Tsetse flies

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ECOLOGY/LIFE CYCLE

Ecology

Significant interactions between tsetse flies and their environment, especially regarding climate, vegetation and fauna, have been reported. A comprehensive review on the biology and ecology of tsetse flies has been recorded by Leak, (1999).

Climate (essentially temperature and vapour pressure deficit) governs the spread of the fly over the African continent. A humid atmosphere makes it possible for tsetse to move away from protected habitats where it survives during harsh conditions (e.g. the rainy season will enable G.tachinoides and G.palpalis gambiensis in the Sudanian savanna to leave the gallery forests and G.pallidipes to leave the Lambwe Valley National Park in Kenya and reach the surrounding arable land).

Temperatures above 38°C and below 17°C are risky for adult flies. They will seek shelter as soon as the temperature reaches 35°C (negative phototactism). At these inadequate temperatures the fat reserve of the pupa becomes also easily exhausted.

The development rate of the various stages of the tsetse fly is directly proportional to the temperature. High temperatures will shorten the interlarval period, the pupal stage (20 days at 30°C but 100 days at 16°C), the lifespan of the adult (although the correlation with the vapour pressure deficit is better) and the period between successive feeds.

The vegetation is determined by the climate and soil. Apart from grasslands, which do not support tsetse flies, all forms of woodland, from savannah to rain forest, can provide a suitable habitat for some species of these flies, but no single vegetation type is suitable for all species. Some species (e.g. G.palpalis) adjust easily to artificial biotopes, such as plantations of coffee, cocoa and palm oil. Thickets (sometimes comprising chiefly Lantana camara), which develop on abandoned agricultural land, are also often good habitats for them. As the type of vegetation, its photosynthetic activity over the course of the year (Normalized Difference Vegetation Indices) and the rate of fragmentation of the natural habitat can easily be monitored by satellite data; these are often used to predict the distribution and density of a Glossina sp. in an area.

A third important environmental factor for a tsetse fly is the availability of hosts. Both vision and odour detection are used by the tsetse fly to locate its host, vision is used in short-range recognition (about 15m) while odours are responsible for attracting flies from greater distances. The choice of a host will depend primarily on the host preference of the fly but, as tsetse flies are opportunistic feeders, host availability will also play an important role (e.g. in the unspoiled forest G.p.palpalis feeds mainly on reptiles. However in West and Central Africa the most important densities of this fly are met around...
villages where pigs are bred. For tsetse flies of the morsitans group such peridomestic habits are seldom observed.

*G. f. quanzensis* feeding on a pig ear

It was shown that tsetse flies, which have fed on a specific host species, have the tendency to return to the same host species for their following meals (Bouyer, 2005). Repeated feeding on the same host species by a disease vector is likely to increase the within-species disease-transmission risk, but to decrease it between species.

In the laboratory, feeding sterile, warm defibrinated blood through a membrane is generally used to maintain colonies of tsetse flies.

**Life cycle**

Tsetse flies have an unusual reproduction method. They are adenotrophic viviparous, the female feeding the larva inside the uterus and producing one fully grown third instar larva (L3) at each reproduction cycle. The deposited larva burrows in the soil prior to transform in a pupa. Consequently, more than half of the total tsetse population lives under the ground as pupae.
Ovulation takes place about 4 days after the first meal of the female. The egg passes into the uterus where it is fertilised by sperma from the spermatheca. After 3 to 4 days the egg hatches and gives rise to a first stage larva (L1), which is nourished with secretions produced by the milk glands. At 25°C the first instar lasts 24hrs the second 36hrs and the third 60hrs. The L3 larva once deposited burrows down into the soil. Then it moults to form the pupa, but remains within the shed third instar cuticle which hardens to form the puparium. Simultaneously with the larval deposition a new egg ovulates. The female fly is between 16 and 20 days old at the moment of the first larval deposition. The subsequent larvipositions generally occur with intervals of 8 to 12 days depending on the species and ambient temperature (for example *G.morsitans* at 30°C - 8 days, at 18°C – 25 days). The length of the pupal period varies according to the sex (shorter for females) and the ambient temperature (on average 30 to 35 days, but pupal periods from 17 up to 88 days have been observed). The young adult emerges from the puparium and the soil using its ptilinum. Young flies of which the exocuticle is not yet hardened and the muscles not well formed, are called teneral flies.
Tsetse flies are relatively long lived, up to 8 to 12 weeks for females, with males having shorter lives of around 4 to 6 weeks. Around 10 larvae are deposited during the lifetime of a single female. Hence the rate of reproduction is extremely slow compared to other diptera.

During mating the male with its superior claspers seizes the female. Repeated mating can cause the female to abort and even die. Therefore, the female generally accepts the male only once and one insemination is sufficient to fertilize the female throughout its life.

Both sexes of tsetse flies feed on blood, mainly from mammals but also from reptiles and birds. Blood meals are taken with intervals of 2 to 3 days. However, the bloodmeal does not cover the totality of
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the nutritional needs of the tsetse. Therefore tsetse flies maintain intracellular symbiotic microorganisms to supplement their nutrition (*Wigglesworthia* spp).

Tsetse flies gain energy for flight through the partial breakdown of proline, an amino acid gained from the blood meal, into alanine. Then alanine is reconverted in proline by using the triglycerides which are stored in the fat reserve of the fly. Considering the reserve of proline must constantly be renewed, the tsetse fly is able to fly for short periods only and on the whole less than an hour per day. Flight speed is around 20 km/h.

**Available multimedia**

*The life cycle of the tsetse fly*

[http://film.wellcome.ac.uk:15151/mediaplayer.html?0055-0000-3674-0000-0-0000-0000-0](http://film.wellcome.ac.uk:15151/mediaplayer.html?0055-0000-3674-0000-0-0000-0000-0)