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The Breeding Sites of the Tsetse Fly *Glossina morsitans.*

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Introduction.

There are two belts of *Glossina morsitans* Westwood which cover much of the north-central and western areas of Tanganyika. The flies from the central belt are distinguishable from those of the great western belt, being generally paler in colour (JACKSON 1950). The object of this investigation was to compare the pupa sites used by the two races during the different seasons of the year, and to look for any seasonal shift of breeding grounds as observed by NASH (1939). Two centres of observation were chosen, Singida District in the central belt and Kahama District in the great western belt.

Description of Singida and Kahama Districts.

Searches were made at about 5° S., 35° E. in the Singida District, near the Rift Wall on the Singida-Kondoa road. The altitude is about 1300 m. below the Rift Wall and 1500 m. above it. Areas both above and below the Rift were searched.

In the Kahama District the area searched was at about 3° 30′ S., 31° 35′ E., not far from Ushirombo, between Kahama and Biharamulo. It lies at about 1260 m.

Singida has a rainfall of about 600 mm., but Kahama is wetter, with an average of about 800 mm. or more.

These places are both in the typical *Brachystegia-Pseudoberlinia* woodland habitat of *Glossina morsitans,* where this species is found at high densities. In Singida there are small settlements near the areas searched, but in Kahama the woodland was cleared of its scattered villages after an outbreak of sleeping sickness and only honey-hunters with permits are allowed into it.

The woodland in Singida is of two main species, *Pseudoberlinia globiflora* (Benth.) Duvign and *Brachystegia spiciformis* Benth., which are co-dominant. In Kahama, in addition to these two species, *Brachystegia boehmii* Taub. is very common and there are

numbers of other large trees including *Burkea africana* Hook., *Pterocarpus bussei* Harms and *Afrormosia angolensis* Harms; hence there is generally much more variety than in Singida. Bushes such as *Popowia obovata* Engl. & Diels, *Canthium burtii* Bullock, and *Randia taylorii* S. Moore are fairly common at both places, but others such as *Annona chrysophylla* Boj. and *Piliostigma thonningii* Schumach only in Kahama. In the dry season the trees in the woodland are completely defoliated from late July to about November and there is no shade during this period. In open glades and shallow grassy valleys several species of *Combretum,* with *Vitex doniana* Sweet and *Lannea schimperi* Engl., are common particularly in Kahama. The grassy valleys of Singida contain generally more thorny trees, especially species of *Acacia* and *Commiphora.* BURTT (1942) gives some photographs of the Singida area. (Plate 2, figs. 1 & 2; Plate 6, figs. 9 & 10.)

The woodland in Singida is interspersed with many small valleys with few trees which open into larger valleys. They have medium to long grass which about August is usually burnt by bush fires. Those in the Kahama area are generally broader and taller grassed and there are fewer of them. The grass in the woodland is very sparse except in the open glades but in Kahama it is rather thicker and there is also more undergrowth than in Singida. The bush fires do not penetrate the woodland completely as there is so little grass. Singida is cooler and drier but in both places the corresponding seasons follow each other at the same times of year. Investigations were made in both Singida and Kahama during three seasons: the cool season in June and July, the hot season in October and the rainy season in April. These months show the extremes of climate when the breeding habits of the tsetse are most likely to differ. Visits were made to Singida in June and October 1951 and April 1952, and to Kahama in June and October 1952 and April 1953. It happened that 1952 was a very wet year and 1953 a dry one.

The soil in the *Brachystegia* woodland at both places is very similar, consisting largely of loose, coarse sand on the surface to a depth of about one inch. Below this is a more compacted layer, also mainly of sand. It was in the loose top layer (77 to 99% particles over 0.25 mm. in diam.) that pupae were found. In a few places such as hollows under logs and rot-holes the top layer of soil was hard, and apparently this is unsuitable as no pupae were found. This hard surface is formed by water lying in the hollows. The ground in the woodland has a covering of dead leaves at all seasons; in the grassy valleys the soil is mainly fine clay, soft and muddy during the rains and hard with many cracks during the dry season.

All pupae, except one, were buried in the soil mostly at about half an inch or slightly more below the surface. The exception was under a log in Kahama during the rains, when one pupa was found on top of the soil but with some leaves covering it. One empty puparium was found in a similar position in a second site, and another on top of the soil where there were no leaves. BURTT (1952) found that pupation of *G. swynnertoni* Austen occurred on or near the surface of the soil during the rains. The reason for the difference between our observations is undoubtedly that the soil where he found pupae during the rains was very wet and had prevented the larvae from burrowing, whereas the sandy soil of the *Brachystegia* woodland does not retain so much water, which seeps downwards leaving the surface comparatively dry.

Methods.

In Singida local African collectors bring in pupae each week for sale and consequently know the places where large numbers can be found easily. On my visits use was made of these collectors as guides and it is partly due to this that larger numbers of pupae were obtained there than in Kahama. On the other hand the number of pupae obtained from a given area would have been greater if these Africans had not been searching the same sites a short time before. In Kahama no searching has been carried out except during my visits.

All places giving some sort of shelter were searched as possible sites for pupae, except clumps of grass in the open, but such clumps were investigated near logs and the bases of some trees. Unless covered by tall, dense grass or with very wet or hard soil underneath, all logs, rocks, rot-holes, leaning trees, palm trees and tree stumps were searched. Also animal burrows that were not full of leaves, small thickets where they appeared suitable and the bases of trees where there was any small crevice underneath were investigated.

Temperatures, humidities and light readings were taken in several sites on each visit. Soil temperatures were read inside the sites and in the ground nearby. An Edney paper hygrometer was used to measure humidity in the site and a whirling psychrometer outside it. In many sites a photo-electric meter in a special holder devised by Mr. A. T. CULWICK was used to measure the light reflected from a piece of paper held at a constant angle to the sun. Direct light readings were taken of some sites in Kahama and of their surroundings. All temperature and humidity readings were corrected to approximately what they would have been at a stand-

ard time of 11.30 a.m. by dividing them into hourly groups and adjusting individual readings by the amount by which their group mean differed from that in the 11 to 12 hour group.

Pupa sites in Singida.

Logs are numerous throughout the *Brachystegia* woodland and there are also a few in the grassy valleys. New trees are continually pushed down by elephants while some of the old logs rot or are burnt in bush fires. Logs of *Burkea* and *Pterocarpus* appear to resist fire and rotting for several years but those of *Pseudoberlinia* and *Brachystegia* disappear quickly. Pupae were found under logs at all three season when searching was carried out, and log sites are by far the most numerous throughout the area. The largest numbers of pupae were found near those parts of the logs which are close to or touching the ground; in only one site was the log nine inches above the pupae, and in all others it was six inches or less. No pupae were found under logs of diameter less than 2½ inches; in June and April the productive logs averaged just over seven inches. On the whole they were also fairly open, with little shade, especially those with the larger numbers of pupae. Logs used in the hot season during October were very much larger, the average diameter being about thirteen inches. Some of these larger logs had a well-shaded hollow or cave under the roots and base of the trunk, which had been formed when the tree fell over. These hollows were often fairly large and at this season the numbers of pupae found in them were much greater than elsewhere. Several logs had a little overhead shade but if the log was large and itself gave a good shade to the ground below, the presence or absence of overhead shade seemed immaterial.

Pupae were more scattered in the rainy season. There were a few instances of more than twenty pupae found under individual logs in the cool and hot seasons; in April the maximum number was twelve, but this was exceptional and all others had less than seven. Of all log sites with pupae the average number of pupae per site was 5.2 in June, 5.0 in October and 2.1 in April. Also, in April only 39% of the total number of logs searched had pupae under them as against 50% in June. As almost all of the pupae found in the area in June and April (97% and 99%) were under logs, it can be seen that they were more difficult to obtain during the rains. This has always been the case with *G. morsitans* pupae in the wet season. In October the situation is rather different. Fifty-eight per cent of the pupae were under logs and only 27% of the logs searched gave a positive result. Therefore there were fewer pupae under logs at

this season than in April or June, although, taking all types of sites into account, pupae were more available than in April though rather less available than in June.

Leaning trees were used as pupal sites only in October when twenty five pupae were taken from nine sites. The majority of the trees were leaning at a large angle to the vertical, some parallel to the ground and others decumbent at the base though growing more upright after a few feet. The trunks of most of these trees in use in October were large in diameter as were the logs also. At Masisi, above the Rift Wall, the majority of pupae were along the edges of the valleys in October, where the trees were mainly *Pseudoberlinia globiflora* and *Brachystegia tamarindoides* Welw. ex Benth., which were just starting to flush. These sites at the valley edges were covered in long grass in April and were damp. They were not searched in June, although then, and at all seasons, more open sites were searched but only empty cases were found.

A few *Brachystegia spiciformis* trees were found to have a slight enlargement of the trunk, just above the base, which overhung the soil forming a small cavity. In the cool season there were three pupae in the cavity under one tree and two in another. In the leafless season in October two empty cases were taken under the former tree but no pupae under any such trees, probably because they are then very exposed to the sun. Nothing was found in these sites in April when the soil in them was very damp.

Rot-holes were found in many trees and were of various sizes and heights above the ground. They were most common in *Terminalia sericea* Burch. and *Brachystegia spiciformis*. Many had no loose soil inside and in June and April the majority were full of water or very damp. Pupae were only found in rot-holes in trees in October when twenty five were taken from nine sites. All of these were at ground level except one where the bottom of the hole was about one foot above the ground. This one was about 10″ high by 4″ wide and only 1″ deep but contained ten pupae, the largest number in any rot-hole. The entrance to another site, a large hollow baobab (*Adansonia digitata* L.), was five feet from the ground though the soil inside was at ground level. Rot-holes at all heights were searched where possible but in only one other instance was there any evidence of holes above ground level being used as pupa sites. In this a few shallow pockets, two to three inches in diameter, each with a little soil, were spaced from two to fifteen feet above the ground, in the trunk of an *Afzelia* tree. Empty puparia were found in one or two of these pockets on each visit. One at about nine feet was the highest recorded.

Few pupae were obtained under tree stumps although several

were searched. In October in a pocket at one side of a large hollow stump there were seven pupae. This site could easily be classed as a rot-hole. Another was found where a large piece of bark was leaning from the ground to a small stump. Underneath the bark there were one pupa in April and four in June. This site was rather similar to many log sites where a piece of loose bark from the log rests on the ground. The pupa found there in April was the only one not in a log site.

Small thickets throughout the woodland were searched but only under one were any empty cases found and these appeared to be very old. However, in October a search was made of a large valley below the Rift Wall in which the grass had been burnt not long before. In this were many trees of *Gardenia* sp. (probably *G. jovistonantis* Welw.) which were in full leaf and had large spreading canopies giving good shade. Under several of these pupae were obtained, most of which were very close to the trunk or roots of the trees. One tree had 14 pupae under it but the others only one or two. The soil was very hard under most but there were some softer patches in which the pupae lay and in one case the pupae were in a crack in the ground. A few other thickets mainly of *Grewia platyclada* K. Schum., *Rhus incana* Mill. and *Combretum obovatum* F. Hoffm. gave good shade and had one or two pupae each, again usually near the main stems arising from the ground. Bushes on a few termitaria were also searched but yielded nothing.

Animal burrows were searched, particularly those of the ant-bear *(Orycteropus afer)*. Many were full of leaves, and in April and June the soil was very damp. No pupae were obtained at these seasons. However, in October two burrows were found with pupae inside, one with seven and the other with one. Both of these burrows were completely in the open but the pupae were deep down, about two feet from the entrance and so were well out of the sun. There were some dry leaves in the entrances but none right inside the holes.

Two separate groups of rocks were seen in the areas searched in Singida. In October three pupae and nine empty cases were found under one rock about two feet in diameter, which had a hollow underneath. Nineteen empty cases were taken under this rock in June and a few others under nearby rocks.

Pupa sites in Kahama.

The country in Kahama is rather similar to that in Singida and the types of sites in which pupae were found were also similar. Generally there were fewer pupae in individual sites and fewer in areas of similar size.

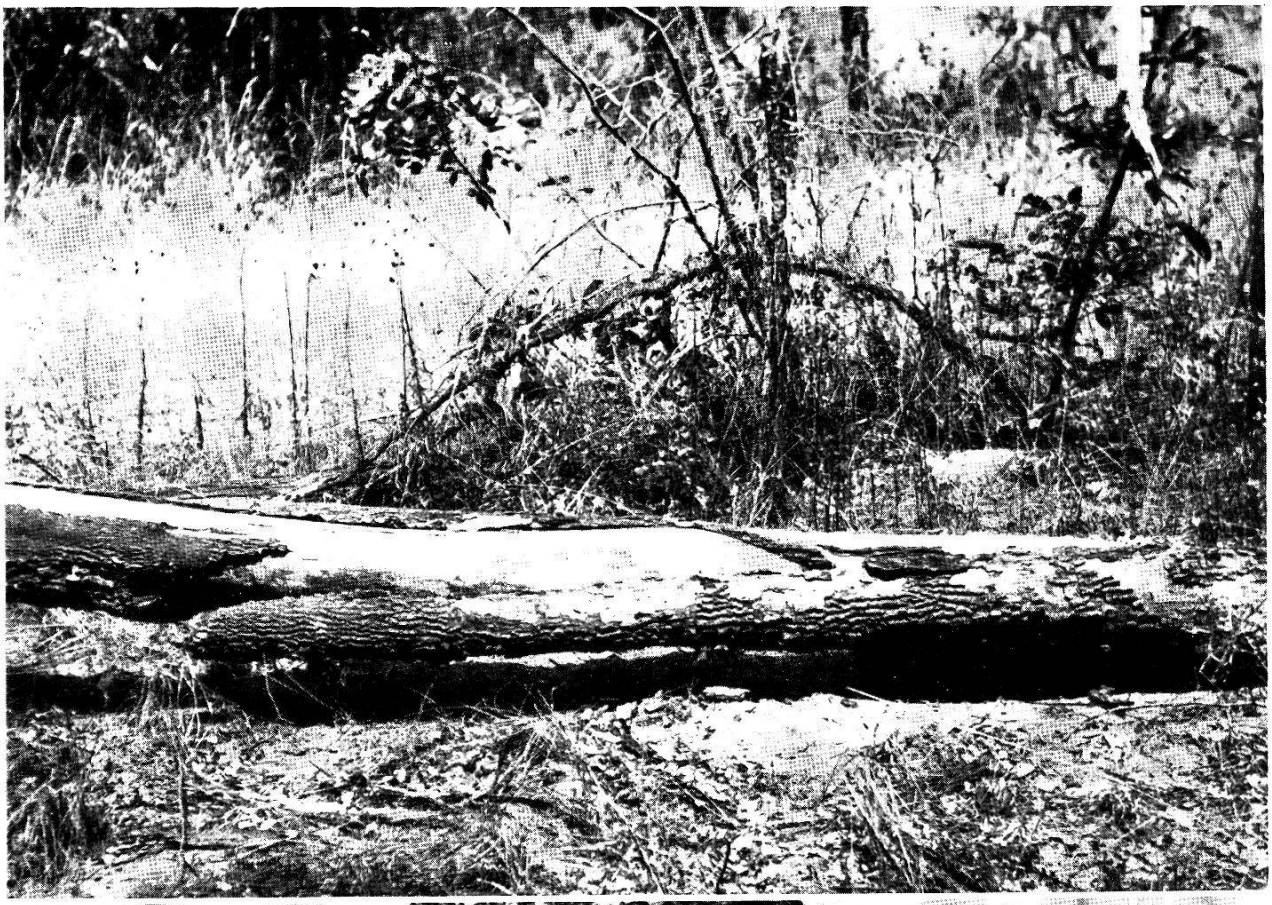

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Fig. 1. Singida, cool season. A typical open log site. Seventeen pupae were found along the trunk which had the highest soil temperature of any productive site (24.3° C.); one more was found in the rains.

Fig. 2. Singida, cool season. Under the enlargement at the base of this *Brachystegia spiciformis* three pupae were found.

Fig. 3. Singida, cool season. This shows the typical *Pseudoberlinia-Brachystegia* woodland with sparse grass. Under the log in the foreground were six pupae.

4

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Fig. 4. Singida, cool season. This old log which was in the open most of the day yielded eight pupae and eighteen empty puparia. The grass had not been burnt when this photograph was taken. A further pupa and eight cases were found in the hot season.

Fig. 5. Singida, cool season. A total of twenty nine pupae were taken under this rotten log, the largest number in any site. There was shade only in the morning.

6

7

Fig. 6. Singida, cool season. This log had slight shade most of the day. Four pupae were found under the fork on the left and a further four under the slight bulge on the right. Another pupa was taken here in the rains.

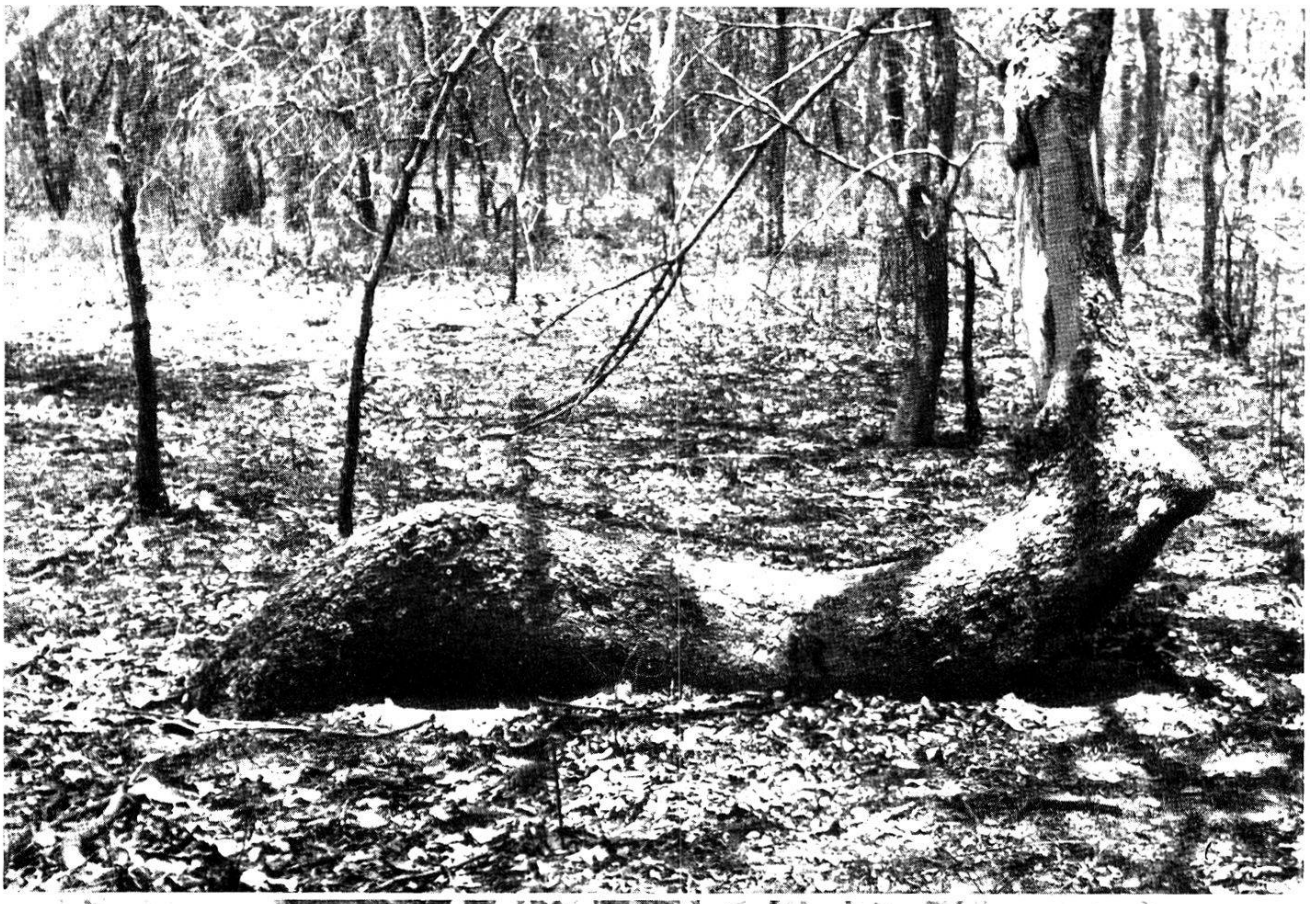
Fig. 7. Singida, cool season. This tree stump with the bark leaning up against it was very similar to many logs where the trunk was broken off just above the ground. There were four pupae under the end of the bark on the ground while two cases were near the stump. There was another pupa under the bark in the rains.

8

9

Fig. 8. Singida, hot season. This log was in an open space in the ecotone. There were eight pupae in the large hollow under the base at the left. Three others were under the blackened part of the log towards the right. Bush fires have burnt the grass and its absence is very noticeable.

Fig. 9. Singida, hot season. This shows the entrance to the burrow of an ant-bear (*Orycteropus afer*). The entrance was steep and its floor was covered with leaves, but at arm's length down, where seven pupae were found it was flatter and there were no leaves.



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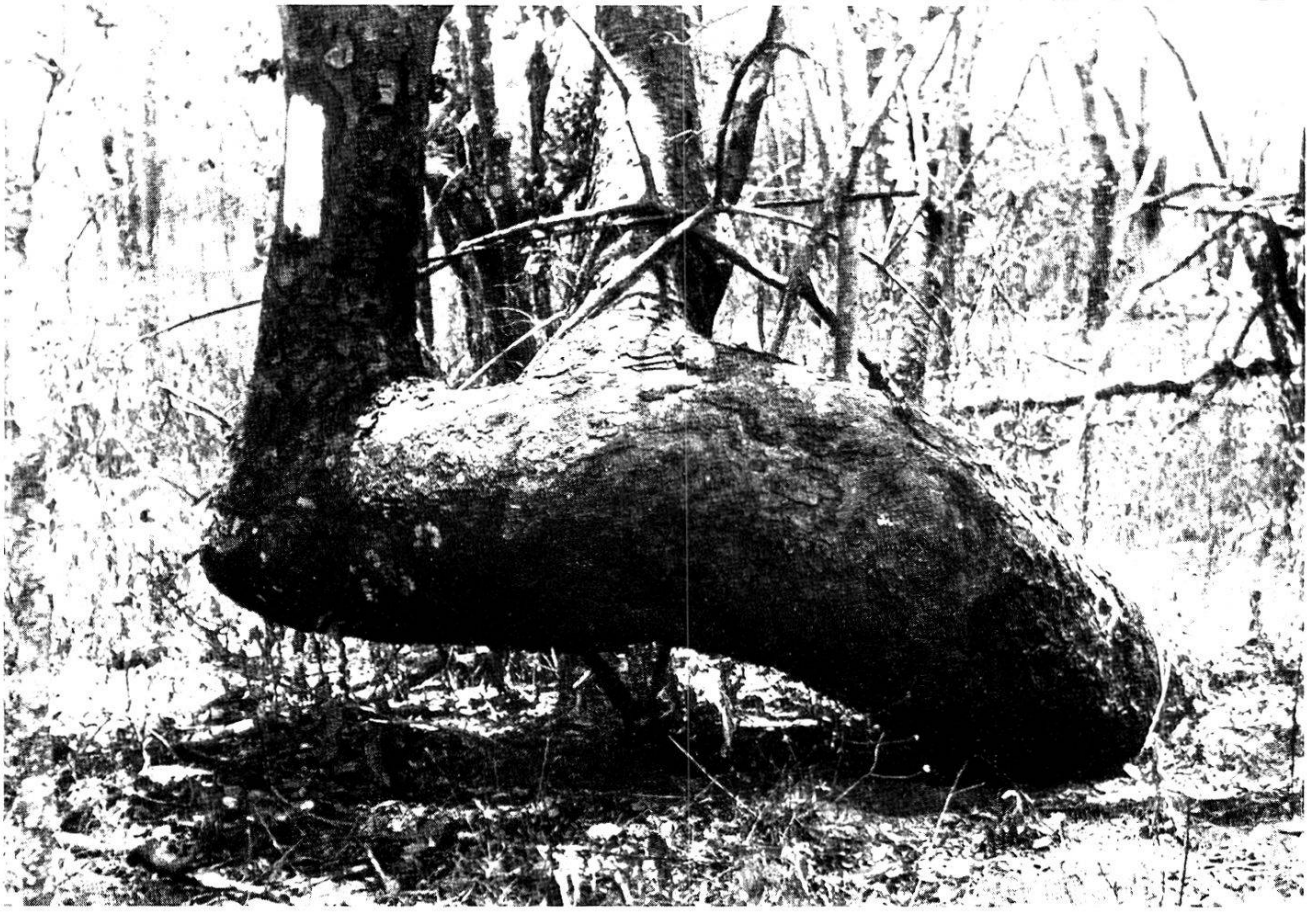

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Fig. 10. Singida, hot season. A partially decumbent *Pseudoberlinia globiflora* in the ecotone. There were six pupae in the space under the trunk near its base on the left, and one other where the trunk leaves the ground on the right.
Fig. 11. Singida, hot season. A leaning *Brachystegia tamarindoides* in the ecotone at a valley edge. The thickest part of the trunk was about two feet in diameter near where it leaves the ground and here there were three pupae.

12

13

Fig. 12. Singida, hot season. A large *Gardenia* tree in a valley where fourteen pupae were taken near the trunk. Five pupae were in cracks in hard soil, the remainder buried in softer patches. The long grass in the background happened to be missed by the grass fires earlier in the year.

Fig. 13. Singida, hot season. This large log was completely in the open in a valley but had a large well-shaded hollow under its base and roots. There were six pupae and two empty puparia in this hollow. It was completely covered with very tall grass in the cool season and the rains.

14

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Fig. 14. Singida, hot season. This thicket was formed by one large *Acacia spirocarpa* surrounded by *Combretum obovatum* and *Grewia platyclada*. One pupa was found very near the surface of a thin layer of loose soil under some leaves. The site was in the same large valley as Figs. 12 and 13.

Fig. 15. Singida, rains. A small log which was completely in the open with no shade. One pupa was taken under it.

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Fig. 16. Singida, rains. A small log with very little shade where twelve pupae and six empty puparia were found. This was the most productive site at this season.

Fig. 17. Kahama, cool season. A small log in the *Brachystegia* woodland where there were three pupae and twenty empty puparia. It had the lowest soil temperature (21.5° C.) of any productive site at this season. The taller and denser grass of this woodland, compared with Singida, is well seen in this photograph.

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Fig. 18. Kahama, cool season. This log was unusually high above the ground (about nine inches) where one pupa and one shell were found, both near the centre of the photograph. It can be seen that the trees generally grow close together and there are more bushes than in Singida.

Fig. 19. Kahama, cool season. The base of a young *Borassus* palm tree. There was one pupa in the soil in a leaf base about one foot above the ground and there were two others in the soil close to the trunk.

Fig. 20. Kahama, hot season. A large rot-hole in a *Vitex doniana* about fifteen inches in diameter. The soil inside was at ground level and in it there were one pupa and six empty puparia.

Logs again proved very suitable as sites for pupae and again were numerous as elephants were present. Pupae were largely under logs at all seasons and in April only two out of a total of fifty four were taken elsewhere. In both June and October 82% of all pupae found were under logs. Thus the proportion of pupae under logs in Kahama was lower in June, about the same in April and higher in October than in Singida. In all log sites with pupae the average number per site was only 1.3 in June, 1.2 in October and 1.9 in April, and at each season only one log in ten afforded pupae. This is a much smaller percentage than in Singida, where it also varied from season to season.

TABLE 1.

The distribution of pupae in different types of sites.

	Singida			Kahama		
	June	October	April	June	October	April
Logs	312	135	87	49	47	52
Young Palms	—	—	—	7	6	—
Old Palms	—	—	—	3	1	—
Leaning trees	—	25	—	1	1	2
Rot holes	—	25	—	—	3	—
Thickets	—	29	—	—	—	—
Tree bases	5	—	—	—	—	—
Tree stumps	5	7	1	—	—	—
Animal burrows	—	8	—	—	—	—
Rocks	—	3	—	—	—	—
Totals	317	232	88	60	58	54

The sizes of logs used as pupal sites did not vary as much between the different seasons as in Singida. The average diameter was 6″ in July, 9″ in October and 7½″ in April and there was no marked change from more open sites in the cool season to shadier ones in October. However, it was noticed that the few very open sites which yielded pupae in June had none in October.

Palm trees (*Borassus aethiopum* Mart.) were present in the woodland and proved suitable as sites for pupae. They fall into two types, young trees where the petioles remain attached to the trunk near its base even when the fronds are dead, and old trees where the bole of the tree is clean and the only fronds are at a considerable height. Pupae were found near the trunk of the young palms usually directly under the base of a petiole. One was also found in some soil in the hollow where a petiole joined the trunk. The only suitable site offered by the old palms was under the fallen fronds on the ground. In June there were seven pupae under four

young palms and in October six under five. Under the fronds of old trees three pupae were taken in June and one in October. None were found under either young or old palms in April, when many of them were completely surrounded by tall grass.

Many rot-holes were searched at each season but again were apparently only used as pupa sites during the hot season, when three pupae were taken, each in a different site. Two of the sites were in hollow *Vitex doniana* trees and the other in a *Parinari curatellifolia* Planch. In each case the hollow was large, exceeding one foot in diameter and all were at ground level. Each appeared very suitable as a pupal site. Fifty-one empty puparia were taken from several rot-holes on this visit, mostly several together in one cavity, and it appears that rot-holes are usually either very suitable or completely unsuitable, as there were few with only one or two empty cases. There was no striking difference between the two types, but where larger numbers of shells were found together they were always in large holes.

Leaning trees were rarely used as pupa sites here. One pupa was found under a leaning tree in June and another under a further tree in October. In two different sites in April a single pupa was taken and these two pupae were then the only ones not under logs. The few empty cases that were obtained only confirmed that leaning trees were little used.

No pupae were taken from any type of site other than those mentioned, although many other apparently likely places were searched. The ground at the base of some termitaria was covered with small bushes such as *Popowia obovata* and *Grewia platyclada* which afforded good shade. A total of six empty cases was found under these bushes; they were scattered on the ground and not particularly near the base of any stem. *Albizzia brachycalyx* Oliv. trees also sometimes grow on termitaria in this district and four old empty cases were taken at the foot of them. The bases of other tree species were searched but nothing was found. None were seen in Kahama as suitable as the two in Singida where pupae were obtained and where there were definite enlargements in the trunks just above the ground. Tree stumps yielded no pupae but under a large one, which was about 18″ in diameter and was leaning at an acute angle, twenty one shells were found. Ant-bear burrows were searched but the majority were rather damp, except in October, and full of leaves. No pupae or shells were taken. There were a few places where some small rocks, up to about three feet long, were seen but, though six old cases were taken from a few that offered suitable cavities, the majority were unsuitable as there was no cavity below.

Soil temperatures.

Saturation deficits were calculated from readings taken both in many sites and outside but no correlation could be found between them and the presence or absence of pupae, and this applies also to the light readings taken. Soil temperatures at a depth of about 1½″ appeared to be the only climatic factor with any bearing on whether pupae were present or not. However, temperatures alone do not necessarily indicate whether a site is suitable; many sites without pupae were in the same temperature range as those with them, although other sites lacking pupae were outside it. During the wet and cool seasons when none of them yielded pupae, the majority of rot-holes, thickets, cavities under rocks and animal burrows, had lower temperatures than the productive sites, but in the hot season were in the same temperature range as the logs used then.

As stated on page 3, all soil temperatures were corrected for the time of day. The average of the corrected temperatures for sites with pupae at the different seasons were as follows: in Singida in June 21.4° C., in October 25.5° C. and in April 23.0° C. The corresponding figures for Kahama were 23.7° C., 27.7° C. and 22.7° C. which are generally slightly higher. It is interesting that the rise in temperature between the cool and hot seasons is the same (4.1° C. and 4.0° C.) in both places. The tolerated range was approximately 5° C. at any one season in both areas.

The most important point brought out by soil temperature readings was in Singida. In October, as mentioned above, pupae were found under larger logs and other more shady places than in June. This was particularly noticeable in the *Brachystegia* woodland at Masungu in Singida. In June 99 pupae were taken from eleven fairly small logs which had an average soil temperature of 21.5° C. as opposed to 29.0° C. in October when not one gave a positive result. The only three logs in this area to yield pupae in October were large and shady and had not been used in June. Five pupae were taken from them where the average soil temperature was 26.0° C. As few pupae were found in sites other than logs in June it can be seen that at this time of the year, the cool season, the warmest shady places available are used. Conversely, in the hot season the coolest places are carefully chosen. In the rainy season pupae are again found in the warmer and more open sites but this is probably partly because the soil in the very shady sites is then very damp. No real shift with rising temperature was found in Kahama and it is surprising that the rise in soil temperature between June and October of those sites with pupae was not greater there than in Singida.

TABLE 2.

The soil temperature range of some pupal sites (all temperatures corrected to 11.30 a.m.).

1″ soil temp. (°C)	Singida		Kahama	
	Histogram of sites	Number of sites	Histogram of sites	Number of sites
June				
19-20	11	2		
20-21	1111	4	11	2
21-22	111111	6	111	3
22-23	1111	4	1111	4
23-24			1111111111111	13
24-25	1	1	111	3
25-26			1111	4
26-27			1	1
October				
22-23	1	1		
23-24	111	3		
24-25	11111111111	11		
25-26	11111111	8	1	1
26-27	11	2	1111	4
27-28	111111111	9	1111111	7
28-29	1	1	11111	5
29-30			11	2
30-31			1	1
April				
20-21	1	1	1	1
21-22	11	2	11111	5
22-23	1111111	7	111111111	9
23-24	111111	6	11111	5
24-25	11	2	111	3
25-26	11	2		

Discussion.

In both areas logs were by far the most important type of pupa site, even when in the hot season other sites were being used. However, in Singida in the hot season the size of the logs was nearly doubled, and these logs, together with rot-holes, thickets and leaning trees, affording pupae only at this season, were the best-shaded and coolest available. The change is definitely due to temperature and it looks as if the pregnant females not only search for cool sites in hot weather but also in cool weather try to find places which are not too cold. Although there was a tendency in Kahama to use slightly more shady sites in the hot weather, there was no such marked change as in Singida.

In Kahama pupae were found throughout the *Brachystegia* woodland at each season and there were few near the valleys, where there was always long grass during that year, enveloping any sites that might otherwise have been suitable. The picture was very different in Singida: in the rainy and cool seasons there was long grass in the valleys and all the pupae were in the woodland, but in the hot season when the valleys had been burnt, most of the pupae were found in them unless suitable sites were absent, when they occurred in the ecotone instead. This desertion of the woodland would appear to be because it is leafless and hot at this season whereas the thickets and bushes in the valleys and at their edges offer more shade.

It has been suggested in the past that tsetse may be able to maintain their pupae at a constant temperature throughout the year by using more deeply shaded breeding sites with rising temperature, but although they did in fact do so in the areas studied, they failed to maintain the pupae at anything like a constant temperature by so doing; the average temperatures varied at least 4° C. from the cool to the hot season and temperature in individual sites showed much greater differences.

In Kahama pupae were about as readily obtainable during the rains as in the dry season but not in Singida where considerably more searching had to be done to collect as many as in the dry season. Pupae are generally difficult to obtain during the rains and the exceptional result in Kahama is possibly due to the abnormally low rainfall of that year (1953). It must be pointed out that, although searching was carried out thoroughly in a given area, the numbers of pupae obtained at any season were not sufficient to maintain the fly population at the level existing at the time of searching, and only a small proportion of the total pupae in the area can have been found. Other workers in the same field have encountered the same difficulty. It means that, although to the searcher certain sites are more productive of pupae than others, they are not necessarily those preferred for larval deposition by the female tsetse. However, this investigation was intentionally limited to the investigation of recognisable sites, where pupae might be expected to occur, and there was no attempt at really random searching.

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Résumé.

Des pupes de *G. morsitans,* appartenant à la race dite centrale du Tanganyika, ont été collectionnées dans le district de Singida ; d'autre part on s'est procuré, près d'Ushirombo dans le district de Kahama, des pupes de la race occidentale de *G. morsitans* qui se distingue nettement par sa coloration plus foncée. Les deux régions représentent un type de végétation appartenant au complexe *Brachystegia,* auquel, en Afrique orientale, *G. morsitans* est typiquement associée ; elles ont été visitées toutes les deux à trois saisons de l'année, à savoir en saison froide et chaude et pendant les dernières pluies.

Dans les deux aires le bois mort abonda et servit fréquemment à l'établissement de gîtes, où des pupes furent trouvées à toute saison, particulièrement pendant les pluies et, à Singida, aussi en saison froide. En saison chaude beaucoup de pupes furent trouvées dans divers autres types de gîtes, spécialement sous des troncs d'arbres inclinés, dans des arbres creux et sous la broussaille, certaines aussi près de souches d'arbres, dans des terriers d'oryctéropes et sous un rocher. A Kahama on a constaté, dans la saison froide et chaude, la présence de pupes, indépendamment de bois mort, sous des palmiers, des arbres inclinés et, en saison chaude, dans des arbres creux. La fréquentation de ces gîtes inhabituels fut moins marquée en saison chaude qu'à Singida, mais plus reconnaissable en saison froide.

La race centrale de Singida, fréquentant des gîtes en pays ouvert pendant les pluies et la saison froide, préférait nettement des gîtes ombragés en saison chaude. Aussi à cette époque la plupart des pupes furent-elles trouvées dans des vallons couverts d'herbe et non pas dans des terrains boisés. A Kahama ce phénomène ne put être observé, parce que l'herbe n'avait pas été brûlée en 1953.

Pendant la saison des pluies, il fut relativement facile d'obtenir des pupes à Kahama, peut-être aussi parce que les pluies étaient particulièrement rares cette année-là ; à Singida par contre il fut plus difficile de les trouver à cette époque qu'en saison chaude. Malgré des prospections très intenses on a réussi à collectionner seulement un petit nombre des pupes qui devaient être présentes.

Zusammenfassung.

Puppen von *G. morsitans,* welche der Rasse von Zentral-Tanganyika angehörten, wurden im Singida-Distrikt, und solche der deutlich dunkler gefärbten westlichen Rasse bei Ushirombo im Kahama-Distrikt gesammelt. Beide Gebiete zeigen das Vegetationsbild sog. *Brachystegia*-Zonen, die in Ostafrika als Habitat für *G. morsitans* typisch sind. Die Kontrollen dieser Gebiete wurden jeweils in drei Jahreszeiten (kühle und heiße Zeit sowie späte Regenperiode) durchgeführt.

In beiden Regionen war Fallholz häufig und bot ausgiebig und zu allen Jahreszeiten Gelegenheit für Puppenplätze, besonders während der Regenzeit

und in Singida auch während der kühlen Periode. Während der heißen Periode wurden viele Puppen an verschiedenen anders gearteten Brutplätzen gefunden, speziell unter schräg gewachsenen Bäumen, in hohlen Stämmen und unter Gestrüpp, einige befanden sich auch bei Baumstrünken, in Erdferkellöchern und unter einem Felsen. In Kahama konnten verschiedene Puppen unabhängig von Fallholz sowohl in der kühlen als auch in der heißen Jahreszeit gesammelt werden, und zwar unter Palmen und schräg gewachsenen Bäumen sowie in der heißen Jahreszeit in Baumhöhlen; die Benützung solcher ungewöhnlicher Brutplätze war weniger ausgeprägt als in Singida während der heißen Jahreszeit, dagegen ausgeprägter während der kühlen Jahreszeit.

Die zentrale Rasse (von Singida) zeigte ein ausgesprochenes Umschlagen der Präferenz von Puppenplätzen von eher offenem Gelände während der Regenzeit und der kühlen Periode zu beschatteten Plätzen während der heißen Zeit. Dies drückte sich darin aus, daß zu dieser Zeit die Mehrzahl der Puppen nicht in bewaldeten Gebieten, sondern in grasbewachsenen Tälern gefunden wurden. In Kahama konnte ein solches Umschlagen nicht beobachtet werden, weil im Jahre 1953 das hohe Gras nicht abgebrannt worden war.

Puppen waren in Kahama während der Regenzeit relativ leicht erhältlich, möglicherweise wegen des geringen Niederschlages in jenem Jahre in Singida jedoch waren sie schwieriger zu finden als während der Trockenzeit. Trotz gründlichem Durchsuchen des Geländes gelang es nur eine relativ kleine Zahl der vorhandenen Puppen zu sammeln.