyg. 58, 27, 3

Leeson, H. S. (1931) Anopheline mosquitos in Southern Rhodesia, Memoir No.4, London School of Hygiene and Tropical Medicine, p. 55

Muirhead-Thomson, R. C. (1958) Bull. Wld Hlth Org. 19, 1116

Map 1 - Carte 1

N.E. REGION of S. RHODESIA showing study areas in the MAZOE VALLEY selected for the investigation on overwintering of A.gambiae at high altitudes

Région nord-est de la Rhodésie avec indication des zones d'étude dans la vallée de la Mazoë choisie pour l'enquête sur l'hibernation de A. Gambiae aux fortes altitudes