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The Scientific Basis of the Control of Glossina Morsitans by Game Destruction

By The Trypanosomiasis Committee of Southern Rhodesia.

It is the policy of the Government of Southern Rhodesia to create and maintain game-free zones of country, for the purpose of preventing the extension, and ultimately causing the retrogression of *Glossina morsitans* tsetse-fly belts. These measures have been operative for twenty-five years; at first in the Gwaai-Shangani area from 1919-1922 and later in the Lomagundi (Doma) area from 1925 onwards. When these experiments had succeeded the method was applied wherever this tsetse menaced important stock areas or wherever land was required for native or European settlement.

To-day, doubt no longer exists concerning the efficacy of intensive and sustained hunting in so ridding the kind of country inhabited by *G. morsitans* of most of the food animals on which this tsetse depends that the flies themselves disappear within a few, usually less than ten, years. Where other species of tsetse are concerned, it is by no means so certain that game destruction alone suffices to eliminate or even effectively check the spread of the insect; the nature of the country favoured by, say, *G. pallidipes*, and the kind of animals usually fed upon by this fly, may make game destruction for its control a measure of real value only when employed in conjunction with some clearing of vegetation.

It is because the Trypanosomiasis Committee realise how successful have been the anti-tsetse measures sponsored by the Government, and how lamentable might be the results if these were discontinued, that they think it desirable to review in this memorandum the reasons why control of *G. morsitans*, at least, is possible through intensive shooting of game alone. They then wish to touch on the wider aspect of the subject, namely, whether this policy really threatens to deprive Southern Rhodesia of an important national asset.

Diet of Tsetse Flies.

"It can be positively asserted that animal blood taken directly from the living body is the normal diet of all species of tsetse flies. There is no evidence whatsoever that tsetse flies can survive for any length of time in the complete absence of animals. In captivity they are easily kept alive and made to reproduce on a diet of blood, while all attempts to breed or keep them on any other diet have failed."

The above extract is from p. 32 of a report, published in 1931, on the available evidence showing the relation of game to the spread of tsetse-fly-borne diseases in Africa. The report forms a special publication (Vol. 1, No. 1) of the American Committee on International Wild Life Protection, and is a model of impartial scientific objectivity.

Within recent years tsetse flies have been studied in detail by very many scientists, all of whom, without exception and whatever they may have previously thought or said, now accept as proved the fact that animal blood is the only important source of food for tsetse flies. It is true that



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captive flies have been induced to probe specially-warmed grapes, and one eminent scientist (G. D. H. Carpenter) from an examination of the gut contents of *G. palpalis* formed the opinion that tsetse flies do sometimes suck water or plant juices. But Carpenter's paper was published in 1913, and since then the theory that tsetse flies can sustain life only on blood has been so strengthened that it is now unassailable. Swynnerton, on p. 228 of his monumental book, "The Tsetse Flies of East Africa," published in 1936, speaks for all research workers on tsetse flies when he says: "To sum up, tsetse flies of both sexes depend on blood for their meat and drink and probably on nothing else." At the present time work on the nutrition of tsetse flies is mainly concerned with preferences for different kinds of blood, and to some extent with the physiology of blood digestion. It has been noted, for example, that certain special biological adaptations associated with an exclusive blood diet are characteristic of tsetse flies. These include the loss of certain ferments which are necessary for the digestion of carbohydrates (*e.g.*, the starch of plants), a great increase in other ferments which are necessary for the digestion of proteins (*e.g.*, nitrogenous food present in blood), and the acquisition of factors preventing the coagulation of blood so that the insect can suck it.

Food Preferences of Tsetse Flies.

Realisation that tsetse flies depend on blood, and that deprivation of such food must bring about their extermination, has caused much attention to be given to the subjects of whether all vertebrates can act as hosts, and if not, whether destruction merely of those most favoured as hosts would suffice to rid an area of tsetse flies. It was soon found that captive laboratory-bred flies show little discrimination; when hungry and otherwise in the right mood they will feed on almost any mammal, bird or reptile against which the gauze-covered mouth of their container is pressed. Wild flies, however, are not thus given easy access to all manner of animals, and there is much evidence to show that each species of tsetse feeds most frequently on those animals that are dependably accessible. Thus *Glossina morsitans*, as it ranges along the edge of a vlei, may see and smell any of a wide range of the more conspicuous mammals, or if it comes on none of these it may find a large bird, such as a vulture, stork or ground hornbill. *G. pallidipes*, on the other hand, does much of its hunting along the game tracks which traverse the thicket where it lives, and thus makes much more contact with bush-pigs and bush-buck than is usually made by *G. morsitans*. Yet another tsetse, *G. palpalis* (not found in Southern Rhodesia) feeds mainly on crocodiles and monitor lizards.

Considerable work has also been carried out using the precipitin test for the identification of animal blood in the tsetse and by direct measurement of ingested blood corpuscles to determine the species of animals used by the tsetse as hosts.

An indirect way of determining whether any particular species of mammal is normally preyed upon by tsetse flies is by determining its reactions to inoculations with the trypanosomes transmitted by tsetse flies. If it is found that a wild mammal is susceptible to trypanosomiasis in the way that domestic animals are susceptible, it is obvious that that animal is not a common host of tsetse flies. Thus purely nocturnal animals, like antbears and porcupines, and certain small diurnal animals like hyraxes, monkeys and the smallest antelopes, are so little resistant to trypanosomiasis when tested in the laboratory that it is certain they cannot be regular hosts of tsetse flies.

Regular and Occasional Hosts.

An important distinction must therefore be drawn between the animals which tolerate tsetse and thereby support them, and those—a far greater number—which avoid contact with fly or successfully resist its attacks. Thus each species of tsetse has comparatively few food hosts, and these may be divided into (a) some which are regular, and (b) others which are occasional.

(a) The regular hosts of *G. morsitans* are the larger grazing and browsing mammals, and haunts of this tsetse are permanent to the extent that some of these animals are to be found *all the year round*. Every hunter knows favoured localities where he can *depend* on finding game whatever the season; these are the places that, within certain climatic and vegetative limits, are the true haunts of *G. morsitans*. Eliminate tsetse from these areas, and the remainder of the flies cannot maintain themselves throughout the vastly larger areas where game are scattered and seasonal in distribution; they cannot survive permanently on chance encounters with food hosts.

(b) Occasional hosts of *G. morsitans* are a varied community. They include, on the one hand, such small or nocturnal or exceptionally active mammals as cane-rats, antbears, monkeys, etc., which only rarely furnish food to tsetse, and on the other hand, species which often furnish blood, but not dependably as they are migratory or are seasonally hidden by long grass; such animals are storks, vultures, bushpigs, and even baboons and elephants. Man usually belongs to the group of occasional hosts.

Further recent scientific research has shown that *G. morsitans* must obtain meals at regular intervals to replace water lost by evaporation. The rate of loss during the hot dry months of the year is high and unless it can be replenished death occurs, although reserves of foodstuffs may be present in the fly's body. To a limited extent, *G. morsitans* and other tsetse can metabolize water from accumulated fat, but not in quantities sufficient for them to dispense with water obtained directly from regular meals of blood. By the extermination of most of the usual food hosts, not only is the fly deprived of opportunities to obtain regular meals, but it is forced to expend much energy and thus lose much moisture seeking other sources of food. Under these circumstances the death rate of both sexes rises much above normal, and females are liable to abort. The final result is complete eradication of the fly.

The point to be made clear is this: To eliminate *G. morsitans* from an area it is not necessary to exterminate every species of animal on which this fly can be made to feed if given the chance; it is merely necessary to get rid of all those which in the aggregate constitute a *dependable* source of food throughout the year. Thus, near the Umniati River, where formerly both game and *G. morsitans* abounded, one sees to-day practically no game (except elephant and very small buck) nor spoor of game at any time of the year, but seasonally there is evidence of elephant, baboons, bushpigs, crocodiles, guinea-fowl and other occasional hosts. Tsetse, if present, could obtain all the blood they required from these accessory food animals throughout much of the dry season, though with some difficulty and at the cost of much energy, but when the river is in flood and the grass is high and dense, neither human beings nor *G. morsitans* could support life by hunting, because the game have gone. The result is that there are now no tsetse in this area.

It should be noted that it is not because a kudu is a kudu that it is a dependable source of food for fly, nor because an elephant is an elephant

it is not a dependable source. Dependability is governed by the local habits of the animals, which in turn are influenced by their comparative numbers and the type of country they inhabit. The habit of migration, for instance, plays an important part. Elephants in the Umniati area are not dependable because they are not always present in the haunts of the fly. In the Sabi area, however, they are dependable, their great numbers ensuring that some are always available.

G. morsitans is the only species of tsetse that is at all widespread in Southern Rhodesia, and it is against this fly that most of the organized game destruction has been directed. In this memorandum little need be added to what was said earlier about the only other species of tsetse that presents an economic problem to this Colony: *G. pallidipes*. This fly is skilful in finding its prey even in thick vegetation, and therefore it has as regular hosts animals like the bushpig which are only occasional hosts of *G. morsitans*. On this account game destruction has to be exceedingly drastic if this measure alone is to succeed in eliminating *G. pallidipes*; it is usually more practical to combine shooting with other measures, as discriminative clearing of vegetation, and closer settlement, coupled with better farming.

Limitation of Shooting Areas.

It has been shown, then, that both in theory and in practice *G. morsitans* can be eliminated from an area by intense and persistent shooting of its dependable hosts. More than this: if the zone of shot-out country has its ends in fly-free country, or alternatively is of great length—fifty or more miles—then it has been shown in practice that by moving the hunters systematically into the fly belt as this recedes, without increasing the width (10–20 miles) of the shooting zone, game can be allowed to flow back into the liberated area without danger of re-introducing tsetses.

To take a concrete example: The original zone of game shooting in the Gatooma district was between fences ten miles apart, situated about forty miles east of the Umniati River. Shooting started in 1926, and within ten years virtual local extermination of game and definite local extermination of tsetse (*G. morsitans*) had been effected. Thereafter the fences were taken up and the hunters were moved systematically westward. By 1938 controlled shooting along both banks of the Umniati had started, and this has been continued to the present day.

Restocking with Game of Areas freed from Tsetse.

The question now arises: shall game be encouraged to return to those areas that formerly had both game and tsetse but now have no tsetse and very little game? To effect this game would be allowed to come in from the side where there is no tsetse and from the ends if these rest on fly-free country. Very little game would break through the cordon of shooters, and as this shooting zone would be practically fly-free before restocking anywhere near it was permitted, any game passing backward from it would not carry tsetse. Of course, there are those who would not believe this, but even if the settlers or would-be settlers of any area under consideration for restocking are convinced that by allowing game back there is no danger of allowing tsetse to return at the same time or subsequently, are they desirous of having the game? Do they not consider the land more valuable if it has no game? If it has to be affirmed that the great majority of agriculturists and many pastoralists prefer not to have more than a sprinkling of game on their land, then it cannot be said that the systematic destruction of game carried out as an anti-tsetse measure has harmed a national asset, unless

it be shown that one or more species of animal have been brought within measurable distance of extermination throughout the Colony by this shooting. This cannot be shown, nor can it be shown that any single species, with the possible exception of the rhinoceros, will not return to the area cleared temporarily of it by intensive shooting, once this measure is relaxed. Maintenance of freedom from tsetse of such restocked game areas undoubtedly must depend on a static or advancing shooting zone which from the sportsman's and naturalist's viewpoints is a depressing place to visit; but compared with the fly-free areas behind and, at present, with the untouched fly belts in front—both of which can have, if desired, their full complement of game—these active shooting zones are small areas.

From the purely veterinary aspect there are very serious objections to the presence of large quantities of game in a cattle area. Apart from the loss of pasturage, the control and suppression of tick-borne animal diseases and diseases such as rinderpest and foot and mouth disease are made infinitely more difficult by the presence of game. Agriculturists suffer heavy losses, particularly by elephant and kudu destroying their crops. Certain animals such as elephant, rhinoceros and buffalo can be a menace to human life.

It is not to be denied that vigorous prosecution of the game destruction policy without compensatory efforts towards game protection on such lines as are mentioned above, must ultimately deplete the Colony's game in the areas over which game destruction measures are taken. What this memorandum suggests is that apart from National Parks (surely much desired by all!) game can be preserved throughout most of the country in spite of tsetse flies, if these be controlled by shooting zones that are strictly limited in width, as at present.

Finally, it must be pointed out that it is usually easier to restore game to a limited shot-out area than it is to restore natural climax vegetation to an area that has been denuded of trees and shrubs on account of tsetse or for any other reason.