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The effect of trypanosome infection on a natural population of *Glossina longipalpis* Wiedemann (Diptera: Glossinidae) in Ivory Coast

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Summary

A population of *Glossina longipalpis* studied in the Southern Guinea savanna zone, Ivory Coast, showed marked differences between non-infected and infected females. Each fly was examined for age, reproductive condition, wear and tear, size and nutritional status. Infected flies were generally and sometimes significantly more active with lower fat reserves, residual bloodmeal and higher residual dry weight. Poorer nutritional condition may be due to energy metabolised by trypanosomes and possibly impaired feeding ability.

Key words: tsetse; *Glossina longipalpis;* Ivory Coast; trypanosome infection, effects of.

Introduction

A limited number of studies have shown that, when infected, tsetse (*Glossina* spp.) are affected by trypanosomes. These effects range from minor morphometric changes of midgut cells (Hecker and Moloo, 1980), damage to the salivary glands (Patel and Golder, 1980) to possible increased longevity (Baker and Robertson, 1957) and tolerance of endosulfan (Golder et al., 1982). Changes in the feeding behaviour of infected tsetse may result from the interaction of rosettes with mechanoreceptors of, and changes of flow in, the proboscis (Molyneux et al., 1979; Jenni et al., 1980; Livesey et al., 1980). An individual tsetse may suffer a daily energy loss of 2.83 Joules due to its trypanosome load,

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which is equivalent to 15% of a males' flight energy and considerably more for females (Bursell, 1980). The latter possible effect is based on theoretical considerations whereas the others are all based on studies of laboratory colonies. This study considers for the first time the effect of trypanosome infection on a wild population of *Glossina longipalpis* in Ivory Coast. The emphasis is placed on changes in activity, size and nutritional status due to, or concomitant with infection.

Materials and Methods

Using biconical traps (Ryan and Molyneux, 1980) *G. longipalpis* were caught in riverine gallery forest within the Southern Guinea savanna zone along the River Marahoué (8°13′ N, 6°39′ W) during April 1982. Traps were set and emptied within a three-hour period in the early morning, the collected females were stored in a domestic freezer and examined within a four-hour period. Females were examined for: wing fray (WF) (Jackson, 1946; Ryan et al., 1980), degree of cicatrizing (CC) (Ryan et al., 1982a), scutellar and humeral bristles remaining (RH and RS), arbitrarily ranked for each bristle as 0, 1, 2, 3 and 4 (for whole, ¾, ½, ¼ or no bristle respectively). After removing the legs and wings, wing vein (WV) (Jackson, 1953) and surface area (SA) (Bursell, 1960) were measured. Probosces were removed and the labrum and hypopharynx examined for trypanosome infection (Lloyd and Johnson, 1924) and degree of infection (Ryan et al., 1982b). Careful dissection revealed the reproductive condition (Ryan and Molyneux, 1982) and ovarian age category (OA) (Saunders, 1960; Challier, 1965) leaving the intestine and fat body intact. Where the uterus contained a larva this was removed and stored separately with the adult in individual microtitre tray wells. Trays were dried, stored over silica gel and returned to U.K. sealed with cling-film. Tsetse were subsequently analysed for chloroform-extractable fat (FAT), residual dry weight (RDW) and spectrophotometric estimation of haematin at 417 μm (HM) (Ford et al., 1972; Rogers and Randolph, 1978).

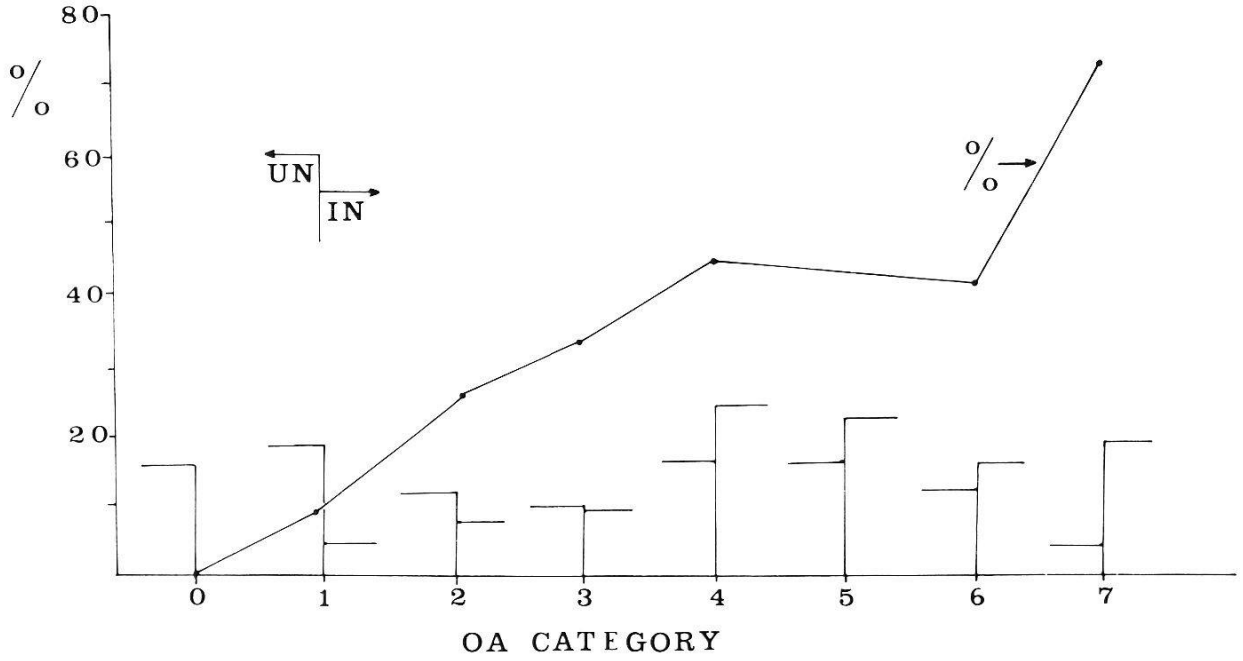

Fig. 1. % female *G. longipalpis* per OA category, uninfected (UN) and infected (IN). The line (% >) is the % infected per OA category.

Table 1. The mean (±S.E.) values of ovarian age (OA), wear and tear (WT), wing vein (WV), surface area (SA), residual dry weight (RDW) and fat in mg, haematin (HM) units at 417 μm for *G. longipalpis* of OA 3–7 subcategory *a* for uninfected and infected females (N = 41 and 17 respectively)

	Uninfected	Infected
OA	52.51 ± 1.78	55.35 ± 3.49
WT	5.54 ± 0.29	7.15 ± 0.36*
WV	2.11 ± 0.06	2.10 ± 0.08
SA	8.91 ± 0.08	8.76 ± 0.12
RDW	8.27 ± 0.15	8.95 ± 0.29
FAT	4.26 ± 0.30	3.70 ± 0.39
HM	0.203 ± 0.09	0.1404 ± 0.12

* indicates a significant difference between the means ($p < 0.001$)

The four indicators of activity, WF, CC, RH and RS were combined to form one wear and tear (WT) category where:

$$WT = WF + CC + (8 - [RH + RS])/2$$

and ranges between 2 and 14. Only females with mature infections are included in the analysis. Mature is considered to be an infection category greater than 2 of the labrum, 3 of the hypopharynx or 4 when combined, which represents a significant and established invasion of the proboscis by parasites (Clarke, 1965; Ryan et al., 1982b). Statistical comparisons of mean values (t-test) are based on females of subcategory OA *a* to avoid the effects of the gonotrophic cycle and of OA 3–7 to avoid age related effects.

Results and Discussion

One hundred and seventy-five females were examined and 58 (33%) were infected, however infection is age related and ranges from 0% to 73% as shown in Fig. 1. Table 1 shows the mean values of OA, WT, WV, SA, RDW, FAT and HM for uninfected and infected females. Wing fray has been shown to indicate activity (Ryan et al., 1980) and is here combined with CC, RH and RS, other variables affected by activity (Ryan et al., 1982a) as WT to allow for greater accuracy and discrimination. The significant difference ($p < 0.001$) in activity (WT) of infected females may be explained by increased feeding activity, necessitated by the parasite load (Bursell, 1980) and/or impaired feeding ability (Jenni et al., 1980). A higher frequency of feeding would offset the effects of infection unless sufficient numbers of hosts were not available, when a decrease in nutritional reserves would be apparent. The values in Table 1 provide some indication that nutritional reserves may be a little lower in infected females, but the differences do not reach the level of statistical significance. This is the first successful attempt to demonstrate the effect of trypanosome infection on the tsetse host in the field.

The sample size is relatively small, however this is offset by the high infection rate encountered and, in addition, the detailed study of ten variables for each individual tsetse. Future studies should involve careful dissection of the gut and salivary glands to detect presence and degree of infections and to study the effect of immature infections. The age of tsetse should be known either as OA or possibly by the quantification of pteridines (Mail et al., 1983). The measurements taken for individual flies, outlined in this report could then be related to the site and species of infecting trypanosome, degree of infection, host density, habitat and sampling bias.

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Baker J. R., Robertson D. H. H.: An experiment on the infectivity to *Glossina morsitans* of a strain of *Trypanosoma rhodesiense* and of a strain of *Trypanosoma brucei*, with some observations on the longevity of infected flies. Ann. trop. Med. Parasit. *51*, 121–135 (1957).

Bursell E.: The measurement of size in tsetse flies (*Glossina*). Bull. ent. Res. *51*, 33–37 (1960).

Bursell E.: Energetics of haematophagous arthropods: influence of parasites. Parasitology *82*, 107–110 (1980).

Challier A.: Amélioration de la méthode de détermination de l'âge physiologique des Glossines. Etudes faites sur *G. palpalis gambiensis* Vanderplank 1949. Bull. Soc. Path. exot. *58*, 250–259 (1965).

Clarke J. E.: Trypanosome infections in the mouthparts of *Glossina morsitans* Westw.: a comparison between extent of labral infection and invasion of the hypopharynx. Ann. trop. Med. Parasit. *59*, 235–239 (1965).

Ford J., Maudlin I., Humphreys K. C.: Comparisons between three small collections of *Glossina morsitans morsitans* (Machado) (Diptera: Glossinidae) from the Kilombero River Valley, Tanzania. Part I. Characteristics of flies exhibiting different patterns of behaviour. Acta trop. (Basel) *29*, 231–249 (1972).

Golder T. K., Otieno L. H., Patel N. Y., Onyango P.: Increased sensitivity to endosulfan of *Trypanosoma*-infected *Glossina morsitans*. Ann. trop. Med. Parasit. *76*, 483–484 (1982).

Hecker H., Moloo S. K.: Influence of *Trypanosoma (Trypanozoon) brucei* infection on the fine structure of midgut cells of *Glossina m. morsitans*. Parasitology *82*, 106–107 (1980).

Jackson C. H. N.: An artificially isolated generation of tsetse flies. Bull. ent. Res. *37*, 291–299 (1946).

Jackson C. H. N.: Seasonal variations in the mean size of tsetse flies. Bull. ent. Res. *43*, 703–706 (1953).

Jenni L., Molyneux D. H., Livesey J. L., Galun R.: Feeding behaviour of tsetse flies infected with salivarian trypanosomes. Nature (Lond.) *282*, 383–385 (1980).

Livesey J. L., Molyneux D. H., Jenni L.: Mechanoreceptor-trypanosome interactions in the labrum of Glossina: fluid mechanics. Acta trop. (Basel) *37*, 151–161 (1980).

Lloyd L. L., Johnson W. B.: The trypanosome infections of tsetse flies in Northern Nigeria and a method of estimation. Bull ent. Res. *14*, 265–288 (1924).

Mail T. S., Chadwick J., Lehane M. J.: Determining the age of adults of *Stomoxys calcitrans* (L.) (Diptera: Muscidae). Bull. ent. Res. *74*, 501–526 (1983).

Molyneux D. H., Lavin D. R., Elce B.: A possible relationship between salivarian trypanosomes and *Glossina* labrum mechanoreceptors. Ann. trop. Med. Parasit. *73*, 287–290 (1979).

Patel N., Golder T.: Some effects of trypanosome development on the salivary glands of *Glossina morsitans*. ICIPE 7th Annual Report, Nairobi, 1979, p. 93–95 (1980).

Rogers D. J., Randolph S. E.: Metabolic strategies of male and female tsetse (Diptera: Glossinidae) in the field. Bull. ent. Res. *68*, 639–654 (1978).

Ryan L., Molyneux D. H.: Construction details for the Challier/Laveissière biconical trap. In: IAEA/FAO International Symposium on the use of isotopes for research and control of vectors of animal diseases, host pathogen relationships and the environmental impact of control procedures, Vienna, 7–11 May, 1979. IAEA-SM-240/40, p. 339–353 (1980).

Ryan L., Molyneux D. H.: Reproduction statistics of a natural population of *Glossina morsitans centralis* Vand. (Diptera: Glossinidae) in Zambia. Ann. trop. Med. Parasit. *76*, 215–218 (1982).

Ryan L., Molyneux D. H., Kuzoe F. A. S.: Differences in rate of wing fray between *Glossina* species. Tropenmed. Parasit. *31*, 111–116 (1980).

Ryan L., Croft S. L., East J. S., Molyneux D. H., Baldry D. A. T.: Naturally occurring cicatrices of *Glossina morsitans centralis* (Diptera: Glossinidae). Z. angew. Zool. *69*, 299–307 (1982a).

Ryan L., Küpper W., Croft S. L., Molyneux D. H., Clair M.: Differences in rates of acquisition of trypanosome infections between *Glossina* species in the field. Ann. Soc. belge Méd. trop. *62*, 291–300 (1982).

Saunders D. S.: The ovulation cycle in *G. morsitans* and a possible method of age determination for female tsetse flies by the examination of their ovaries. Trans. roy. ent. Soc. Lond. *112*, 231–238 (1960).