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FINAL REPORT ON THE

PREPARATORY PHASE OF THE PROJECT ON TRYPANOSOMIASIS CONTROL IN THE KAGERA BASIN (RAF/87/132)

(August 1988 - December 1989)

(Funded by the United Nations Development Programme)

In collaboration with the Kagera Basin Organization
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The Kagera River Basin area comprising parts of Burundi, Rwanda, Tanzania and Uganda is a region with great potentials for agricultural and livestock development. Tsetse and Trypanosomiasis have been the major constraints to realising the full potential of these resources. During the preparatory phase of the United Nations Development Programme (UNDP) funded Trypanosomiasis control in the Kagera Basin and executed by the Economic Commission for Africa (ECA) with technical input from the International Centre of Insect Physiology and Ecology (ICIPE), information was gathered on the extent of tsetse and trypanosomiasis problem in the basin. The status of the problem was validated through surveys carried by the national teams (of the respective member states) dealing with tsetse control in the basin area. A map of the current tsetse and trypanosomiasis situation was produced.

A prototype area was selected in Rwanda where experimental tsetse suppression was carried out using the ICIPE baited NG2B traps. The prototype area included the ranches of Rusumo and Mpanga ranches, however, Nasho ranch was included as control for comparison.

From March to December 1989 baited NG2B traps were deployed in Rusumo and Mpanga ranches at a density of two traps per square kilometre. Tsetse population in the two experimental areas were closely monitored to assess changes in density and age distribution. These changes were compared with data collected from Nasho where no suppression traps were deployed. The results obtained have demonstrated that these traps can be used to effectively suppress G. pallidipes population under different ecological zones. It has also been demonstrated that the trap is effective against G. morsitans centralis. The trap can therefore be used for a regional assessment of the tsetse problem over the entire Kagera River Basin. It is recommended that this trap along with other "soft" methods for tsetse control be the main components for Trypanosomiasis control in the Basin area during the second phase of this project.

PREPARATORY PHASE OF TRYPANOSOMIASIS CONTROL PROJECT IN KAGERA RIVER BASIN (RAF/87/132)

AUGUST 1988 - DECEMBER 1989

BACKGROUND

The Kagera River Basin area has great potentials in terms of agricultural and livestock development for the Member States of Kagera Basin Organization (KBO) (Burundi, Rwanda, Tanzania and Uganda). In order to realize these potentials, the Member States have drawn up plans which include reclamation of land from tsetse infestation. Tsetse and trypanosomiasis have been the main constraints in exploiting these potentials. The KBO has taken the initiative to look for support from donors to enable them to reduce the tsetse and trypanosomiasis problem. It is with this background that ICIPE was identified to provide technical expertise in tsetse pest management.

The immediate objective of this programme is to design an integrated pest management system for the benefit of the Member States. Donor support is provided by UNDP through ECA. The project was divided into 2 phases: The first phase was for 9 months, the second one will be continued after satisfactory completion of the first phase. ECA in consultation with KBO and in association with FAO, were willing to implement with Member States a project on tsetse control in the Kagera River Basin; and ICIPE was appointed to participate in the execution of the first phase of the project as a contractor. In this regard, a joint Memorandum was signed by ECA and ICIPE in May 1988.

A meeting was held in Nairobi from 8 to 9 June 1988 at ICIPE Headquarters in order to review the work plan and implementation schedule of the preparatory phase of the project. The meeting was organized at the request of KBO in conformity with the Project Document and Work Programme of the first phase of the project. The work plan had been reviewed and endorsed by the Member States of KBO in February 1988. The Member States unanimously agreed to carry out studies for tsetse control in Rusumo as a prototype area in Rwanda, while the tsetse surveys for distribution were to be conducted in the Kagera river basin areas in Tanzania, Burundi, and Uganda.

ICIPE agreed to implement the activities as annexed to the Memorandum of Understanding it signed with the ECA, within the available resources and time-frame provided that the external factors were controlled, especially the availability of qualified counterpart project staff from all Member States and the timely disbursement of the funds as per the implementation schedule.

ACTIVITIES IMPLEMENTATION

In order not to lose too much time, ICIPE initiated activities using its own resources. For the scheduled activities, the following were undertaken:

A. Preliminary activities

- Collection of information on status of tsetse and trypanosomiasis research and control strategies in all Member States.

- Selection of prototype areas was made in consultation with KBO; and experts from Member States confirmed the choice in February 1988.

- Technical meeting to review Work Plan and Implementation schedule was held in June 1988 in Nairobi.

- Procurement of equipments and materials : ICIPE has bought microscopes, material for making traps, automatic weather station, generator, computer and some expendables. Furthermore, the first two cars were received in January 1989, one is on the prototype area in Rusumo, the other one was taken to Tanzania to be used in Missenyi pilot and other areas under an agreement with the Tanzania Government. The other two were received in April and sent to Uganda and Burundi respectively. All cars could not be acquired at the same time, because the vehicles were not available in one lot.

- Training of project coordinators from Member States (see Annex A).

- Training of National Coordinators, one from each Member State, in tsetse control methodologies was made from 10 to 25 August 1988 in Nairobi. The next training will be on Computer Data Management and is now scheduled for July 1989 at ICIPE Headquarters, Nairobi. Two trainees shall come from each Member State. (See Annex B)

- Resident Scientist in Rwanda.
ICIPE put a Project Coordinator on site from November 1988, with his tsetse technician. These have since been strengthened. They were joined by 2 counterpart technicians from the Rwanda Government; the first one arrived on 14 February

and the second on 1 March 1989. A third ICIPE staff joined in April 1989.

B. Field Activities - Tsetse survey in Prototype area

- By the first week of March 1989, 125 traps had been put in the Rusumo Government ranch which covers 56 km^2. The traps are visited daily and flies caught are checked for species and sex identification. The species of flies so far observed are Glossina pallidipes, G. morsitans and G. brevipalpis.

- Two demonstration traps were installed in the Mpanga ranch which is a private ranch, at the request of the Managing Director in mid-February 1989. The aim was that, if they prove to be effective against the tsetse fly species in the ranch, the management may want to adopt the traps as one of their control strategies. After only 3 days, the flies caught were so many that the management was impressed. Following this observation, they decided to adopt the trap in suppressing fly population in the ranch.

- Mapping (human population, vegetation, animals, weather and climate, physical features (etc.). For this activity, detailed physical and vegetation maps were prepared for the Rusumo study area. A more general map prepared for the entire basin area.

C. Activities in the Rusumo Prototype Area - Tsetse suppression

The Prototype area in Rwanda includes the following ranches. These are Rusumo, Mpanga, and Nasho Ranches. Although it had originally been planned to work only at the Rusumo ranch, tsetse surveys indicated that the fly population was too low in this place. Consequently it was decided to include Mpanga Ranch in addition to Rusumo. Nasho was chosen to be the control area where no fly suppression was be carried out. The data obtained in Nasho were compared with those obtained at Rusumo and Mpanga.

1. RUSUMO RANCH

1. Background

Rusumo Ranch was established in 1968 by Belgian Aid with the objectives of providing livestock to the local population, providing breeding bulls to the local livestock keepers, and breeding for meat production. In 1978 it was handed over to the Ministry of Agriculture, and a year later it was handed over to the Bugesera-Gisaka-Migingo Development Project. It is still under the Bugesera-Gisaka-Migongo Development Project but the main objective now is meat production.

The ranch covers an area of 56 Km^2 and at the moment there are 2805 cattle. Trypanosomiasis is the major livestock disease with the present infection rate of 5-9%. Before tsetse control measures were instituted , the infection rate was as high as 30-40%. Other disease problems include East Coast Fever, intestinal worms, and snake bites also account for some morbidity and mortality.

The cattle are block-treated with Berenil 3-4 times a year at 5 mg/kg body weight since 1986 as prophylaxis with Trypamidium was stopped due to resistance.

The ranch is infested with Glossina pallidipes, Glossina morsitans, and Glossina brevipalpis. Tsetse control has been carried out by bush clearing and the use of insecticide-impregnated blue or black screens. A total of 260 black screens measuring 90 x 100 cm were sprayed with 3% Deltamethrin (DECIS) and deployed in the area. These were resprayed every two months. No odour bait was used with the screens. This operation continued from 1986 to 1988 but the infection rate remained high inspite of this control programme and the use of drugs. Treatment of the screens was stopped in November 1988 to make it possible to carry out population suppression by traps.

Population suppression

A total of 115 NGU traps were sited in the ranch in such a way that there were two traps per square kilometre. These were baited with acetone and cow urine. Two lines of 10 monitoring traps each were set from one end of the ranch to the Akagera River on the other side. These were baited with acetone and cow urine and are emptied everyday to monitor the tsetse species caught. Samples for flies were ..... dissected to determine trypanosome infection rates and

ovarian age classes. A large number of cattle were also screened for trypanosome infections.

2. NASHO RANCH

a. Background

Nasho Ranch lies to the south of Mpanga Ranch and covers an area of about 8000 hectares. It is divided into three zones, i.e. Zone I, which borders Mpanga Ranch, covers 3000 ha, Zone II in the middle covers an area of 2000 ha, and Zone III to the north of Rusumo Ranch covers 3000 ha.

The ranch is infested with Glossina pallidipes , G. morsitans and G. brevipalpis. Tsetse control was carried out by the World Bank in 1976 and 1979 using dieldrin. Between December 1985 and March 1988 "Africare" carried out tsetse control operation using odour baited targets impregnated with deltamethrin. A total of 876 targets were used with a barrier of targets at 150 metres intervals around the periphery of the ranch. Population monitoring was carried out using biconical and F3 traps baited with acetone and octenol.

The ranch is being surveyed and demarcated into sections to be allocated to private livestock keepers for development as a communal ranch.

b. Population monitoring

Twenty NGU traps were sited in Zone II of the ranch to monitor the population and serve as a comparison for the population in Mpanga Ranch and Rusumo Ranch. The traps were emptied on a regular basis to monitor the tsetse species caught. Samples of flies were routinely dissected to determine trypanosome infection rates and ovarian age classes.

3. MPANGA RANCH

a. Background

Mpanga Ranch, which lies at an altitude of 1380 metres, is almost completely surrounded by Lake Cyambe, on the western side, and Lake Mpanga, on the eastern side. Both lakes lie at an altitude of 1290 metres. The ranch, which has an area of 18 square kilometres, was established in 1982 by "La Rwandaise" as its agropastoral department. "La Rwandaise" is a private motor importation and servicing company. Ownership of the ranch was transferred from the "La Rwandaise" to

private shareholders in November 1987 but it continued to breed livestock for beef production.

The ranch has maintained upto 1750 head of cattle but livestock breeding was stopped in November 1988 due to disease problems. Animal trypanosomiasis has been the major disease among the livestock kept, and at one time, up to 15% of the cattle were infected. Some cases of East Coast Fever, Piroplasmosis and Anaplasmosis were also experienced.

The ranch maintains game animals for meat production and attraction to tourists. Another objective is to protect and multiply endagered game species. At the moment the ranch maintains the following game animals: Aepyceros melampus, Phacochoerus aethiopicus, Hylochoerus meinertzhageni, Potamachoerus porcus, Damaliscus lunaticus, Kobus defassa, Redunca redunca, Hippotragus equinus, Equus burcheli, Papio doguera, Ourebia ourebi.

The ranch is infested with dense populations of Glossina pallidipes and Glossina morsitans with low populations of Glossina brevipalpis. Trypanosomiasis control was carried out by treating the cattle with Berenil every three months because former prophylaxis with Trypamidium was stopped because of resistance. Tsetse control was carried out by bush clearing at first, but the use of 500 blue tyres sprayed with 3% Dieldrin, and placed every 100 metres beside the different roads in the ranch, was adopted as another control technique. These tyres were resprayed twice a month and it was expected that the insecticide combined with bush clearing would be very effective. There was no odour bait such as, acetone or cow urine used with the tyres, and no monitoring was carried out to show how effective this control technique was against the different tsetse species.

b. Population suppression

A total of 42 NGU traps were sited at least 50 metres from the roads and distributed in such a way that each square kilometre had two traps. These traps were baited with acetone (500 mg/h) and cow urine and left to capture the different species for two weeks before they were emptied. A line of six monitoring traps was set beside the road which runs from the entrance of the ranch to the other end. These were set about 1.4 Km apart and baited with acetone and cow urine. These are emptied every day to provide information on the different tsetse species. As for the two ranches fly dissections were also carried out.

A total of 507 female flies and 298 male flies from the ranch were dissected and checked for infection rates.

INTEGRATED TSETSE CONTROL

Trypanosomiasis control, treatment or eradication is expensive and is only justified if the benefits exceed the costs. The choice of the approach to trypanosomiasis control will depend on prevailing conditions, particularly:

(1) existing situation of livestock husbandry (breeds used, production systems etc.)

(2) the level of trypanosomiasis challenge and whether it is permanent or seasonal during the year

(3) ranking and relative importance of trypanosomiasis among other development constraints. If the challenge is not permanent chemical treatments will be given higher priority.

Pressure on land is a major factor of success in control campaigns, as high rates of land occupancy following these campaigns contribute greatly to avoiding reinvasion risks. If the area is large and cannot be isolated, eradication will be hard to accomplish and the logical choice is tsetse control, and chemical prophylaxis should be integrated with tsetse control. In the Kagera Basin "pour on" combined with traps and targets for tsetse will be the best option.

The oldest method of dealing with tsetse was to avoid contact with the fly by moving the human population out of tsetse affected areas. Translocation of the population took place in Uganda and several other African countries during colonial times. It is, however, not presently feasible as a long-term viable solution to the tsetse problem.

During the late 1950's the technique of bush-clearing became popular. This tactic was combined with shooting out the game, the wild herbivores, which are reservoirs of the disease. This approach was tried in Tanzania. People were moved, animals shot, and forests and bushes cleared. Severe erosion resulted from this action; and such methods are now recognised as environmentally unsuitable. During this same period, chemical pesticides started to be used for insect control. As the tsetse was very sensitive to insecticides, it was generally believed that tsetse could be controlled in this way. At first, the residual insecticides, such as DDT and later dieldrin, were deployed against Glossina. These compounds are not easily biodegrable. They remain active in the environment for a long time, and accumulate along the food chain. A large number of non-target organisms are killed and the technique leads to high levels of pollution

in the environment. This technique evolved from ground spraying to aerial spraying, a method which is continuing at the present time. Aerial spraying of synthetic pyrethroids such as cypermethrin, from small planes kills vast numbers of non-target organisms. The compound, endosulfan currently in use, must be sprayed six times at intervals of 10 days, so that, as adult tsetse emerge from pupae in the ground, they will be killed. Partial success was achieved using these techniques, particularly along the margins of the tsetse's range, in Southern Africa and Northern Nigeria. A 100% kill can never be achieved through the use of insecticides. Aerial spraying is a high cost, high technology system which cannot be attempted by individual farmers or, even in many cases, by countries.

None of these conventional techniques have brought about significant changes to tsetse distribution over the last 50 years. In some areas, the tsetse might actually be spreading. Insecticide action for example, may kill off the predators so that after a short time there may be a larger population of tsetse than before. Tsetse resistance to insecticides is another possible dimension to the problem. It is obvious that chemicals offer only short-term solutions as tsetse reinvade an area very soon after spraying. Eradication of vegetation or livestock are undesirable environmentally. A different approach is obviously required to deal with the problem of tsetse infestation in Africa.

Ideally, control techniques should be able to be understood and operated by the African subsistence farmer, who, within his own community, should be able to continue operating the technology after participating in its field testing, and to carry the responsibility for its maintenance. These requirements have been given priority in this phase of the project.

Workers in Zimbabwe have utilized a technique of using the so-called targets to control tsetse. A "target" consists of a cloth impregnated with an insecticide, hung up in the zone where tsetse regularly move. When the intercepted flies touch the cloth, they receive a fatal dose of insecticide from which they subsequently die. The ICIPE did not adopt this particular technology as its main tsetse control methodology for several reasons: insecticides are an imported commodity for the experimental region, and are therefore costly; the resident community does not possess the technical capability to utilise the pesticides carefully; insects may well develop resistance to these insecticides; and the flies do not die by the side of the target, and thus the resident community does not immediately have the demonstrated assurance that the target is effective. As it is essential to involve the community in sustainable tsetse control and the community needs to see the control technology working, the ICIPE has concentrated

on an effective and usually demonstratable trapping technology. Tsetse traps have been used since the 1920's but, when insecticides came into vogue, they lost popularity among the scientific and administrative communities. Workers in Zimbabwe revived interest in traps after the mass deployment of insecticides in the 1960's did not achieve its intended goal.

TSETSE TRAPPING

Research carried out at the ICIPE on devising novel cost-effective tsetse trapping systems led to the discovery of NGU trap. To be effective, a tsetse trap must be inexpensive to produce, and must be able to be made by the local people themselves from locally available materials. An earlier version of the NGU trap cost K.Shs.400 ($20/year, to be made in Nairobi); newer traps now cost Shs.100 ($5/year) to be made locally. They are now built entirely by the people of the community themselves from materials available.

Trapping will be the main method of tsetse and trypanosomiasis control in the Kagera River Basin. New trap designs for those species which do not respond well to NG2B traps will be investigated. Targets will be used in those areas where G. morsitans is the main vector species and judicious application of (pour on) live target will be employed where it is necessary.

Live target

Flumethrin, a synthetic pyrethroid has been shown to be effective against ticks, biting and sucking lice and mites under field trials. Laboratory tests of this compound on Glossina palpalis gambiensis has demonstrated that flumethrin is a potent insecticide when applied to cattle. Its effect last for about 20 days post treatment.

This is a relatively simple control technique for tsetse. The persistent and rainfast pour-on insecticide formulation offers flexibility in treatment and requires a minimum of technical equipment. Its potential is greatest where livestock are evenly distributed and are the sole or major food resource for the fly. It is also amenable to community participation.

The bait methods of control have been considered (1) an artificial bait consisting of visual target provided with odour attractant and coated with deltamethrin insecticide. (2) natural bait consisting of cattle dipped in the insecticide. A cost benefit analysis suggests the costs of clearance are well justified in those operations using once-off applications of cheap technique but not in operations

involving several annual applications. The final economic assessment, however will depend on the future cost and effectiveness of keeping flies out of the areas now freed, and on the future policies of land use.

There are many problems in estimating costs in one situation from those observed in different situations in other countries. One must consider labour, tracks, transport, equipment, buildings, administration and technical officers involved in the project. The apparent low costs for dipped cattle in the Zimbabwe are misleading, in that cattle are already being dipped against ticks. In this case, the cost is simply that of substituting the deltamethrin dip for the normal tick dip; otherwise, the control measure is exceedingly costly, and may be totally impractial in some areas, e.g. game reserves.

Geographic Information Systems (GIS)

An Automatic Weather Station was installed at Mpanga Ranch and programmed to provide information on air temperature, soil temperature, relative humidity, rainfall, wind speed, wind direction, and solar radiation.

The climate and habitat which tsetse flies need in order to survive are well known and from vegetational, elevational and climatic maps of the region it should be possible to identify those areas which are most likely to be infested by tsetse flies. This should greatly facilitate the field work of the ecologists working on the project and it should also be borne in mind that information of this kind will provide the basis for any future planning which takes place in the region.

ICIPE' facilities

ICIPE has a substantial investment in GIS. The hardware available in the institute includes a 36 inch digitizer, a 36 inch plotter, two IBM PC's (16 Mhz, 287 processors), EGA colour monitors and a Bernoulli drive. The software which we use includes the vector-based system ARC/Info and the raster-based system CRIES. We are able to convert data from one to the other. At the moment we have no remote sensing software or personnel. The remote sensing work would have to be done in collaboration with other institutes or by contracting work out.

Currently Available Data

National topographical maps are available at scales ranging from 1:1,000,000 down to the more practical and preferred scale of 1:50,000. Added to these are thematic maps at varying scales and covering the geology, soils, climate and vegetation of the area although many of these

are now old and out of date. Maps are also available dealing with population, infrastructure, and economic activities. Tsetse data is very sparse and will be updated in the ongoing surveys. A substantial part of the project will be concerned with collecting data.

The preparation of detailed maps is a time consuming and labour intensive operation. We will begin by developing coarse maps that cover the whole basin and the surrounding areas, so that we can subsequently work down to a finer scale. As coarse maps are developed, parallel ground surveys will provide a gross picture of the distribution and prevalence of the various species of tsetse in the area.

The next phase of the project will require the commissioning of aerial surveys of key parts of the basin so that we can characterize the vegetation in more detail. This will permit a quantitative assessment of the relationships among various geographic features: human settlements, tsetse flies, wildlife, and cattle.

THE CONTROL OF TSETSE FLY AND TRYPANOSOMIASIS

Impact of Suppression
Tsetse Population Ecology

Altogether, the suppression and monitoring traps have removed about one and a half million tsetse flies from the three ranches between April and December 1989, with the largest quantitative impact at Mpanga ranch: 1,474,458 (Mpanga), 9,591 (Nasho), and 6,272 (Rusumo). The catches have consisted primarily of G. pallidipes and G. morsitans, with G. brevipalpis common only at Nasho (Fig. 1). Trends in tsetse population density are illustrated in Figs. 2-4, with numbers averaged over half month periods. With the single exception of the very low density population of G. brevipalpis at Mpanga, the catches of all tsetse species at all ranches have declined progressively since the start of the project. Levels of reduction achieved in the last half of December relative to the first half of April ranged from 86 to 92 % for G. pallidipes, 96 to 98 % for G. morsitans, and 38 to 100 % for G. brevipalpis. The largest reduction for all tsetse species combined (94 %) was obtained at Rusumo, where fly density was already extremely low at the start of the study. The smallest reduction (86 %) was obtained at the control area (Nasho), where fly density was also low, and where no suppression traps were in place. At Mpanga, where fly densities were extremely high, a 89 % reduction was effected by the end of December 1989.

A comparison of the relative changes in tsetse density at the three ranches is given in Fig. 5 for all tsetse species combined. Throughout the 9-month period of trapping, there has been a progressive decline in tsetse densities on

all ranches, including the control. The largest relative changes occurred during the first three months of monitoring, with about a 70 % reduction in density on all areas. Since early July, densities have been declining more gradually, but still appear to be decreasing. This trend is particularly evident in the low density populations at Rusumo ranch, where species such as G. morsitans and G. brevipalpis are now very rarely caught (Fig. 3). As of the end of December, the overall reduction in tsetse densities at Rusumo stood at 94 %, compared with 86% at Nasho (the control). The reduction in tsetse density at Nasho is presumably related to the removal of large numbers of flies in the monitoring traps, even though no suppression program was carried out. A crude estimate of the effect of this monitoring program can be obtained by dividing the 20 traps at Nasho by an approximate area of sampling next to the lakeshore of 5 km X 2 km_2 (= 10 Km^2). Hence, the trap density at Nasho is about 2 / Km^2, which is similar to the combined density of monitoring and suppression traps at the other ranches (about 3 Km^2).

Although initial results are quite promising, we anticipate two problems that will affect the ultimate levels of reduction sustained in the long-term. First, based on trapping results from Zimbabwe, odour baits, although extremely effective in attracting G. pallidipes, may be less effective in attracting G. morsitans. Similarly, based on trapping results from coastal Kenya, G. brevipalpis may also respond poorly to both conventional odour baits, and tsetse traps. Based on these observations, we would expect G. morsitans and G. brevipalpis to account for a progressively larger proportion of the tsetse catch as suppression efforts continue. Surprisingly, this has not occurred. Rather than decreasing, the ratio of the catch of G. pallidipes to G. morsitans has increased on all areas (Fig. 6). For whatever reasons, odour-baited NGU traps have been quite effective in catching G. morsitans centralis (the subspecies found in Rwanda), even though they are relatively ineffective against G. morsitans morsitans (the subspecies found in Zimbabwe). Similarly,the traps have been successful in effecting modest reductions in the numbers of G. brevipalpis on 2 of the 3 ranches (Figs. 2-4).

A second, and more substantial problem, is the question of reinvasion from areas not subjected to suppression operations. For example, at Mpanga, where over a million flies have been removed from an 18 Km^2 area, tsetse catches still average about 50 tsetse/trap/day. Increasing the density of suppression traps to 3 / Km^2 at the end of July has had some impact on tsetse (Fig. 2), but it will obviously take considerable time or effort to reduce densities to the very low levels observed at Nasho and Rusumo.

The resilience of the Mpanga tsetse may be due to a continual influx of flies from surrounding areas. We can look for evidence of this phenomenon by examining changes in sex ratios. Based on our work with G. pallidipes in the Rift Valley of Kenya, we suspect that large changes in sex ratio towards more females, and older females, are indicative of immigration.

Sex ratios of G. pallidipes and G. morsitans at Mpanga varied between about 20 and 50 % male between April and December 1989 (Fig. 7). A preponderance of females is normal in tsetse populations, as they typically live longer than males. Large changes towards more female-biased ratios were, however, evident in the recent data collected for G. pallidipes. Although these changes may be seasonal, we suspect that they reflect changes in the ecology of the population caused by the continual removal of flies. These changes may reflect reinvasion from surrounding areas, and hence, suggest that the effective population size of tsetse at Mpanga is incredibly large. This population is probably contiguous with other fly populations existing outside the 18 Km^2 boundary of the ranch itself. Effective suppression will obviously require efforts on a larger geographic scale.

Sex ratios of G. pallidipes and G. morsitans at Rusumo were similar to those observed at Mpanga (Fig. 8). At Nasho, sex ratios were consistently more female-biased than those observed at the other ranches. Coincident with the large relative reduction in density at Rusumo (Fig. 5), sex ratios of G. pallidipes have fluctuated through time, perhaps reflecting seasonal influx of flies from across the Akagera River in Tanzania. Hence, this low density population may now be maintained by reinvasion from surrounding areas. Eradication of this population should therefore be possible. In contrast, sex ratios at Nasho have remained stable, and consistently female-biased. These trends suggest that the Nasho population has always had a large immigration component. The proximity of the high density population at Mpanga will make the control of flies from Nasho difficult, unless the sources of reinvasion are identified.

In addition to examining sex ratios, it is possible to gain some understanding of the population ecology of tsetse through an examination of changes in age structure. Successful control of local populations is invariably reflected in changes in the age distribution of flies. With the removal of substantial numbers of old flies by traps, younger age classes initially predominate in catches. This is followed by loss of these younger age classes as the reproductive output of the population decreases. Eventually, catches consist mainly of older, presumably immigrating flies. Dissections of tsetse have revealed some of these changes in age structure coincident with the suppression program (Tables 1-2). Representative trends are illustrated

at Mpanga and Nasho in Fig. 9 for female G. pallidipes captured early and late in the suppression exercise.

At Mpanga, the removal of quite large numbers of flies has had a minimal impact on the age structure of G. pallidipes. These results support our premise that the Mpanga population is incredibly large. At Nasho, there has been a shift towards more flies in older age classes in recent collections. Combined with the stable, and strongly female-biased sex ratio at Nasho, these data suggest that the Nasho population is maintained by large numbers of immigrants. Confirmation of these preliminary conclusions will obviously require experimental work. At present, it is difficult to separate the effects of suppression alone from seasonal factors related to the vastly different ecology of the three ranches

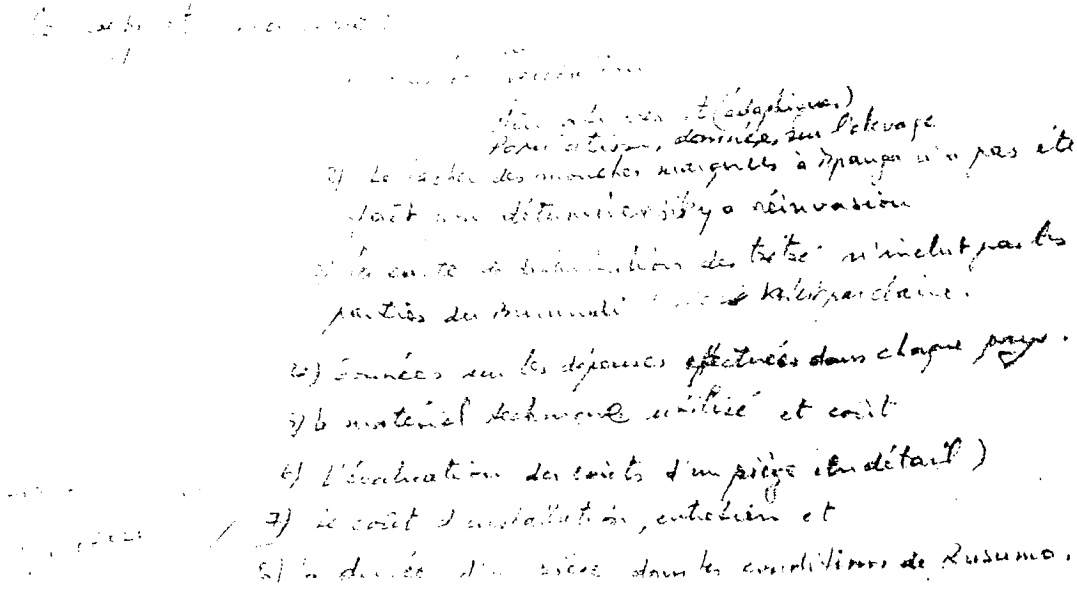
Trypanosomiasis

Throughout the suppression period, large numbers of tsetse were dissected to identify the trypanosome species responsible for disease in livestock (Table 3). Only T. congolense and T. vivax were detected. All three species of tsetse appeared to be important vectors of disease in all areas. Infection rates varied from a low of 0.6 % (T. vivax in G. brevipalpis) to 2.7 % (T. vivax in G. morsitans). With these relatively uniform, and low infection rates, the importance of the three tsetse species as vectors can be equated approximately with their relative abundances (Fig. 1). As suppression efforts continue, this picture of disease transmission will change as a result of the differential effect of traps on each tsetse species (Figs. 1-3). This will become increasingly important in areas such as Nasho, where G. brevipalpis accounts for a modest proportion of the tsetse catch.

Monitoring of disease in cattle was done only at Rusumo ranch. Cattle were bled on a monthly basis and examined with the microhematocrit, thin and thick smear techniques. Roughly 300 cattle or about 10% of the herd were monitored each month from May to December. Prevalence rates from May to July varied from 2.1 to 2.6 % for T. vivax, and 3.3 to 7.1 % for T. congolense (Fig. 10). Between 19 July and 29 July, the herd was treated with Berenil. Consequently, very few infections were detected in the August sample taken between the 7th and 11th. The fact that a few infections were still detected at this time further suggests that some drug resistant strains of trypanosomes may be present at Rusumo. Since August, only a few cases of T. vivax infection have been detected. In contrast, T. congolense is still prevalent at the ranch (Fig. 10). The reduction in T. vivax infections may be related to the importance of G. morsitans as a vector at Rusumo (Table 3). This species has almost disappeared from this ranch during the course of suppression

(Fig. 3). Alternatively, there may be an overriding seasonal trend, as most T. vivax infections were detected at the start of the study (Table 3).

The lack of a dramatic effect on the prevalence of T. congolense in cattle at Rusumo is open to interpretation, but is most likely caused by current ranch practices. Although nearly eradicated from most of the ranch, tsetse are still being caught in the traps near the Akagera River. As cattle are routinely brought to the river for watering, they are most likely being challenged by flies invading from outside the ranch boundaries in Tanzania. As with Mpanga and Nasho ranches, effective control will likely require an integrated effort over larger areas.



COUNTRY REPORTS:

UGANDA

The Survey of Tsetse Fly Distribution and incidence of Trypanosomiasis in the Kagera River Basin

The Survey of Tsetse Fly distribution and incidence of Trypanosomiasis in areas within the Kagera River Basin is a component of the Preparatory Phase which the International Centre of Insect Physiology and Ecology (ICIPE) subcontracted to national governments of the Kagera Basin Organization (Burundi, Rwanda, Tanzania and Uganda) (KBO). The agreement stressed the following areas of activities:-

- Produce a sketch map of the existing tsetse distribution from the last recorded information.
- Carry out survey to confirm tsetse distribution particularly in areas where information is not available showing the species and the number of flies caught.
- Undertake trypanosomiasis survey and record the various trypanosome species.
- Prepare a report on tsetse and trypanosomiasis control activities indicating number of treatments, regime for the disease, and techniques used for tsetse control.
- Produce sketch maps containing available information on tsetse and trypanosomiasis distribution.
- Produce a report on development activities in progress and livestock development plans for the area.

Development activities in progress and livestock development plans for the area

Rainfed agriculture:

The entire agricultural activity within the project area is by the private sector and is rainfed. Tsetse fly infested areas, including the peripheral penumbra areas, involve four counties of Mbarara District and 3 counties of Rakai District. The total area under cultivation is some 474,175 hectares involving 109532 households. Farming in the entire 7 counties falls under 3 main farming systems characteristic of this area. The main crops are bananas, beans, sweet potatoes, coffee and maize but other crops are grown, such as sorghum, cassava, Irish potatoes, onions, shallots, groundnuts, soyas, cow peas and field peas. The Government intervention for increased production involves provision of extension advisory service, facilitation of the

imp[illegible] machinery, tools and pesticides and assistance in marketing of export crops.

The total livestock population in tsetse infested areas and the associated penumbra areas stands at 418,702 head of cattle. If tsetse flies are left to advance into threatened counties to the north, this would endanger a further 577,358 head of cattle.

In Rwampara county (now Rwampara and Ruhama counties) cattle are variously kept on farms and localised communal grazing. However, Isingiro county and adjoining Koki fall within a zone of strong traditional pastoralism and cattle have been raised in traditional semi-nomadic fashion often influenced by lack of facilities to guarantee all year round availability of water and good pasture.

In the dry months, particularly January and February, some pastoralists in border areas (where water facilities are scarce) drive their cattle to graze and water in the Kagera valley, across the border.

Development projects:-

Regarding the livestock sub-sector the Rehabilitation and Development plan covering the period 1987/88 - 1990 there are 6 nationwide projects which would serve to restore the productive capacity of the economy within the project area. These projects are detailed as below:-

Development project and funding:

Title	Funding Agency	Funds Invol. US $m.	Project Area	Project Objectives
Livestock Disease Control Programme	IDA EEC France U.K. Germany	32.14	Nationwide excl. 7 7 districts under AG 04	Strengthen Vet. Service - animal disease control
Rehabilitation of Dairy Industry	EEC WFP FAO/UNDP ADB. IDA	65.70	Nationwide	- restore Production - milk collection - strengthen extension
Rehabilitation V. Tank and bush clearing	IDA 11 U.K.	5.45	Nationwide	- water for lives - feeder roads - bush clearing for pasture development and tsetse control.
Rehabilitation of the Beef Industry	ADS Kuwait Australia	39.90	Nationwide	- rehabilitation ranches and exp promotion
Communal Livestock facilities		4.89	Kabarole and Mbarara	- rehabilitation existing Valley Tanks and dams
Tsetse Fly and Trypano-somiasis Control	EEC IDA UNDP FAO	6.15	Nationwide excluding 7 districts under AG 04	- Control of huma trypanosomiasis eliminating the vector
Hides and skins Industry		0.18	Nationwide	- rehabilitation Leather Industr export promotic

The definitive record of tsetse distribution within the Kagera River Basin area, which has been Uganda's Mbarara/Rakai Tsetse Control Scheme was last made in 1985. This was based on area wide tsetse surveillance using man and had net, routine patrols with adhesive black screens on bicycles, catches of traffic borne tsetse at pickets, pupae search, and veterinary record of trends in the incidence of bovine trypanosomiasis.

There are four tsetse species. The predorminant species is Glossina morsitans centralis Mach. This was previously cleared from some 10,800 square kilometres of open savannah woodland territory; it has since advanced into some 1950 square kilometres of this area with a trend to re-advance further northwards into the proximal Lake Mburo National Park. From here it is likely to get unlimited access into wooded grazing areas to the north. Two other species G. pallidipes Aust. and G. brevipalpis are of relatively minor significance in this area owing to their limited distribution. G. pallidipes has been confined to 2 small foci, one in the wooded Bagasha river valley at the Tanzania border, 14 km east of Nsongezi (Nsungezi, Nsongezi) camp and a diffuse pocket in the river Kafunzo valley (West of the road from Kafunzo trade centre to Merama Hill customs Post). G. brevipalpis has been limited to the thicket fringes at the river Kagera bank occurring for a distance of some 14 km from Nsongezi area westwards.

The fourth species G. fuscipes fuscipes, occurs in diffuse pockets in lacustrine fringes of Lake Victoria.

Confirmation of tsetse distribution

As indicated above, Uganda's Kagera Basin area affected by re-infestation by tsetse is estimated to be 1,950 square kilometres.

Surveys have only been done along 9 out of the 14 projected survey lines, namely:

The	Rwamurunga	-	Rurongo
	Ngarama	-	Kasharara
	Burungamo	-	Nyakibingo
	Katovu	-	Buganga
	Rwangabo	-	Nyakayojo
	Bwarkasani river valley		
	Ruisenya river valley		
	Magabi	-	Biwa
and the	Kabobo river valley.		

In areas surveyed, catches of Glossina morsitans centralis have been made within close proximity of the Tanzania border. Distances are within 10 Km of the border.

The Uganda side of the Kagera River Basin has had protracted drought throughout the June-September period and there has also been areawide bush burning. This has affected the availability of fly, notwithstanding the degree of efficiency of the survey technique. The situation would be different during the rains.

No record has been made of Glossina pallidipes. The characteristic thickets which used to harbour the fly in the Bigasha and Kafunzo river valleys are currently not there.

No catch has been made for Glossina brevipalpis. It is however, necessary that more intensive follow up searches are made for this fly to establish its presence or complete absence.

No surveys have been made in the Kagera Basin area between the Kakuto - Mutukula road and Lake Victoria. G. fuscipes fuscipes is expected to occur in this area. The projected area of infestation is approximately 1,900 square kilometres (see maps).

TANZANIA

Tsetse and Trypanosomiasis situation in the Kagera Region

In the 1960's and early 1970's tsetse control operations in the Kagera region were focussed on the sleeping sickness endemic areas of Bwanga, Nyakehura in Biharamulo district, Nterungwe and Muronzi in Ngara district, and in Nyabionza in Karagwe district. The operations were carried out using conventional tsetse control methods, such as clearing barriers, ground spraying of DDT, Dieldrex 15T (E.C.). Most of the activities were carried out around Ujamaa villages. However, due to unprecedented social and economic factors, most of the cleared areas were not fully utilized and soon were reinfested with tsetse. This resulted in sleeping sickness [illegible] 1972 reached epidemic proportions.

District	number infected
Biharamulo	109
Ngara	31 →
Karagwe	57 →

During the same period, the National Ranching Corporation launched several cattle ranching schemes at Kitengule, Missenyi, Mabele and Kagoma where a total of 170,300 hectares was cleared and ground sprayed. This operation enabled some 25,000 cattle to be stocked in the four ranches.

The Mwisa Tsetse Project supported by USAID was started in 1972 and was implemented in the four ranches. The aerial operations used thiofog 50,710 litres at a concentration of 12.02%. Aerial spray was complemented with ground spraying and bush clearing. These operations were completely interrupted during the Uganda liberation war in 1978.

The magnitude of animal trypanosomiasis in the Kagera region can be appreciated if it is realized that between 1984 and 1986 the losses incurred as a result of this disease amounted to Tanzania shillings 84,000,000.

Tsetse and Trypanosomiasis survey was carried out in Karagwe and Ngara districts of the Kagera Region. A limited tsetse survey was carried along the main truck roads, because of their accesssibility. The initial survey was done at a time when the weather was too dry and this must have affected the abundance of flies. However later tsetse surveys carried out in the game reserves and national ranches within the region revealed the presence of G. morsitans centralis. These are, Missenyi to the north and Kitengule immediately to the south of Missenyi ranch.

Cattle trypanosomiasis

Cattle were examined for the presence of animal trypanosomiasis in those areas where no tsetse were detected. These areas were Kakuvaijo, Nyakaiga, Rwakikoboko in Nyabiʻonza and Rusumo, Kihinga, Ntanga, Muvusagamba in Ngara district.

In all these study areas cattle were subjected to regular prophylactic treatment with samorin 4% and infected animal were treated with Berenil, Ethidium, Novidium and (veriban?). Animal trypanosomiasis incidence was therefore very low. T. congolense was however seen in cattle.

Sketch map of tsetse and trypanosomiasis distribution in the Tanzania part of the Kagera region is shown in the map.

Development Projects and Livestock Plans in the Project Area

- Area: 28,500 Km^2 of which 20,000 Km^2 are suitable for crops and livestock production.
- Population: (1981 census) 1.3 million (45% in the age groups of 15-65 years) Density: 28-80 persons per km^2.
- Livestock sector: There are cattle - 356,509
  Goats - 325,305
  Sheep - 52,937

In 1960s and 1970s the government and local Cooperative Union and Livestock owners co-operated to provide veterinary infrastructures and services. The region at the moment has:-

Veterinary Centres	-	17
Cattle dips	-	113
Vaccination centres	-	25

Later in 1982 the Kagera Small Holder Dairy Development Project (KSHDEP) was started by the Netherlands Assistance and over 1400 dairy heifers and bulls have been distributed. Milk production has increase to 1.86 million litres per year.

Other projects funded by Dutch Development Aid were:-

- Kikulula Heifer Breeding Unit started in 1976
- Kagera Indigeneous Livestock improvement (KILIP) started in 1988.

A new project has been formed: Kagera

Livestock Development project with the following short term objectives:-

By 1994, the following targets should be attained

- 2000 efficient dairy farmers should be operating
- Cattle offtake is expected to increase to 30-40% (present offtake is 11%).
- Increase heifer production from 220 to 330 pregnant heifers per annum.
- 505 of the new dairy farmers should be women farmers from the low income group.

Along with the above project, there are other regional projects in the Agriculture sector assisted by several donors as shown below

A. Regional Projects

Name of Project	Area covered project	External Finance	When started	Expected to end
KILIP	Bukoba/ Karagwe	Netherlands	1988	1st phase 1989
KSHDEP	Bukoba/ Karagwe/ Muraba	-do-	1982	1989
Banana Improv. and Pest Control Project	-do-	EEC	May 1982	1st Phase 1989
Bukora Rural Development Project	Bukora District	Netherlands	1986	Project cycle 1990-94
Kikula Hiefer Breeding Project	Karagwe	-do-	1986	1989

B. National Projects (projects operating in Kagera region but also being implemented elsewhere in Tanzania)

1.	National Agri. Liv. Revival Project (NALERP)	The whole region	World Bank African Development Bank	1989/90 1997/98	1st Phase
2.	Farm System Research	Bukora District	Netherlands	1988/90	?
3.	Larger grain Borer control Project (Dumuzi control)	All of Kagera Region	FAO	1986	?
4.	Fertilizer Project	All of Kagera Region	FAO	1988	1st Phase 1989
5.	Coffee Improv.	-do-	UNDP	1988/89	?

Foreign and local investment costs to finance the Kagera Livestock Development project will be from:-

- The Netherlands
- Ministry of Agriculture/Livestock Development
- EEC/WFP
- Farmers contribution
- District Council

Here below are some of the projects in Karagwe and Ngara Districts which are not included in the Kagera Livestock Development Project.

ECT NAME	IMPLEMENTATION SECTORS	PROJECT LOCATION	SOURCE OF FUNDS	DURATION OF PROJECT	TARGET	REMARKS
truction and bilitation ips	Veterinary Department	Mabele/Murusa-Gamba in Ngara District reha- 20 dips in Ngara District	District Council	1989/90	For dipping 8000	Tick borne disease is th tmost prevale in the District
ghing and lower ivation	Agriculture Dept.	Ntobeye Mugereza Ranch Muyenzi and Lemera in Ngara District	- do -	-do-	To plough 300 ha. and buy spare parts	The District is evolving from traditio hoe cultivati to cultivatio plough
restation	Natural Resources Dept.	Involving many parts of Ngara District	District Councils	-do-	To raise 3,000,000 seedlings and replant them.	1,760,000 cu are required annually for firewood
r gravita- al and mes	Water supply	In both Districts	HESAWA Sida UNICEF	1989- 1992	Improvement of health.	Apart from tsetse, wate is the major limiting factor in the KBO Tsetse Project.
srooms teachers es	Education Dept.	- do -	District Councils	- do -	Education improvement programme	-

ensaries bilitation projects	Health Dept.	In both Districts	UNICEF DANIDA EPI and District Councils	1989 - 1990	Improvement of health	Malnutrition marasmus Kwashiokor are common in the region
truction rop es	Co-operative Dept.	In both Districts	Several foreign donors	1989/90 - 1991/92	Crop collection and protection	-
age surveys lots tment	Lands Dept.	In Karagwe and Ngara Districts	District Councils	1989 - 1992	For proper village and town planning	Routine service
bilitation orks	Communication and Works Dept.	District Councils Donor Agencies and Central Govt.		1989 1992	Improvement of communication network and buildidngs	Transport and communication is another main problem in the KBO Tsetse project area

BURUNDI

Introduction

The prime objective of the project was to draw an incidence and distribution map of the tsetse fly in Burundi and to evaluate the impact of animal trypanosomiasis in the country.

Two surveys in each zone were planned, one during the dry season, another one in the rainy period.

The programme activities took into account data obtained from the Department of Animal Health on the status of trypanosomiasis in Burundi as well as the reports of the missions carried out by Dr. Mawuena in 1986 and 1987.

The objectives of field activities were as follows:-

- assist the tsetse control unit to trace viable protozoological and entomological survey circuits from which information can be obtained on the existence or absence of Glossina and trypanosomiasis in all the endemic and/or suspected areas.

- put together information related to the accessibility of the areas, determine catch points, delineate areas where intensive control action was to be carried out.

- gather data on the climate and the vegetation so as to evaluate the ecological status of the areas in relation with the pressure of Glossina.

- draw maps of the incidence and the distribution of Glossina and animal trypanosomiasis in Burundi.

The present report is therefore a compendium of the data as gathered by the survey team on the field. This is by no means a final record of the prevailing situation but it can be used as an indication. It is possible to conduct further in-depth surveys and this will be continued and intensified during the next phase which will be dealing more specifically with tsetse and animal trypanosomiasis control.

It is this global situation which inspired the programme of activities of the tsetse and trypanosomiasis control national unit. The Team

was thus led to carry out a survey in the Northern and East Northern parts of the countries which correspond to the Kagera Basin region where the highest rates of trypanosomiasis are found (1141 in the Muyinga Province and 149 in the province of Korundo).

The eastern parts of the country with Ruyigi (136 cases of trypanosomiasis) Cankuzo (107), the southern region with Rutana (224 cases) of a Makamba (55) were also surveyed in depth.

Lastly, all the region of the Imbo plain, which corresponds to the areas of low altitudes, bordering in part, L. Tanganyika on other rivers received the special attention of the team.

As will be seen in the present report, the results of the surveys are more often than not, quite different from the data on trypanosomiasis distribution as compiled by the department of animal health during 1988. This would be due to many reason, of which the major ones, in our opinion are as follows:-

often, field workers do a clinical diagnosis which is rarely confirmed by an authorised laboratory

cases can be duplicated (from one month to another) by the workers who have no means of counter checking.

Glancing through the distribution map of trypanosomiasis in 1988, the reader of this report might be surprised to see the provinces of Ngozi, Gitega, a big portion of Bururi represented as prime foci of the disease. One must say that such cases can be attributed to and explained only by the phenomenon of transhumance, to effect. Many animals spend part of the dry season in the Mosso and Imbo regions.

Once infested there, they remain the hosts of trypanosomes which can trigger the disease while they are back in the high altitude areas.

We have given the distribution map to show the areas where the survey team was to visit during the surveys in the incidence and distribution map of tsetse and trypanosomiasis in Burundi.

Activities undertaken

During the 1989 rainy season the team of the national unit for tsetse and animal trypanosomiasis control carried out a series of surveys in all the areas that are infested or suspected to be infested by tsetse flies. Another series of surveys in the same area was planned for the dry season, to draw a map of the incidence and distribution of tsetse and animal trypanosomiasis in the country.

During the dry season, our surveys were conducted in the following regions:-

1. Kagera Basin with the camping site in the "commune" of Giteranyi

2. South-west region of the country with Nyanza - lac on the activity centre.

3. Moso region with our base on Gihofi

4. Central-South Imbo region without base in Rumonge

5. National Park of Ruvumbu and Mishiha zone.

These areas were selected because they are representatives of the country. That is why we consider the results thus obtained are reliable and can be extrapolated to regions with similar climatic and vegetational conditions which were not visited during the season.

Exchange of experience in Rusumo, Rwanda

The head of the National Unit for Tsetse Control undertook a (working) mission in the pilot zone of the tsetse control project in Rusumo. This was a 4 day mission which concentrated mainly on familiarization with trapping technique, sampling, fly species identification, various aspects pertaining to tsetse classification, etc.

Thus, how to make the Nguruman types of traps received a special attention, given the fact that this trap was tested by ICIPE, Nairobi and is amongst the best both for the control and suppression of tsetse.

Results of surveys, carried out during the rainy season and the dry season.

Provinces of Muyinga, Kirundo and Cankuzo

These 3 provinces are of special interest as most of the "communes" are to be found in the Kagera Basin. We give here below the results of surveys carried out in these

provinces where the climatic, adaptive and vegetation conditions are quite similar. They are all plateaux at altitudes varying between 1500 and 1700 m with swampy valleys.

The climate is tropical with a long dry deason with temperatures in the range on 20°. The vegetational cover is dominated by the savanna with acacia and forests ranges and varied species. Fauna is abundant especially in the PARC of Ruvumbu. The entomological survey was conducted using Nguruman and Challier traps.

Surveys in trypanosomiasis

The surveys suffered many setbacks owing to lack of adequate materials for work, such as haematocrit centrifuge, capillary tubes, staining chemicals etc.

The results, however obtained in the Northern and East-Northern region of the country (Kirundo, Muyinga and Cankuzo) which lie in the Kagera Basin are at first sight surprising, especially if one takes into account the fact that trypanosomiasis has worked havoc in the region. But, when one considers the various actions already taken to eradicate the disease the frequent spraying and the fact that there are a growing number of farms and agricultural settlements in the region one can easily understand why there is not much trace of tsetse.

However, a. the presence of many mechanical vectors (e.g. Stomoxys and others) b. and the presence of animal trypanosomiasis found by field workers and other personnel both from the Department of animal health and the survey team from the National Unit for tsetse control make necessary to have the areas under constant monitoring. To these factors, must be added the proximity with endemic zones in neighbouring countries (Rusumo in Rwanda, border with Tanzania).

For all the above reasons, we cannot say that this area is safe. it must remain under permanent monitoring to safeguard our national cattle and fauna (Park of Ruvubu).

Provinces of Ruyugi, Rutana and Makamba

This area is characterized by the depressions to the East which ends with the Mosa plain. It covers + 150 km in length and 10 to 30 km of width depending on location South-East to East of the country. Plane terrain with 1200 - 1400m of altitude. Tropical climate with temperatures often higher than 23oC. Vegetation: mainly savana and forest patterns with various species. The team conducted surveys in the province of Ruyugi in the following locations: Gisuru, Kinyinya and Kayongezi in the province of Rutana;

Giharo, Bukemba, Gitanga and Kayogoro in the province of Makamba.

C. Provinces of Makamba, Bururi, Bujumbura, Bubanza, Cibitoke

These are results recorded and compiled from data collected in the "communes" of the Imbo plain: regions of less than 1000 m of altitude surrounding to the Rusizi plain to the samll plains of the eastern bank of Lake Tanganyika. It is the hottest region in the country with temperatures higher than 23°C on all the stations. The vegetation is varied but the savanna is predominant.

Rwanda covered central and northern Imbo up to the Ruhwa River during the rainy season and south Imbo during both the rainy and dry seasons.

Remarks

The Imbo region is infested by tsetse from south to north in variable proporting south Imbo is the most infested area while central and northern Imbo are less infested. The only species of Glossina identified in Burundi is Glossina fuscipes of the palpalis group, whose favourite biotype is the river on lake zone.

One may be surprised by the fact that not many cases of trypanosomiasis were found in these regions. However, one must take into consideration that there is almost no cattle in south Imbo in the rainy season and the herds which come there during the dry season receive a regular treatment of trypanocides. The surveys on goats give negative results but more in depth surveys must be conducted to confirm whether or not small ruminants are trypanosome reservoirs as are wild species.

GENERAL CONCLUSION

The team of the national unit for tsetse and animal trypanosomiasis control has inspected the two main periods for the surveys - one during the rainy season, the other one during the season - as scheduled in the programme activities. Only central Imbo and north Imbo were not visited during the dry season but data from the rainy season are quite relevant.

It appears that the western regions of the countries are infested, from north to south. The regions of Nyanza is also infested. Glossina fuscipes of the palpalis group, is the only species identified.

The regions of the north, north-east, east and south east of the country do not seem to have the presence of Glossina. But they have been endemic zones and cases of animal trypanosomiasis are still recorded. A special attention must be given especially where transhumance still persists, since transhumance herds always fall victims of trypanosomiasis (at the beginning of the rainy season, according to the herders). Those areas that are apparently tsetse free but where trypanosomiais is still persistent must be under constant monitoring while a systematic control must be carried out in those regions where the presence of tsetse is confirmed.

RWANDA

1. Geographical Distribution of Tsetse
Most of Rwanda, made of high plateaux and mountains, is free of Glossina.

Glossina are found in the shrubby savannas of eastern Rwanda (from the border with Burundi -south to the border with Uganda - north) along the Tanzania border (east) in the whole of the Kagera.

Glossina morsitans centralis Machado 1970 is the most common species. Glossina pallidipes Austen, 1903 is however confined to the thickets of Kagera National Park and in the Gisaka - Migonogo (Rusumo) region.

Glossina brevipalpis Newstead, 1910 is found in the forests of the Kagera. Before the development of the Rusizi valley one found Glossina fuscipes Martini Zumpt 1935.
The recent survey conducted by the Tsetse Control Ntional Unit gives an up date of the data as follows:

Commune Rusumo

Nasho : G. brevipalpis
G. morsitans
G. pallidipes

Commune Rukira

Cyambe : G. morsitans
G. pallidipes

Commune Kigarama
Kabare II (Paysanat)
G. pallidipes
Commune Kayonza : 0

Commune Rukara
NyaKabungo G. pallidipes
Commune Murambi (Prefecture Byumba)
G. pallidipes 4 females
3 males.

2. The surveys have shown that tsetse is confined to the National Kagera PARC and its surroundings. No tsetse were found in the "prefecture" of Cyangugu (Commune Bugarama)

Traps used: Challier - Laveissiere type, biconical traps no odour bait no insecticide.

3. For the survey on trypanosomiasis, microhaematocrit centrifuge.

Prefecture		Number of cases
01.	Kigali	127
02.	Gitarama	147
03.	Butare	167
04	Gikongoro	-
05	Cyangugu	8
06	Kibuye	6
07	Gisenyi	33
08	Ruhengeri	-
09	Byumba	1.254
10	Kibungo	1.380
	Total	3.122:0.5%

Comments

The highest number of cases are still to be found in Byumba and Kibungo. The ratio of positive cases in relation with the haematological tests carried out in these two "prefectures" represents 47 and 7,84% respectively.

For the whole country, 3122 cases were diagnosied in cattle, 1 in sheep and 13 in goat. No case was reported in Gikongoro and Ruhengeri. T. congolense and T. vivax were found. Rusumo has an infection rate of 37%.

4. Campaigns against tsetse fly and trypanosomiasis

In order to acquire new lands for farmers and safeguard cattle in Rwanda, a vast programme was started in 1960 with the aim of developing and reclaiming the semi arid and sparsely populated regions of the eastern parts of the country: Bugesera - Gisaka - Migongo - Mutara.

Bugesera 1960

Aerial spraying using Dieldrin at 2.6% : 8 applications was carried out every 28 days up to 1963 when the exercise was discontinued due to lack of funds.

1969 - 1969

Selective manual spraying with dieldrin 3% in the permanent habitats of the Glossina. Bugesera was found to be Glossina free.

Gisaka Migongo - 1977 -1978: BGM for Pastoral Project

Selective manual spraying with dieldrin 3% was carried out at Nasho and Rusumo field.

Mutara

Bush clearing (acacia) land occupation/use (agriculture, pastoralism) in the framework of the OVAPAm project. About 80,000 ha was acquired between 1975 and 1980 and some 10,000 farmers and herders with 25,000 head of cattle was settled in the area. A further 10,000 ha was reclaimed in 1981. Africare then took over the tsetse control at Rusumo and Nasho until they stopped operations in 1988. The KBO project is therefore a timely support for these effort.

Remarks

Studies in other parts of Africa have shown that G. morsitans does not readily respond to trapping. It is therefore very interesting to note that this species is responding to the NG2B trap. This is particularly encouraging. Other odour baits will be incorporated to see if we can increase the numbers of G. morsitans being caught.

In conclusion, our preliminary suppression efforts with the NG2B trap have proved to be effective against the tsetse species found along the Kagera River in the Rusumo area. Since the three species are the main problem species, we feel confident to recommend this approach of tsetse control. For more dramatic impact on tsetse populations, it is recommended that four traps per Km^2 be used for suppression, rather than the two that were used in this preliminary study.

ANNEX A

Training for Kagera River Basin Member States Project Co-ordinators: 10 - 25th August, 1988

Field participants from Rwanda, Burundi, Tanzania and Uganda took part in a training programme arranged at ICIPE from the 10th to 25th August, 1988. The training programme emphasized the following topics:

1. Tsetse population dynamics

   - Tsetse mortality rates
   - Immigration and emmigration
   - Population modelling
   - Larviposition sites.

2. Tsetse vectorial capacity

   - Trypanosome detection in tsetse and in cattle.

3. Using traps and targets for control

   Introduction to traps and targets/odour baits
   - Results of pilot project at Nguruman
   - Manufacture, siting and maintenance of the NGU trap.

4. Experimental techniques used to develop traps and targets

   - Use of Latin squares to compare traps/odour baits and electric screens for testing trap and target efficiency.
   - Practical demonstration of electrical screens.

5. Field operations

   - Use of targets to control tsetse in Lambwe Valley. (KETRI/Ministry of Livestock example).
   - Demonstration of NGU traps as barriers to tsetse infestation. (Nguruman and Lambwe Valley examples).

6. Laboratory demonstrations
   - Tsetse ageing
   - Trypanosome infection in tsetse.

ANNEX B

COMPUTER DATA MANAGEMENT COURSE: ICIPE DUDUVILLE CAMPUS, NAIROBI

Monday to Friday 24th July - 5th August 1989
COURSE OUTLINE

A. BASIC STATISTICS

1. Statistical Data Types
2. Data Collection and Procedures - Survey and Expectal Types
3. Data Collection and Analysis - Ticks
4. Data Collection and Analysis - Tsetse
5. Basic Sample Procedures
6. Data Organization and Summarization
7. Data Screening Procudures
8. Data Coding and Transformation

B. DATA ANALYTICAL PROCEDURES

9. Measures of Central Tendency
10. Measure of Dispersion
11. Parametric Relationships
    - Linear Relationship
    - Proportions
    - Analysis of Variance - Orthogonal Contrasts

12. Non-Parametric Statistics
    - Rank Test
    - K-S Test
    - Kruskall Wallis
    - Randomness

C. COMPUTER APPLICATIONS

13. MS - DOS
14. Lotus 123
15. SAS for Data Analysis and Summarization
16. Hardware Maintenance
17. Geographic Information Systems (GIS)

Table 1. Ovarian dissection age classes of female tsetse at Mpanga ranch in 1989

Groups	Age Class								
	Oa	Ob	1	2	3	4	5	6	7
Mpanga *G. pallidipes*									
May	9	8	75	74	30	42	40	20	11
June/July	1	3	10	11	5	13	12	9	2
August 2	1	2	23	24	10	11	10	4	2
21	3	5	23	39	11	16	14	15	3
September	[illegible]	[illegible]	18	29	20	11	13	8	10
October	0	1	27	18	19	21	7	11	4
November	0	10	43	31	16	23	27	24	13
December	2	12	52	45	22	30	25	14	10
Mpanga *G. morsitans*									
May	1	6	45	40	18	15	15	19	3
June/July	-	-	-	-	-	-	-	-	-
August 2	0	1	3	4	5	2	6	2	0
21	0	1	2	2	2	4	2	0	3
September	[illegible]	[illegible]	14	7	11	8	6	5	2
October	-	-	-	-	-	-	-	-	-
November	-	-	-	-	-	-	-	-	-
December	-	-	-	-	-	-	-	-	-
Mpanga *G. brevipalpis*									
May	6	1	1	3	0	0	2	0	0
June/July	-	-	-	-	-	-	-	-	-
August 2	-	-	-	-	-	-	-	-	-
21	[illegible]	[illegible]	-	-	-	-	-	-	-
September	[illegible]	-	-	-	1	-	-	-	-
October	1	0	1	3	0	0	0	0	0
November	0	0	1	0	0	0	0	1	0
December	0	2	0	0	0	0	0	0	0

Table 2. Ovarian dissection age classes of female tsetse at Nasho ranch in 1989

Groups	Age Classes								
	0a	0b	1	2	3	4	5	6	7
Nasho G. pallidipes									
May	4	24	55	34	13	19	21	11	7
June/July	0	1	17	15	9	16	11	7	2
August	0	1	6	3	3	10	8	4	0
September	0	1	2	2	2	0	0	0	0
October	0	0	0	2	3	0	0	0	1
November	1	2	9	3	0	4	1	0	0
December	1	5	3	1	1	1	3	2	2
Nasho G. morsitans									
May	0	8	24	18	4	12	12	8	6
June/July	-	-	-	-	-	-	-	-	-
August	-	-	-	-	-	-	-	-	-
September	0	0	0	1	0	0	0	0	0
October	-	-	-	-	-	-	-	-	-
November	-	-	-	-	-	-	-	-	-
December	-				-	-	-	-	-
Nasho G. brevipalpis									
May	2	3	3	3	1	4	4	0	1
June/July	-	-	-	-	-	-	-	-	-
August	0	1	1	0	0	0	0	0	0
September	0	0	0	0	0	1	0	0	0
October	1	0	1	0	0	0	0	0	0
November	0	1	4	0	3	4	3	4	0
December	1	0	1	0	0	0	1	0	0

Table 3. Infection rates in tsetse in 1989 based on dissection

Group	G. pallidipes			G. morsitans			G. brevipalpis		
	Tc	Tv	Neg	Tc	Tv	Neg	Tc	Tv	Neg
Mpanga									
May	5	2	527	5	3	253	1	0	15
June/July	5	1	112	-	-	-	0	0	1
August 2	3	0	124	0	0	31	-	-	-
August 22	1	6	175	0	0	24	-	-	-
September	1	1	148	0	2	63	0	0	1
October	1	0	134	-	-	-	0	0	3
November	-	-	270	-	-	-	0	0	4
December	-	2	328	-	-	-	0	0	6
Nasho									
May	2	9	271	1	7	114	1	1	76
June/July	2	9	84	-	-	-	0	0	1
August	3	0	36	-	-	-	-	-	-
September	1	0	12	-	-	-	-	4	4
October	0	1	6	-	-	-	1	0	1
November	2	0	33	-	-	-	0	0	31
December		0	33	-	-	-	0	0	19
Rusumo									
May	2	0	32	0	2	9	0	0	3
Totals									
N	38	33	2325	6	14	494	3	1	165
%	1.59	1.38	-	1.7	2.72	-	1.8	0.6	-

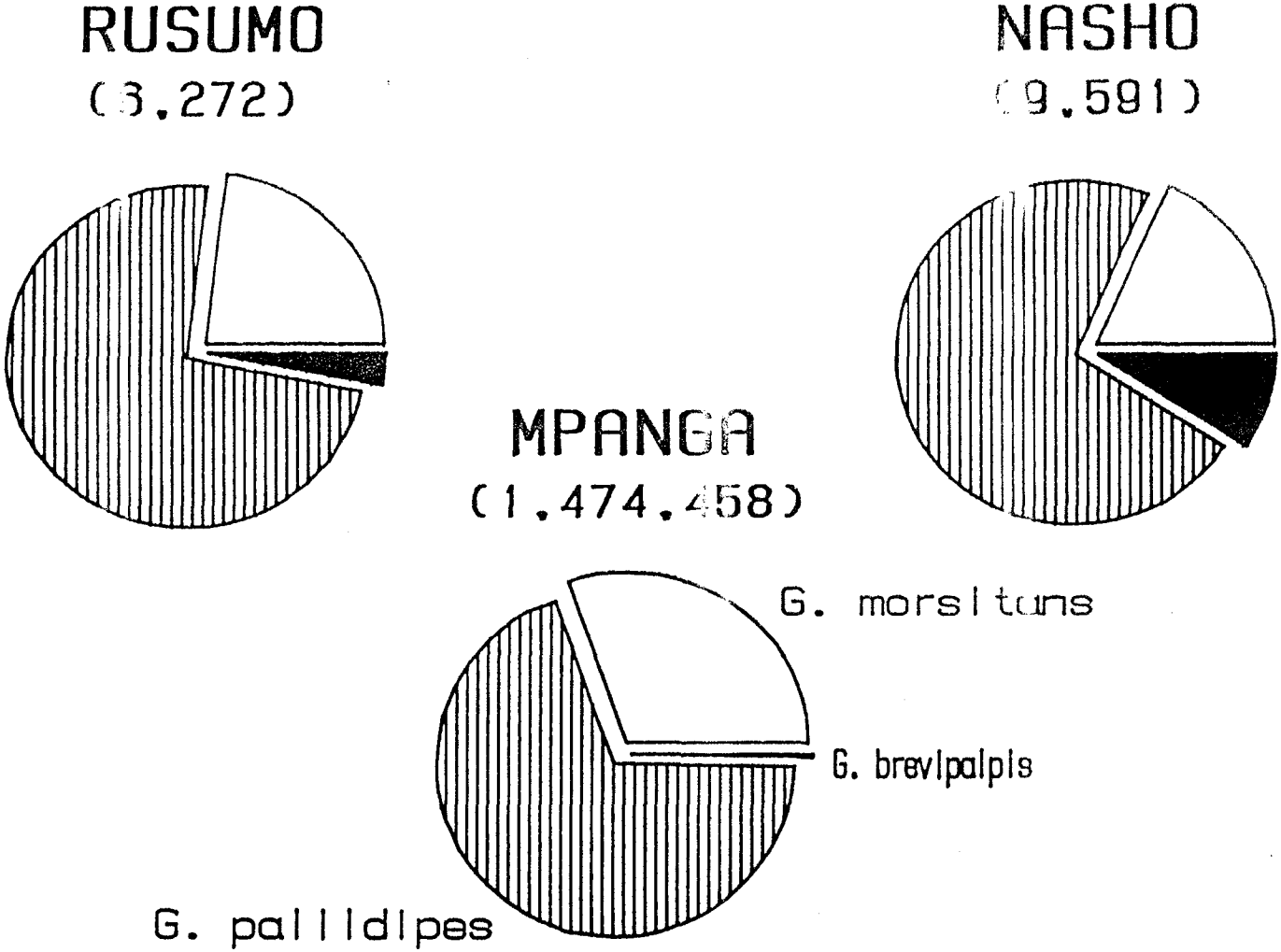


FIG. 1. Species distribution of the tsetse catch at Rusumo, Nasho, and Mpanga ranches from April to December 1989 with estimates of the number of flies removed by all monitoring and suppression traps.

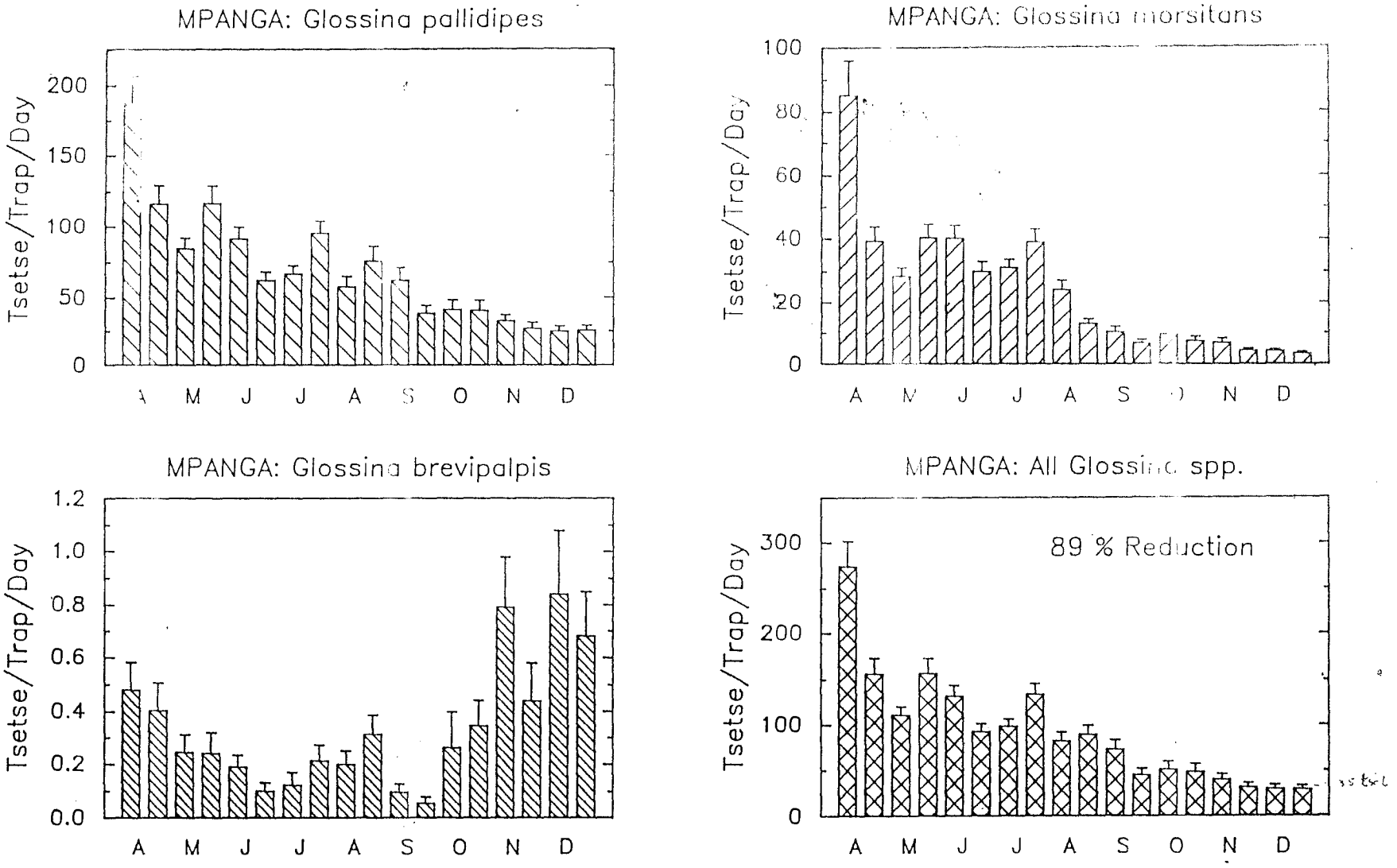


FIG. 2. Trap catches at Mpanga ranch from April to December 1989 for each tsetse species and all tsetse combined (data are summarized by half month periods, error bars are standard errors).

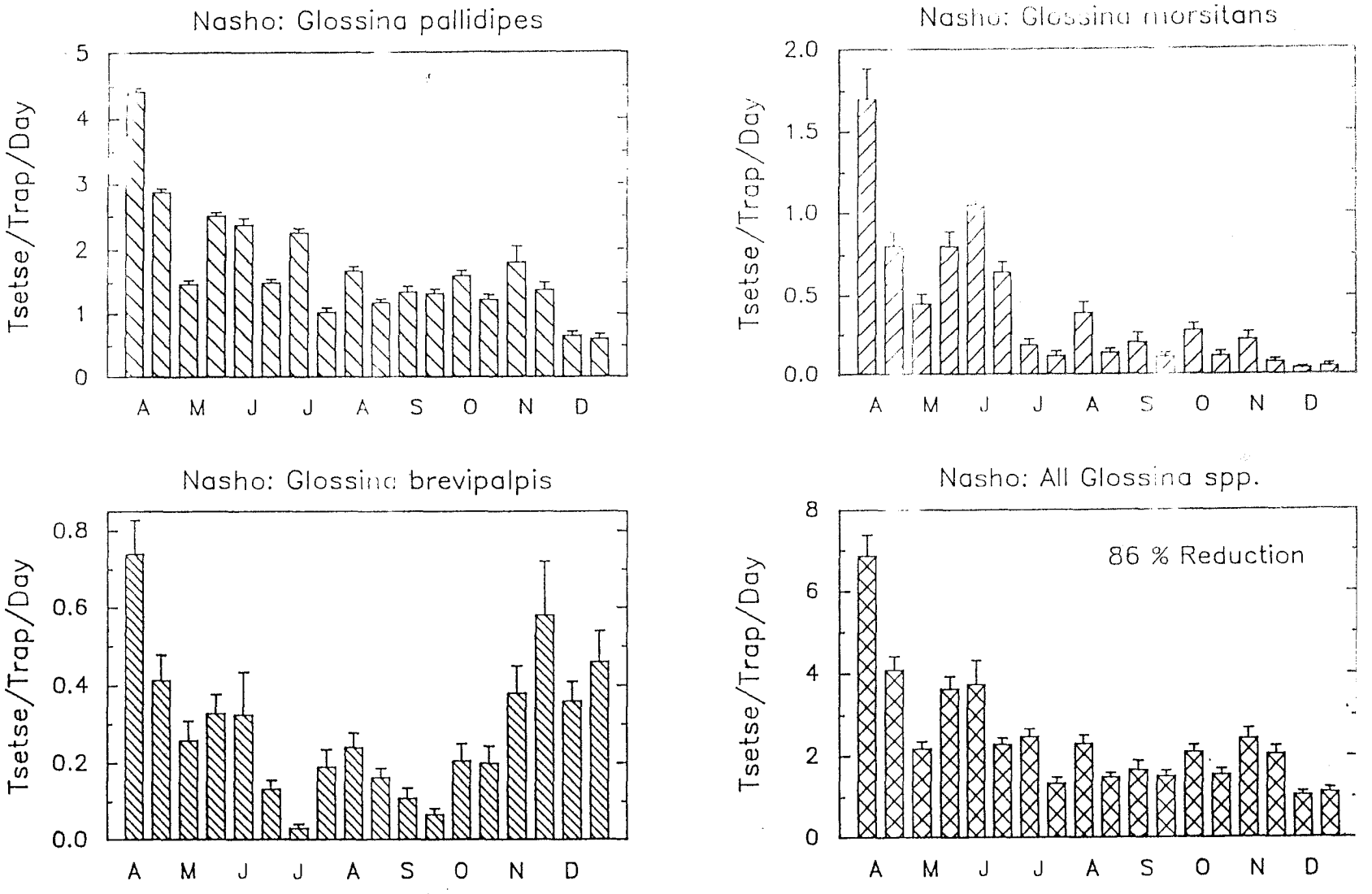


FIG. 4. Trap catches at Nasho ranch from April to December 1989 for each tsetse species and all tsetse combined (data are summarized by half month periods, error bars are standard errors).

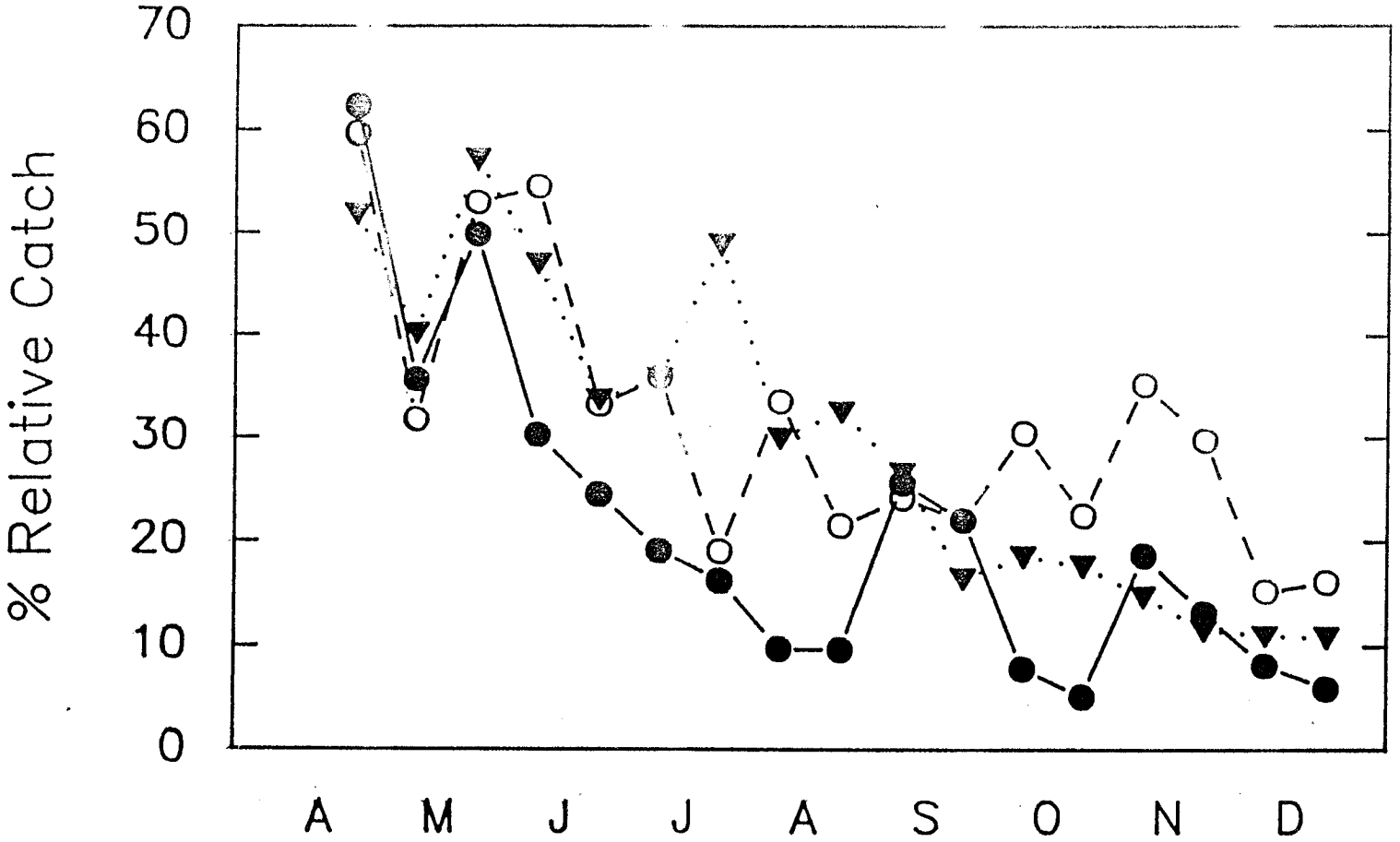
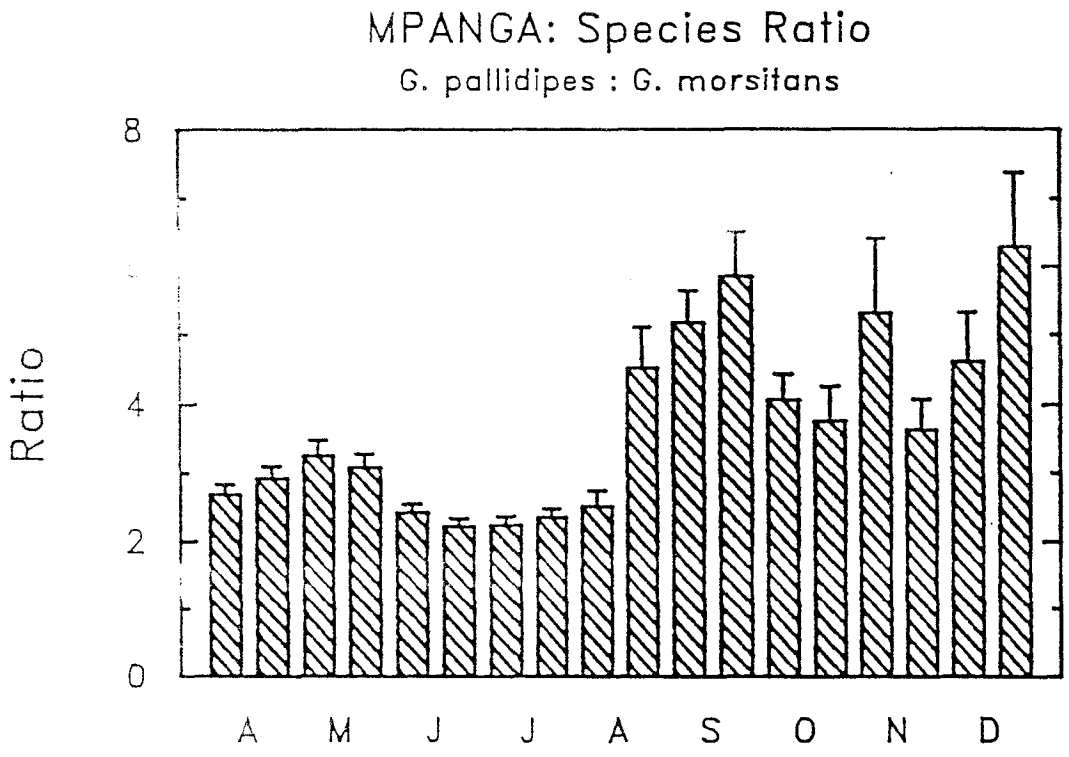


FIG. 5. Total tsetse catches at Mpanga, Rusumo and Nasho from April to December 1989 expressed as a percentage of catches observed in the first half of April.



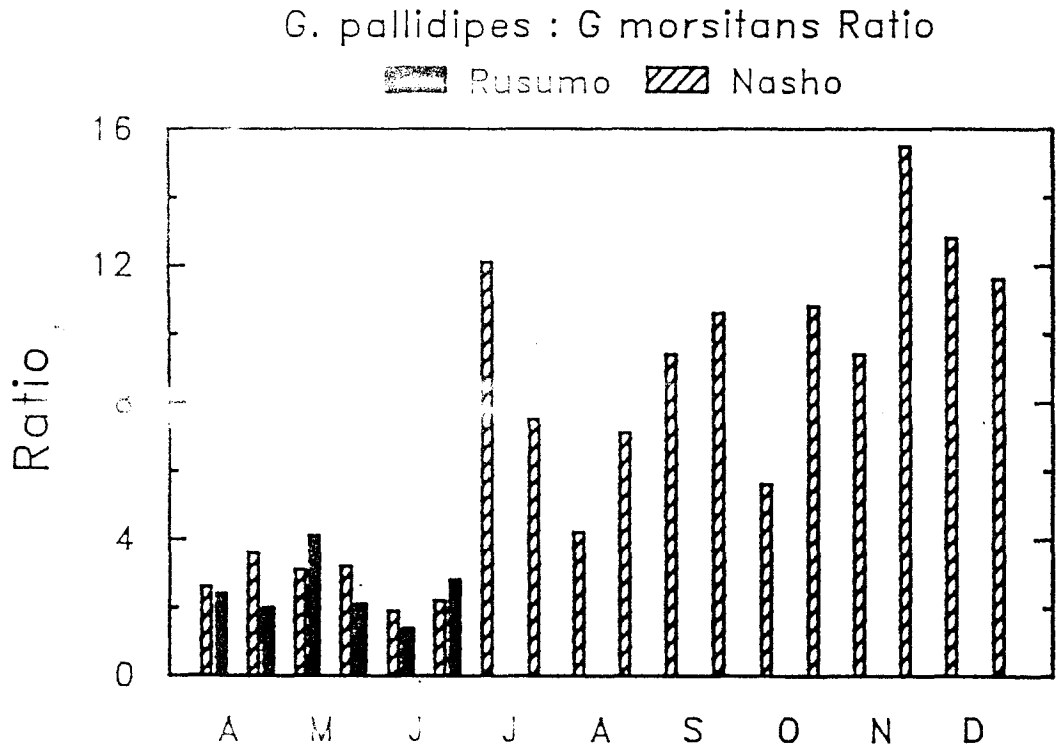


FIG. 6. Ratio of G. pallidipes to G. morsitans in the catch from Mpanga, Rusumo and Nasho ranches from April to December 1989. Ratios for Mpanga were calculated on a per trap basis for traps catching at

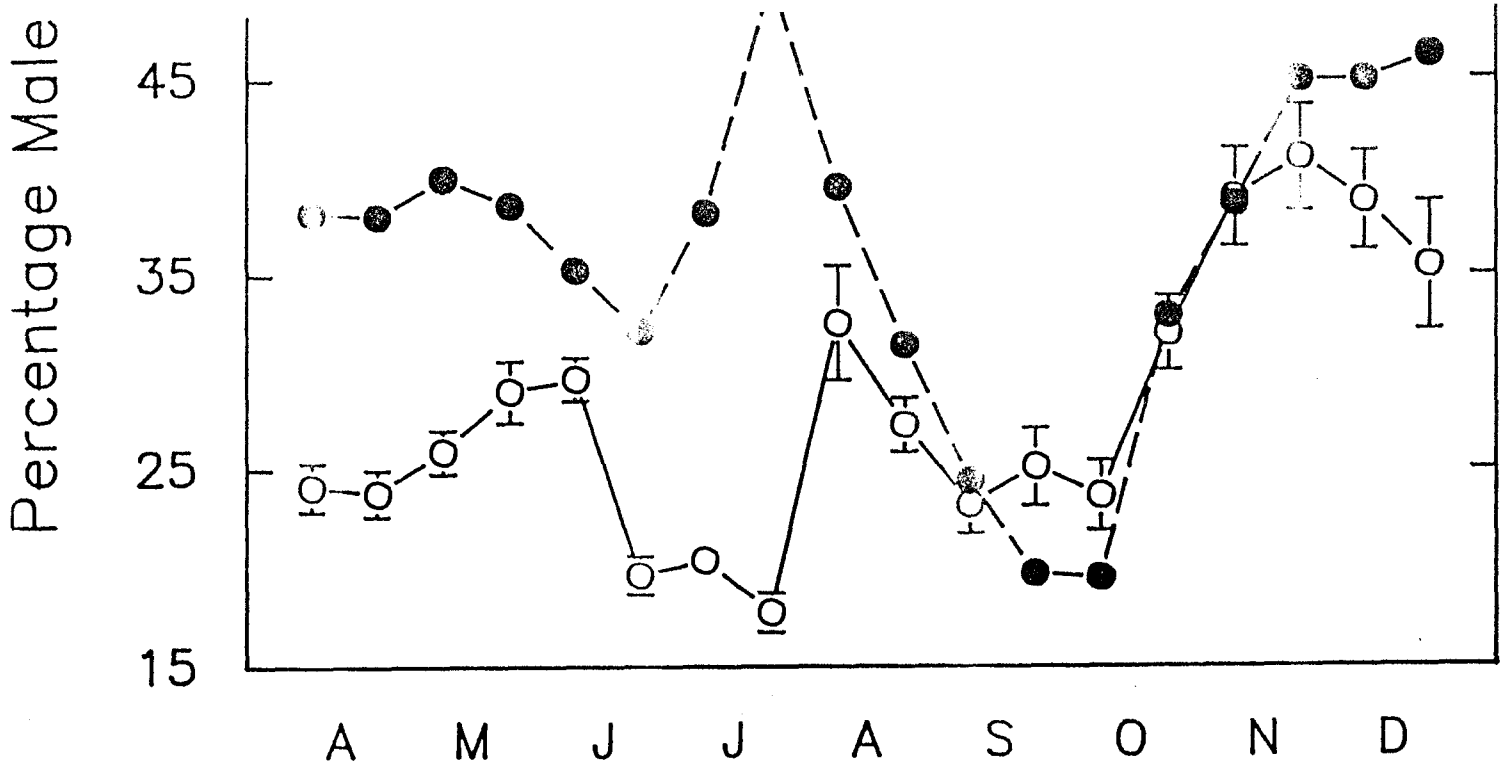
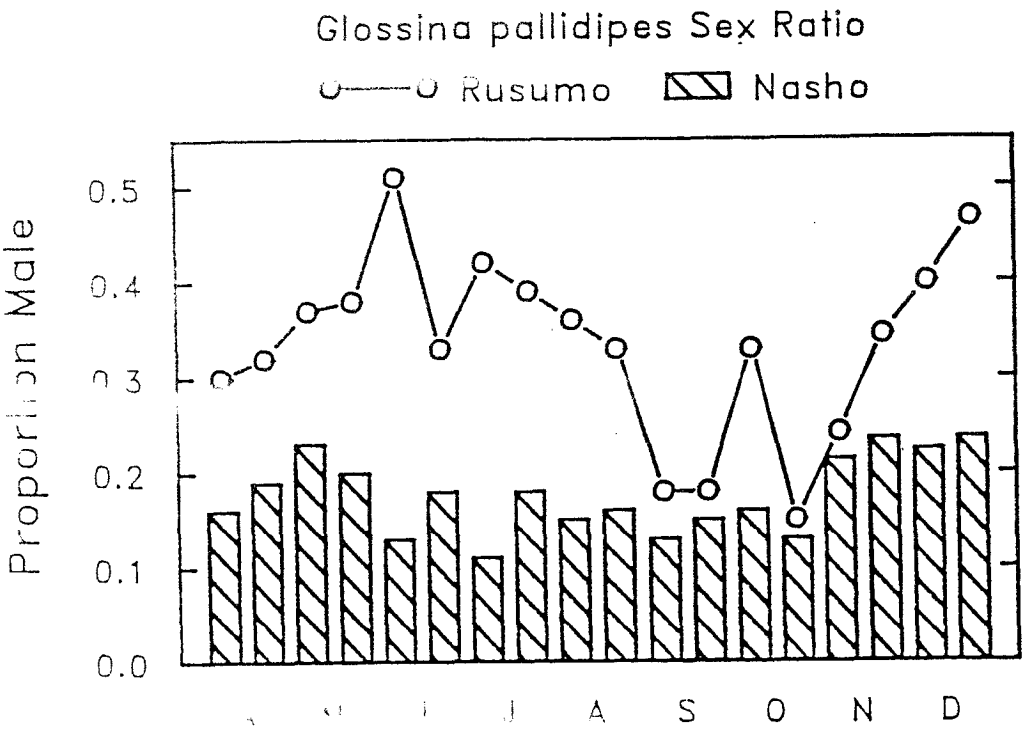
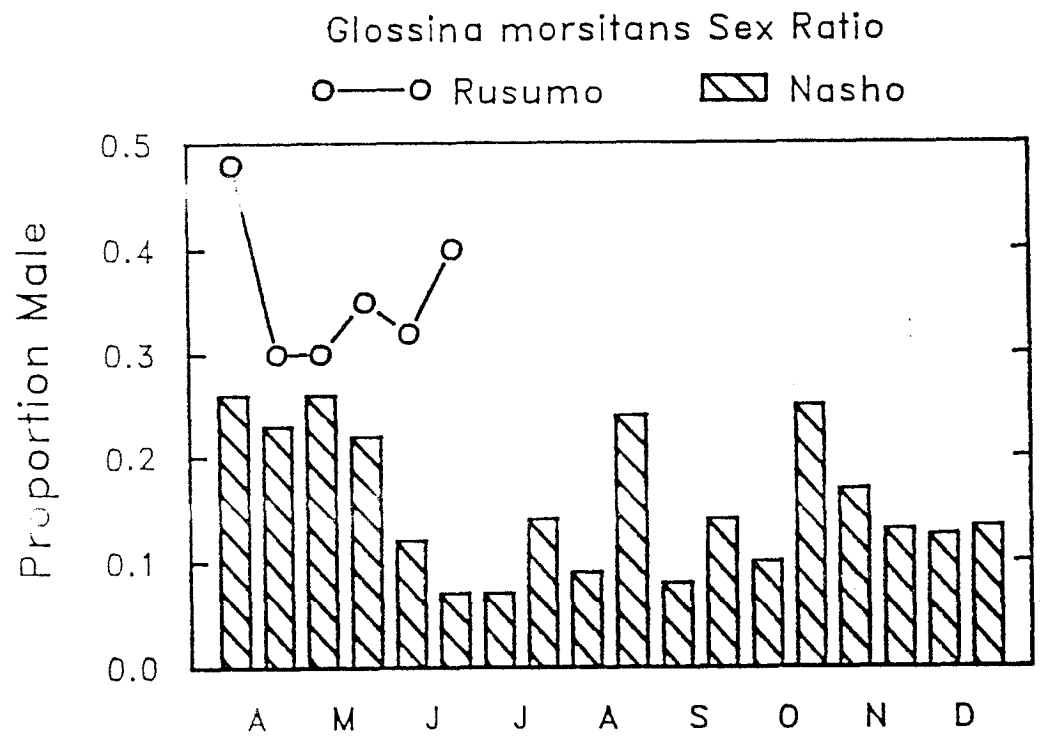
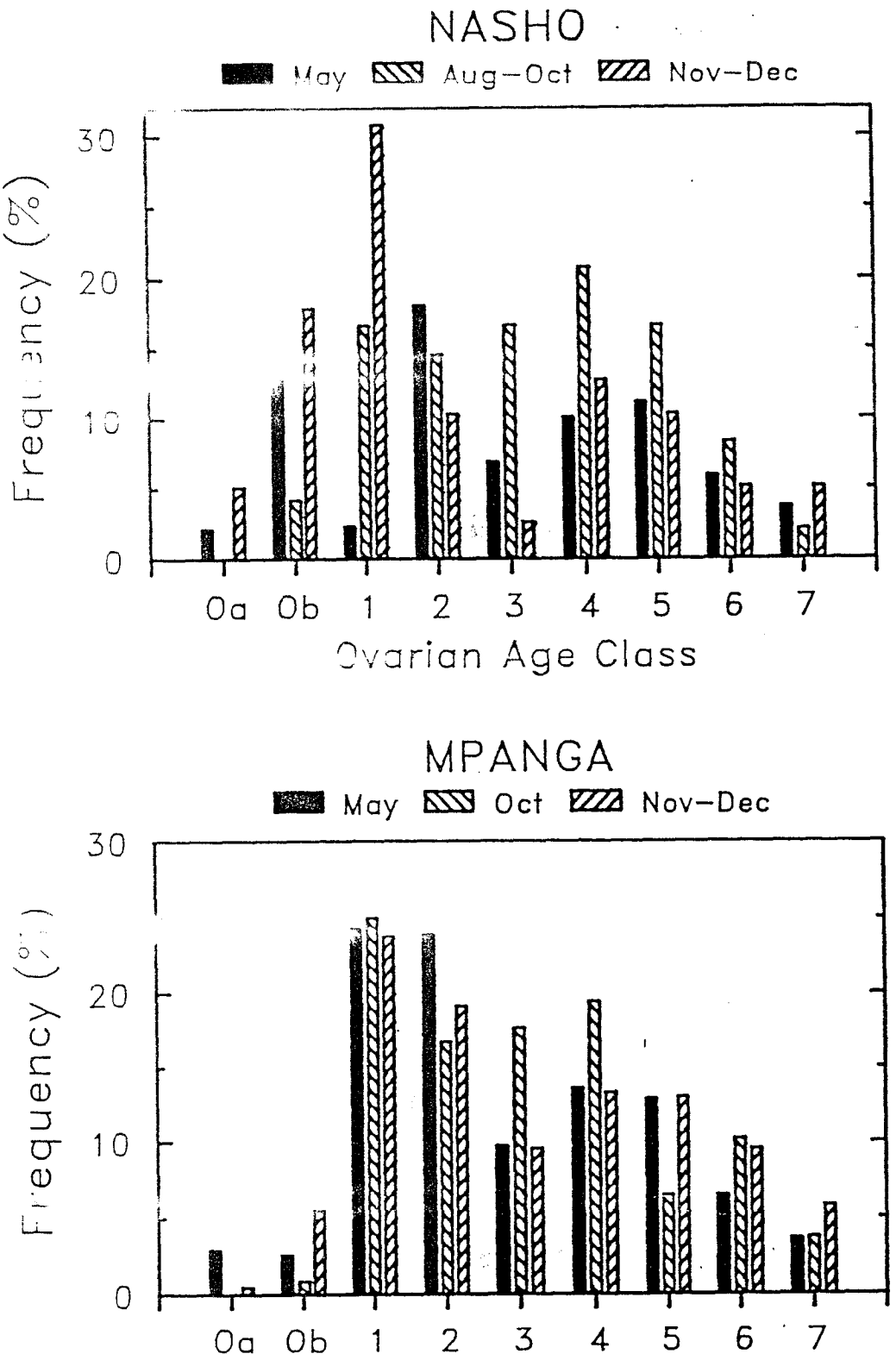


FIG. 7. Male sex ratios of the catch of G. pallidipes and G. morsitans at Mpanga ranch from April to December 1989. Ratios were calculated for any trap catching at least 20 flies.





IG. 8. Male sex ratios of the catch of G. pallidipes and G. morsitans at Rusumo and Nasho ranches from April to December 1989. Ratios were calculated from the entire catch at all traps for each period. Toc



IG. 9. Representative age distributions of female G. pallidipes from

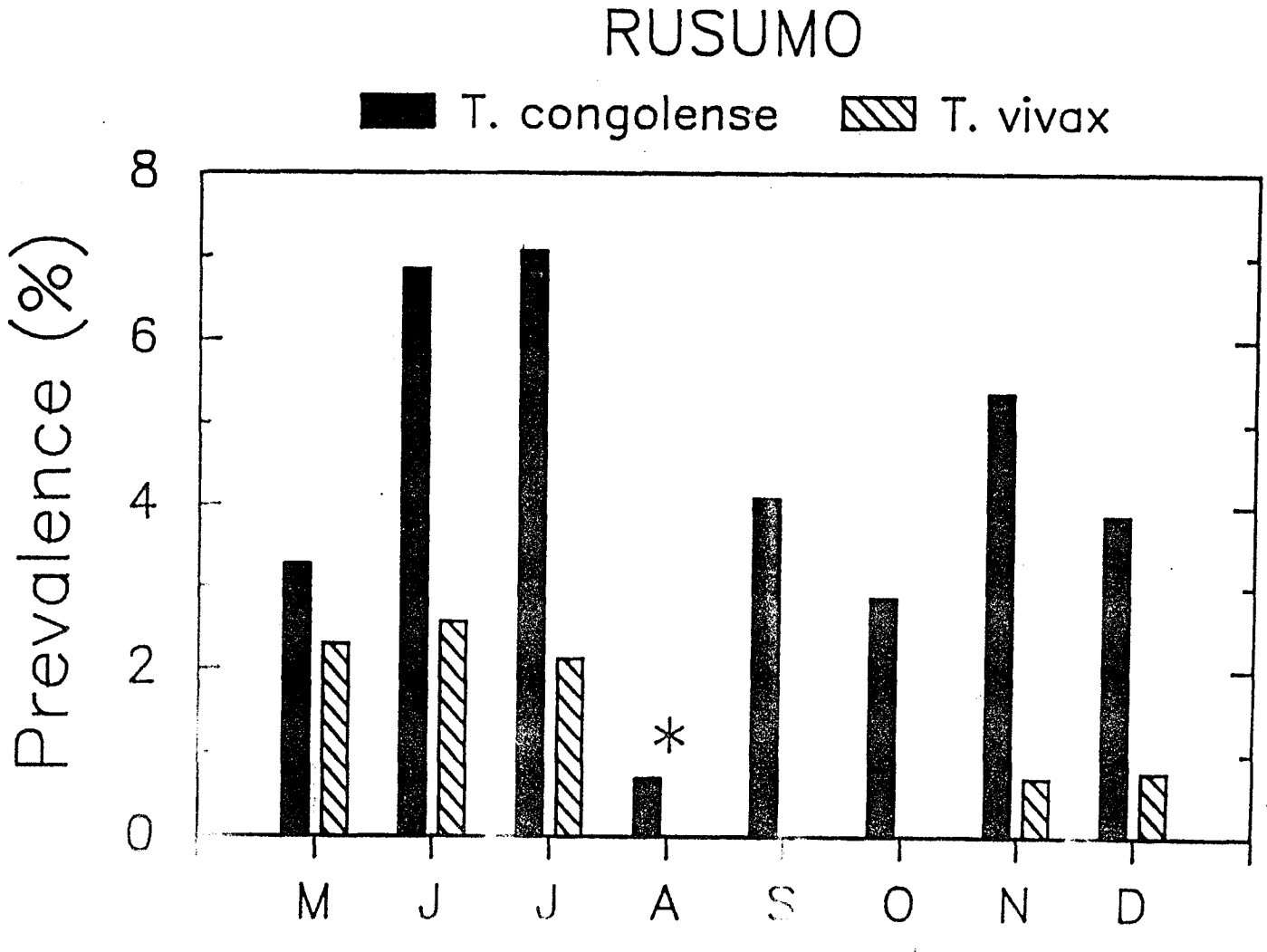
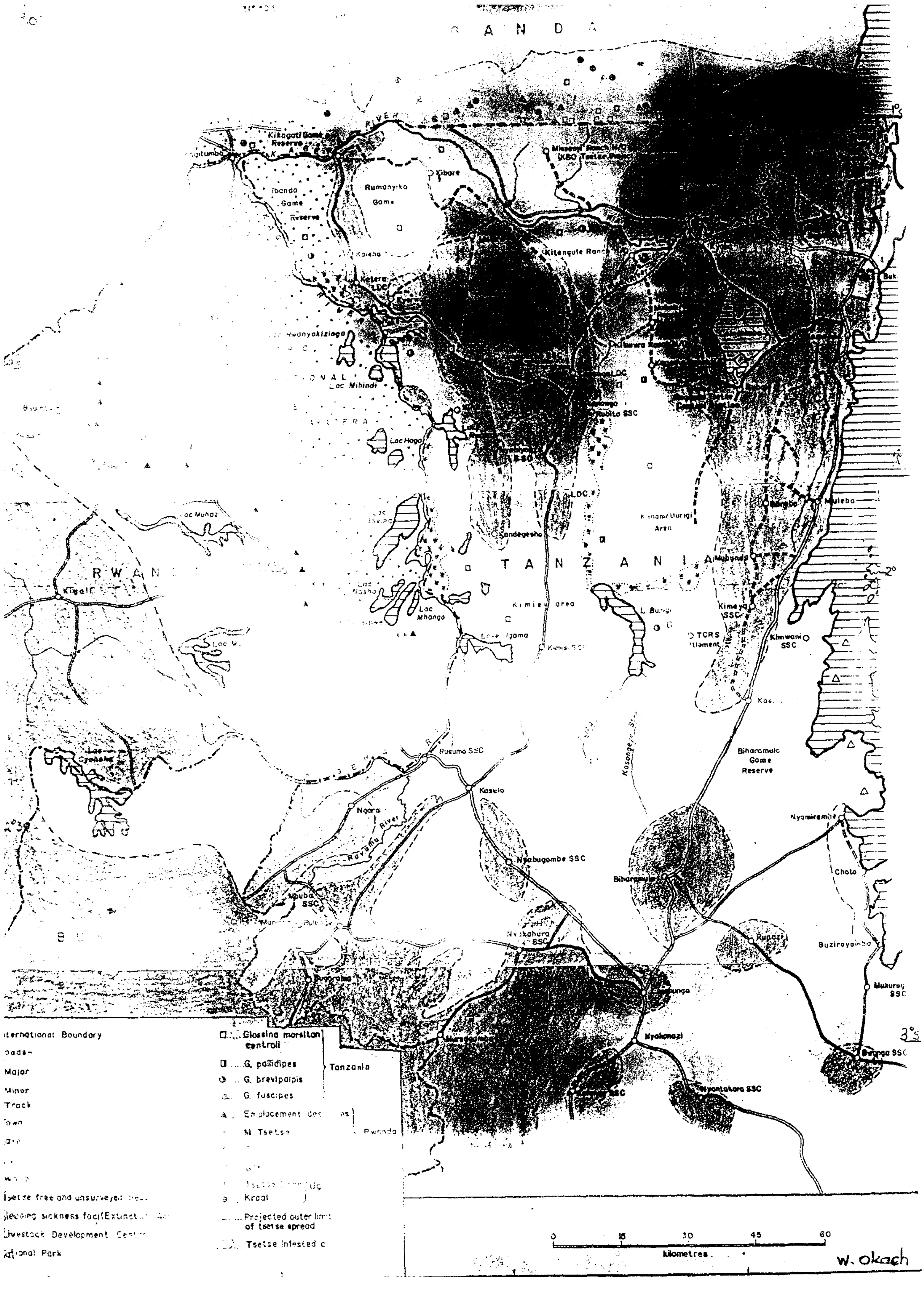


FIG. 10. Trypanosome infection rates in cattle from Rusumo ranch based on monthly examination of blood samples from May to December 1989. The asterisk marks an artificially low prevalence rate resulting from block treatment of cattle with Berenil in late July


RWANDA
TANZANIA
Kikagati Game Reserve
Ibanda Game Reserve
Rumanyika Game
Kibare
Misenyi Ranch H/Q
Kitengule Ranch
Lac Mihindi
Lac Hago
Kigali
Lac Cyohoha
Rusumo SSC
Kasulo
Ngara
Ruvumu River
Nyabugombe SSC
Mbuba SSC
Nyakahura SSC
Biharamulo Game Reserve
Biharamulo
Runazi
Nyamirembe
Choto
Buziroyaimbo
Mukuruji SSC
Nyakanazi
Nyantakara SSC
Bwanga SSC
Kasongeye
Kimwani SSC
Kimeya SSC
Mubunda
Muleba
Kimisi SSC
L. Burigi
Kimisi area
Karagwe/Burigi Area
Sandegesho
Lac Mhanga
International Boundary
Roads
Major
Minor
Track
Town
Tsetse free and unsurveyed areas
Sleeping sickness foci
Livestock Development Centre
National Park
Glossina morsitans centrali
G. pallidipes
G. brevipalpis
G. fuscipes
Tanzania
Rwanda
Kraal
Projected outer limit of tsetse spread
Tsetse infested
0
15
30
45
60
kilometres
w. okach
2°
3°S