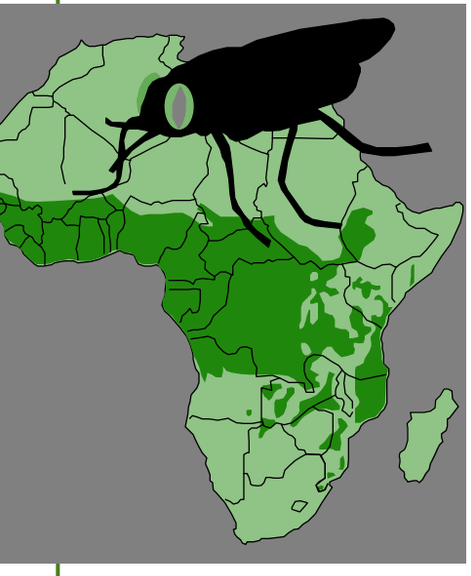
Tsetse Eradication: Zanzibar

Tsetse flies (*Glossina sp.*) continue to make livestock production difficult or impossible throughout a very large part of Africa. One of the most promising techniques for eradicating tsetse from certain locations is the environmentally safe Sterile Insect Technique (SIT). In collaboration with the Tanzanian authorities, the Department of Technical Co-operation is sponsoring a programme, with technical support from the Joint FAO/IAEA Division, to eradicate tsetse from Zanzibar using the SIT.

Scourge of Africa

The 22 species of tsetse fly carry a group of protozoal diseases causing trypanosomiasis. Trypanosomiasis, in one or more of its forms, is found throughout Africa between 15°N and 20°S latitudes and causes widespread loss to livestock due to sickness and death. Human trypanosomiasis, known as 'sleeping sickness' is also endemic in some parts of Africa.

As a result of the continuing presence of tsetse, livestock production (cattle, sheep, goats and horses) is not possible over many thousands of square kilometres. Human habitation may also be a risk and, even where there is settlement, agriculture has to function without the benefits of livestock – draft power, utilisation of crop by-products and production of manure. The population is also denied nutritious animal products including meat and milk.



The regions of Africa overshadowed by tsetse.

Options for control

For four decades control measures for tsetse depended on spraying insecticides on vegetation favoured as resting sites by tsetse, or clearing such vegetation.

The cost in chemicals and personnel, and concern over widespread spraying of pesticides, has led to alternative, more environmentally sensitive control measures.

- Bait and trap. Blue or black attractant cloth screens impregnated with synthetic pyrethrins attract tsetse and contaminate their feet with a lethal dose of insecticide. This technique can reduce tsetse numbers substantially.
- Sterile Insect Technique. Where natural populations of tsetse have been reduced to pre-determined levels the sustained release of sterile male flies can reduce tsetse populations even further and ultimately eradicate a population entirely.

Tsetse life-cycle

The tsetse is a unique insect. it gives birth every 9–10 days to a full-grown larva, which immediately burrows into the soil and forms a pupa. Thus the egg and larval stages of tsetse are not subject to the usual hazards and losses experienced by other insects.

Female tsetse produce at most nine larvae. Tsetse flies unquestionably have the lowest reproduction potential of any insect, and this fact makes them a good target for SIT.

A single mating provides sufficient sperm for fertilization through the female's 90–100-day lifespan. Since females usually mate only once, if they are mated by a sterile male they will not produce any offspring.

The Sterile Insect Technique

The SIT is a specific, environmentally friendly technique to control or eradicate tsetse by using gamma radiation. It depends on rearing large numbers of insects in purpose-built 'fly factories', sterilizing the males with carefully controlled doses of gamma radiation, and releasing them in the target area.

The gamma radiation is sufficient to induce sterility but does not reduce the treated flies' ability to fly or to compete with native males or to mate. Mating between the sterile released insects and the native population produces no offspring. When sufficient sterile males are released (usually 15 sterile males to 1 native male) over a long enough period suppression or eradication results.

Other suppression techniques precede the SIT to reduce the native population so that fewer sterile insects are required. In this way the SIT complements other tsetse control techniques.

'SIT may be the key missing link of integrated tsetse and trypanosomiasis management in many parts of Africa'

Udo Feldmann, FAO/IAEA

Boxes of sterile tsetse files being loaded

The FAO had an animal disease control project on Zanzibar from 1986–1993 with a tsetse control component using insecticide on cattle and artificial attractant devices. This programme greatly reduced the tsetse on the island but failed to eradicate it. This is why the programme has been followed up with this SIT model project.

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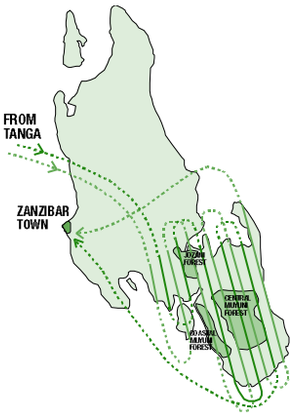
The model project

The model project was initiated on 1 January 1994. Its objective is to eradicate tsetse from Unguja Island, the main island of Zanzibar in the United Republic of Tanzania. Only one species, *G.austeni*, is present on the island and its attack is confined to wild and domesticated animals. Zanzibar is an excellent location for this project for two reasons:

- It is an isolated location and gives an opportunity to conduct research as well as refine techniques on all aspects of SIT.
- The isolation of the island means that the eradication will be enduring and have a lasting impact on livestock development in Zanzibar as trypanosomiasis will no longer be a problem.
- Following eradication, monitoring will continue and land will be freed for better utilisation.



Aerial release

Aerial release of tsetse from aircraft provides optimal dispersal of sterile insects even in inaccessible areas. The first aerial release of tsetse flies in Zanzibar was in August '94 and there have been releases every week subsequently. Currently flies are released twice a week over the southern part of the island *(see map)*. In 1996, releases will be extended to cover the entire island.

Aerial release is giving a much better distribution pattern of the flies and should enhance their quality and effectiveness in the field.

Insects are multiplied in a fly factory at Tanga on the mainland, where they are sterilised with gamma radiation and packed into specially designed degradable cardboard containers, which open as they are ejected from the aircraft. Flies disperse widely and evenly.

Newly designed fly rearing cage with partitions, which more than doubles fly breeding capacity

Monitoring objectives

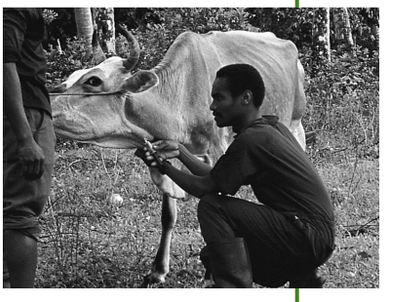
Entomological and veterinary monitoring activities are essential to assess project progress. A series of 21 locations with at least 5 'leg panel' sticky traps have been established in the tsetse release area. The traps provide data on the distribution and survival of the released insects and establish the ratio of sterile to fertile insects in all these habitats. Based on this information, numbers released over certain areas are adjusted as required to make best use of the sterile flies.

Captured wild female flies are dissected to find out whether they mated with a fertile or sterile male. Those mated by fertile males should contain a developing larva whereas those mated by sterile males show a degenerating egg, developmental arrest of the larva, abortion or oviduct blockage.

Blood sampling of animals at risk is another way of monitoring the extent of trypanosomiasis transmission and therefore the presence or absence of tsetse flies. The absence of new infection is an indication of tsetse eradication.

Project progress

The Tsetse and Trypanosomiasis Research Institute (TTRI) at Tanga now has the largest tsetse production system in the world. Two newly refurbished insectaries supported by quality control measures contributed to a steady rise in the female colony from less than 23,000 in December 1991 to more than 400,000 in December 1995. This colony produces more than 50,000 sterile males per week for aerial releases. As a result, the wild fly density in the primary tsetse habitat on Zanzibar, the Jozani Forest, has been reduced to a very low level. Only 0.02 wild males per trap/day were captured in December 1995, compared to 0.4 in March 1995 and 3.5 before initiation of control/eradication activities. During the last quarter of 1995 already 65% of the captured wild females were found to be mated by sterile males. In view of these developments it can be expected that the tsetse population in the Southern part of the island will collapse in 1996 and eradication activities for the entire island are anticipated to be completed in 1997.



Blood sampling for presence of tsetse transmitted parasite trypanosoma

Refining procedures and techniques

In order to integrate the SIT into sub-regional area-wide efforts for tsetse and trypanosomiasis management (see box below), the Joint Division will increase the efficiency of tsetse SIT with special emphasis on:

- tsetse rearing automation
- improved attractants
- tsetse genetics

Future prospects

- The SIT has a unique attribute, namely increased efficiency of tsetse control with decreasing population density of flies. After initial suppression of fly populations by conventional techniques, the SIT, with its applicability even in very inaccessible areas and its proven capability to eradicate with highest species specificity could be, for many situations, the key missing ingredient in the current mix of efforts to combat the tsetse fly.
- Several areas of the northern and southern limits of the tsetse belt should also prove suitable for tsetse eradication using the SIT to complement other control techniques. Sites in Senegal, Mali, Ethiopia and Zimbabwe are currently among those under consideration.
- Through the systematic and integrated use of conventional and SIT technologies, it seems possible that progressively larger areas could be cleared of the vector and the disease. Further, these tsetse-free zones could then be maintained at a smaller cost than conducting continuous tsetse control. Indeed, eradication could be achieved from some zones which have naturally occuring or man-made barriers against reinfestation.

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Designed and produced by WREN, Fressingfield, Eye, Suffolk IP21 5SA, UK