Wellcome Film Project

Life Cycle of the Tsetse Fly

Wellcome Trust Film Unit, 1987.

Written and narrated by Dr LG Goodwin, FRS.
Directed and photographed by Douglas Fisher.

Filmed at the Medical Research Council's Tsetse Research Laboratories, Langford, Bristol; and at Kariba, Zimbabawe.

Colour
Duration: 00:08:22:13

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<**Goodwin narrates over close shots of tsetse flies, their habitats and feeding patterns**>

There are 22 species of tsetse flies all of which can carry trypanosomes that cause diseases in animals. Some are vectors of human trypanosomiasis, sleeping sickness. Adult flies measure from 6-14mm in length and are found only in Tropical Africa.

Their habitats range from rainforest to dry savannah woodland. The tsetse fly can be distinguished from other flies by the pattern of the veins in the wing, forming the so-called hatchet cell. It also has a proboscis that projects forwards. A widespread and economically important species, Glossina morsitans, occurs in Savannah woodlands, concentrating in areas of denser vegetation at the end of the dry season when temperatures are high and humidity is low.

Tsetse flies feed exclusively on blood. This one is on a man's hand. The various species have different feeding preferences – Glossina morsitans often feeds on

warthogs. It is also attracted to antelopes such as the bushbuck and it feeds on cattle while they are grazing in the bush. Here are two lightly coloured young flies feeding.

The fly's tubular mouth parts are lowered and inserted into the tissues of the host, in this case human. The mouth parts break up tiny capillary blood vessels under the skin, forming a pool from which blood is sucked up into the fly. The fly swells up as it feeds and the amount of blood taken up greatly exceeds the weight of the fly itself.

<**Goodwin over close shots of tsetse fly reproduction, including animated explanatory diagram**>

Male tsetses can easily be distinguished from females by the presence of the hypopygium, the external genitalia at the end of the abdomen of the male. And this is a female. Female flies mate when very young, probably most do so when taking their first blood meal. A non-volatile contact sex recognition pheromone in the cuticle of the female assists in care formation. If a decoy is soaked in a solution of this substance male flies will attempt to mate with it.

The flies can remain paired for several hours and although females may mate more than once only one pairing is necessary because sperms are stored in the spermathecae of the female.

This diagram shows the sexual organs of a female tsetse. Here is the vagina, the uterus, the ovaries, the oviduct, the sperm ducts and the spermathecae. When mating, a spermatophore, a bag of sperms, is deposited by the male near the ends of the spermathecal ducts. Sperm leave the spermatophore and move into the spermathecae. Unlike most insects that produce large numbers of eggs, the tsetse fly gives birth to one living larva at a time.

An egg is ovulated into the uterus from the right ovary when the fly is about 9 days old. It is fertilised by a sperm from the spermathecae and the embryo develops. After about 4 days the egg hatches into a first-instar larva which feeds on milk produced

by the uterine glands. The larva moults twice; it comes to occupy most of the mother's abdomen, replacing the original blood meal as it grows.

<**Goodwin over close shots of female tsetse fly laying larva, followed by development of larva and emergence of new tsetse fly**>

The pregnant fly selects a shady spot, settles on soft leaf litter, soil or sand and gives birth to the fully formed larva. It comes out tail first and the black objects on the rear end of the larva are respiratory organs, the polyneustic lobes.

00:04:38:11

The maggot weighs almost as much as its mother and from the moment of birth is very active; it burrows head first into the soil by peristaltic movements while its mother waits. When she flies away it will be to obtain another blood meal and to produce another larva in 9 days time.

When the larva has gone deep enough it stops moving. The larval cuticle hardens and, seen here on the surface and speeded up, changes in colour from white to black. The larva has now become the puparium and the adult develops inside it.

Two moults take place within the puparium: the first produces the pupa and the second the imago. Here you can see the changes by x-ray. Like all stages of the life cycle, the duration of the puparial period depends on the ambient temperature; with a mean temperature of about 25˚C it lasts about 30 days. This is the best stage at which to collect tsetse flies for laboratory work. Here soil from a dry river bed is being sieved and the pupae collected.

When it is ready to emerge, the imago breaks the anterior end of the puparium. The balloon-like ptilinum on the head of the fly between its eyes expands and contracts repeatedly and helps it to get out. The fly is on its back, its proboscis springs out and it slowly struggles out of the puparium. Normally, of course, all this takes place underground.

Movements of the ptilinum assist the upwards passage of the insect through the soil. The fly breaks through to the surface and rests while its wing veins fill with fluid. The wings gradually expand and then dry out. This takes several minutes, here you see the process speeded up 5 times. The fly has some food reserves left over from the puparial stage, but it's important for it to obtain its first blood meal as soon as possible. When its wings are strong enough the fly goes in search of a new host and the cycle is complete.