Use of Tiny Targets to control tsetse flies in Gambian HAT foci: standard operating procedures

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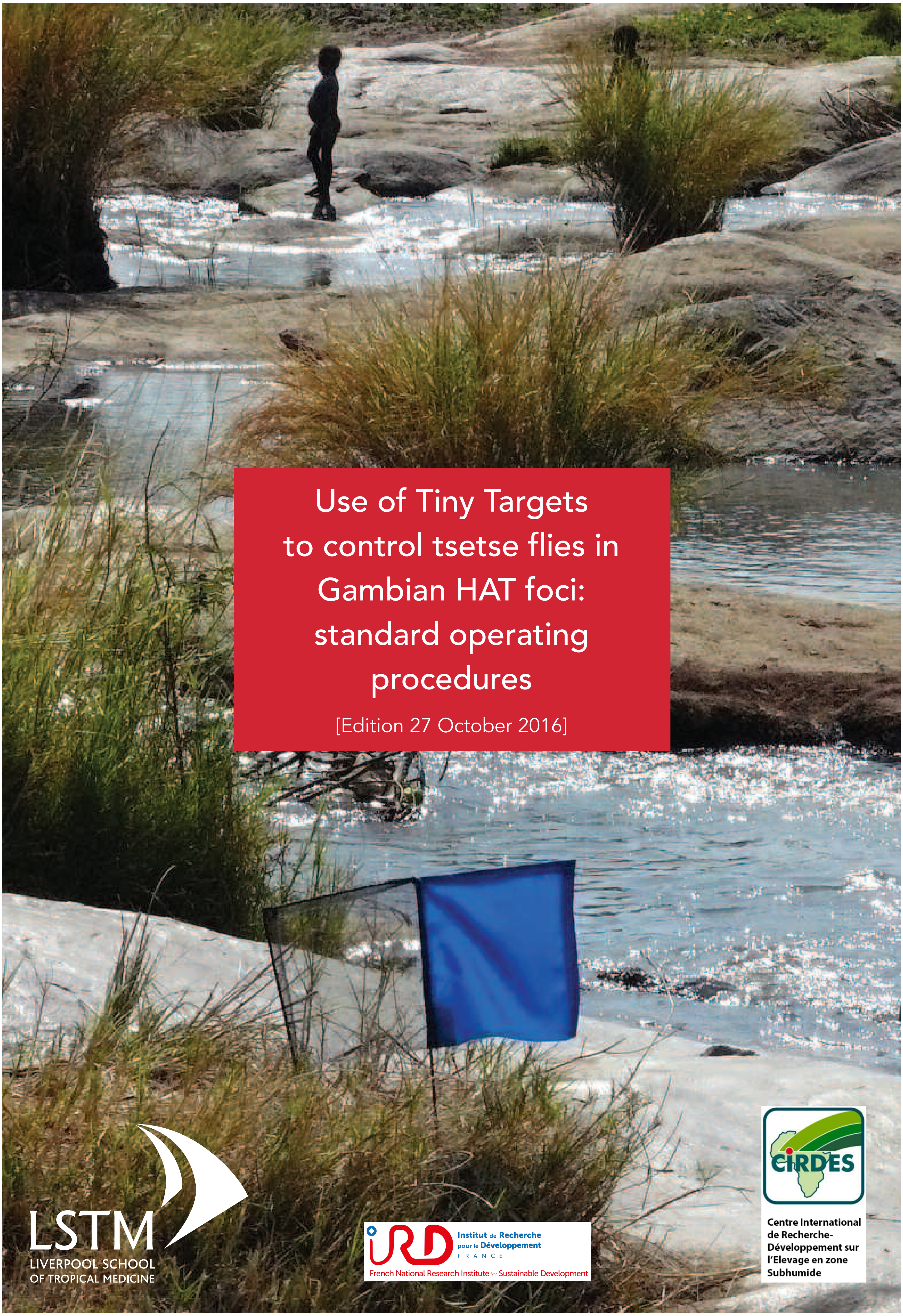

LSTM
LIVERPOOL SCHOOL OF TROPICAL MEDICINE

IRD Institut de Recherche pour le Développement FRANCE
French National Research Institute for Sustainable Development

CIRDES
Centre International de Recherche-Développement sur l'Elevage en zone Subhumide

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ABBREVIATIONS AND DEFINITIONS

CI	Cumulative Incidence
CIRDES	Centre International de Recherche-Développement sur l'Elevage en zone Subhumide (Bobo-Dioulasso, Burkina Faso)
COCTU	Coordinating Office for Control of Trypanosomiasis in Uganda. COCTU coordinates MAAIF and MoH in the control of tsetse and animal/human African trypanosomiasis
DRC	Democratic Republic of the Congo
gHAT	Gambiense Human African Trypanosomiasis
GIS	Geographic Information System. A system designed to capture, store, manipulate, analyse, manage, and present geographical data
GPS	Global Positioning System (satellite-based navigation device)
HAT	Human African Trypanosomiasis or sleeping sickness
HQ	Headquarters
IPR	Institut Pierre Richet (Côte d'Ivoire)
IRD	Institut de recherche pour le développement (Montpellier, France)
IRED	Institut de Recherche en Élevage pour le Développement (Chad)
LSTM	Liverpool School of Tropical Medicine (Liverpool, UK)
PNLTHA	Programme National de Lutte contre la Trypanosomiase Humaine Africaine (Institutions in each of Guinea, Chad, DRC)
PNETHA	Programme National d'Elimination de la Trypanosomiase Humaine Africaine (Côte d'Ivoire)
SOP	Standard Operating Procedure
Target	This is the deltamethrin-impregnated device used for control of tsetse flies
Trap	This is a device for catching tsetse flies enabling them to be counted; itis used in preliminary surveys and also to monitor the effectiveness of control operations

1. Background

Traditionally the control of the Gambian form of Human African Trypanosomiasis (HAT, or sleeping sickness) relied largely on the detection and treatment of human cases. This was because operations to control the tsetse fly vectors of HAT were considered too expensive and difficult to organise in resource-poor settings. In recent years development of insecticide impregnated 'tiny targets' has reduced the cost and difficulty of vector control in gHAT foci. This technology is currently used in several countries to control gHAT by reducing the density of its main tsetse vector, namely Glossina fuscipes (e.g. Uganda, DRC and Chad) and G. palpalis (e.g. Guinea and Côte d'Ivoire).

The aim of vector control in these gHAT settings is not the eradication of tsetse flies. Instead it is the more achievable aim of reducing tsetse densities below the threshold required for transmission of the disease. In other words the objective is to decrease human/tsetse contact. If this can be maintained for a number of years (currently estimated at 4-5 years because of the duration of the disease in humans), while the medical teams are also addressing the human reservoir of trypanosomes, the parasites may disappear from the focus. The times required for operations and their intensity are the subject of ongoing empirical and modelling studies. As things stand the level of vector control required to stop transmission has been independently calculated twice to lie between 60-75% using data from DRC and Uganda. Current control activities in Guinea, Chad, Uganda and DRC show that such levels of vector control are readily achievable. The cost of such operations in Uganda in 2015 has been measured to be US$85 per km2 per year.

The set of standard operating procedures (SOP) described below provides guidance on the steps necessary to carry out a tsetse control operation with tiny targets. It is primarily meant to assist those organising tsetse control operations in discrete gHAT foci varying in size from about 100 to 5,000 km2. Such operations are normally organised in an active gHAT focus (e.g. the Mandoul Region in Chad, Boffa Prefecture in Guinea, West Nile in Uganda, the Marahoué Region in Ivory Coast). The hope is that this set of SOPs will assist in control planning by the national programmes for gHAT control (e.g. PNLTHA in Chad and Guinea, PNETHA in Ivory Coast, COCTU in Uganda, etc.), local governmental institutions (e.g. health districts, district governments, etc.), NGOs or other national or international institutions.

The procedures detailed below refer to the planning of a tsetse control operation in a gHAT focus using the so-called Deltamethrin-impregnated "tiny targets". This SOP follows a general "top-down" strategy at the beginning of the process with the control operation being managed by at least one professional entomologist and carried out with the support of field assistants recruited in the field. Ideally after a given time, involvement of local communities should permit achievements to be sustained. Most of the procedures themselves are also relevant to more community-based interventions.

2. Organisational structure (human resources and responsibilities)

Tiny targets are a very simple and effective technology. However, tsetse control operations are highly demanding and the success of the operation will depend (among other factors) on having in place a suitable management structure. This allows:

- The operation to be financed, planned and managed effectively.
- The effective organisation of field teams and their training.
- Performance of the field work.
- Adequate supervision of the field work.
- Quality control of field operations.
- The compilation and analysis of data and the production of timely reports.
- Acceptance of the tool by the local population, and their involvement in maintaining its effectiveness

In the table below we suggest a generic management structure. This is based on our experience of working with several national control programmes each with a different level of existing expertise and organisational structure. To ensure a successful control programme this management structure should be established before any field activity is initiated. We suggest organising the management structure at three different levels each with the following responsibilities.

Role	Responsibilities
General Management - normally operating within the responsible government ministry (or NGO).	Responsibility for obtaining the finance and the overall organisation of the control programme. To have direct liaison with donor agencies and any technical support team provided by an external agency. Support the area entomologist (ATL) in planning and management of field activities and in preparation of maps and data analysis. Provide the ATL with funds for activities in a timely fashion. Facilitate timely acquisition of equipment outside of the country i.e. traps, targets, GPS units, etc. Primary responsibility for data management and analysis. Participate in supervision and quality control of field activities.
Area Team Leader (ATL) - permanently working in the district containing the gHAT focus. This is a pivotal role in control operations and is the crucial post that is often missing in affected countries. Particular attention needs to be taken in filling this post. We suggest one ATL is responsible for each 500 km^2 to be controlled. External technical experts may need to be recruited in some countries.	Responsibility for: planning and coordinating activities at the local (focus) level. supervision of field activities and quality control. collection of data (entomological, geographical and financial) and its transmission to General Management through submission of weekly reports.ensuring the field team have the required equipment and means of transport and all other technical support required (e.g. paying field team salaries, vehicle maintenance, security management etc.).
Field Team (FT) – locally recruited and often working in the community where they live	Under supervision of an ATL they are responsible for the deployment of traps and targets according to the SOP. They will need training in: (i) use of GPS, (ii) criteria for selecting field sites suitable for deployment of targets or traps, (iii) basic knowledge in entomology (i.e. tsetse identification), and (iv) data recording. They are responsible for informing ATL of materials needed in a timely fashion. They need to be fit and able to deal with the considerable physical demands of the field work. They need to be reliable especially in terms of time keeping and to have the level of literacy and numeracy required to record results and calculate daily catches.

3. Selecting the intervention area

Effective tsetse control operations involve a significant mobilisation of resources both human and material. This fact imposes an important limitation: effective tsetse control cannot be carried out in the whole tsetse belt. Therefore, intervention areas should be selected within the tsetse belt and, since HAT is a focal disease, within the active transmission area of the focus. This will maximise the cost-effectiveness of the operation. With that in mind, we suggest the intervention criteria are defined as follows:

- Budget: The first limitation is budget. Before planning a tsetse control operation, the following questions should be answered: (i) how long is the intervention going to last and how much is it going to cost? (ii) do we have enough budget to treat a whole focus during the planned period?, (iii) if not, how are we planning to obtain the funding? An intervention with insufficient funds is inadvisable. The cost of tsetse control using 'tiny targets' estimated in 2015 at about$85/km^2 per year.

- Intervention period: The objective of the tsetse control intervention is to reduce the vector density below the threshold for gHAT transmission (i.e. to significantly reduce tsetse/human contact). Ideally, operations should remain in place until all risk of reemergence ceases. Considering that the average duration of a gHAT infection is 3-4 years, it is currently estimated that vector control will be required for about five years, if medical activities are conducted at the same time in an efficient way.

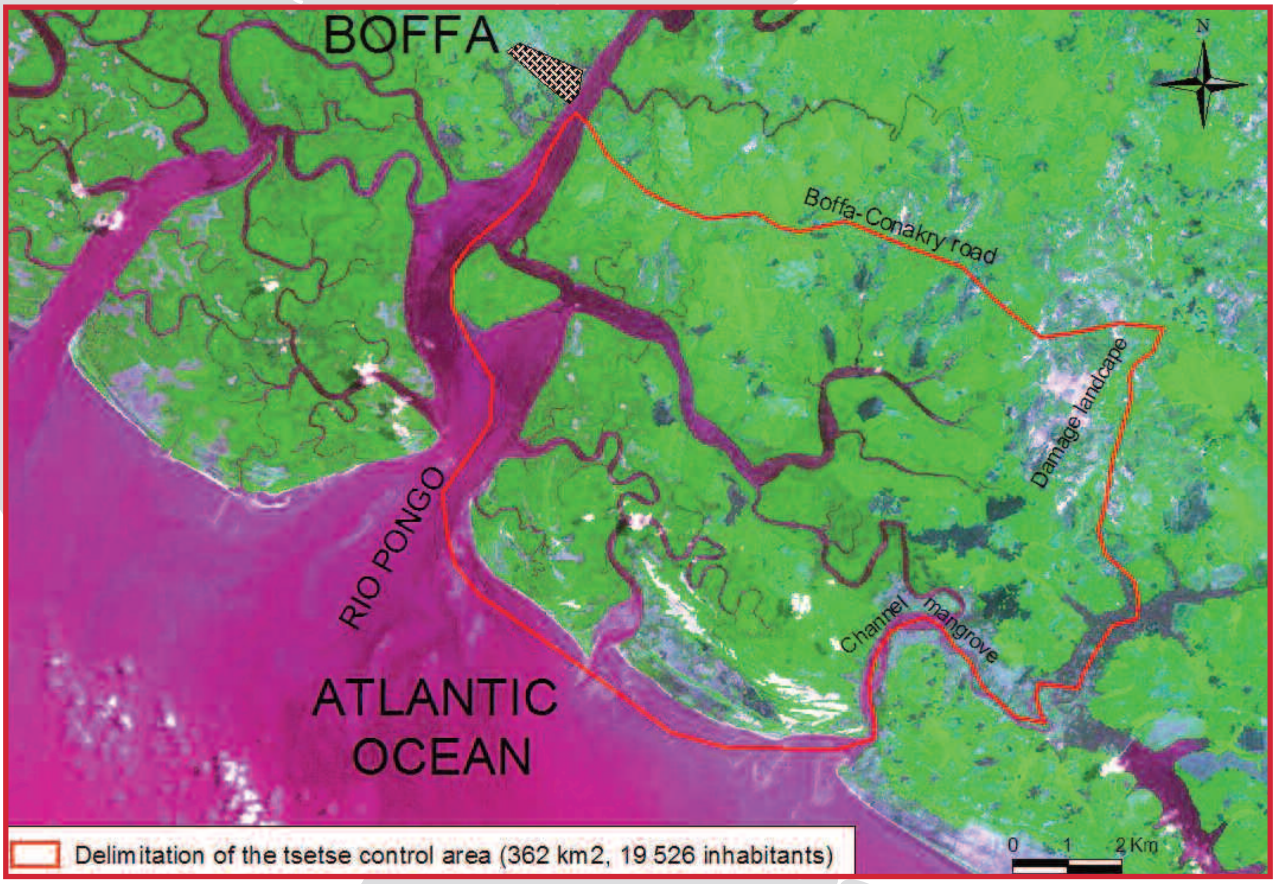
- Epidemiological criteria: Only foci with active gHAT transmission (i.e. there is currently a local population of tsetse flies transmitting trypanosomes which are causing sleeping sickness) should be considered for the vector control intervention. Within these areas, the vector control intervention will be limited to those places suitable for tsetse, which can be identified from a knowledge of the bio-ecology of the tsetse species to be controlled.

- Logistic criteria: Tsetse control operations with tiny targets involve accessing the tsetse habitats. In some circumstances, those habitats may be located far from the roads, waterways or other means of transport, limiting their access. Suitable means of access need to be established.

- Scale: Field trials with tiny targets have shown that interventions in areas smaller than ~50km^2 are not effective because pressure from re-invasion of flies is too high. In our experience, effective control operations with the methods described here can be carried out in regions varying in size from 50 - 5,000 km^2 or more. Ideally, the intervention area should have limited contact with tsetse populations in untreated adjacent areas thereby limiting the risk of re-invasion. Figure 1 shows an example of a good, well delineated control intervention area.

Figure 1: A good, well delineated intervention area bounded by the Atlantic Ocean in South, the Rio Pongo in the West, a main road (Boffa-Conakry) to the North and channel mangrove to the East.

(Boffa, Guinea).

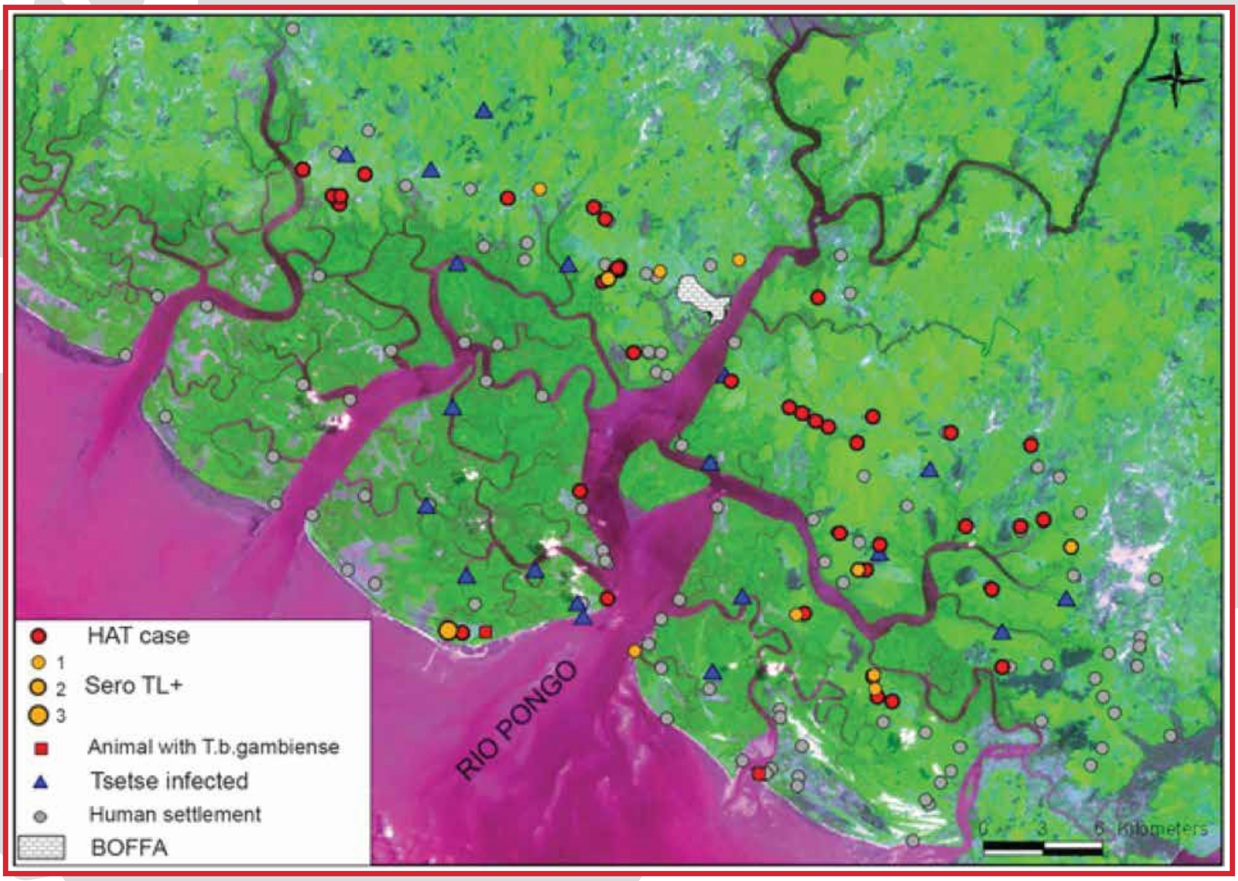


Epidemiological data to select the intervention area

Areas for intervention are those currently suffering from Gambian HAT. Village scale data on HAT incidence is normally available both from the Ministries of Health in individual countries and from W.H.O. Simple large-scale maps for all HAT foci are available from WHO and these can be combined with Google Earth images to produce simple maps of an operational area. More sophisticated maps can be produced using Geographical Information Systems (GIS) to collate data from different public and private sources (habitat, rivers, tsetse species, HAT cases) but this requires specialist knowledge and GIS software.

It should be noted that the W.H.O. maps indicate where the case was diagnosed or where the person lives it does not show where the actual transmission takes place (i.e. people are normally bitten when they access the tsetse habitats, normally located next to water with suitable vegetation). For example, wood cutters living in Conakry contact HAT during their stay in the neighbouring mangrove focus of Dubreka. Consequently planners need some local knowledge when deciding on the limits of the intervention area. However, in the first instance we would suggest being guided by the epidemiological maps and including as many cases of gHAT as possible in the intervention area. An example of plotted epidemiological data is shown in Fig. 2.

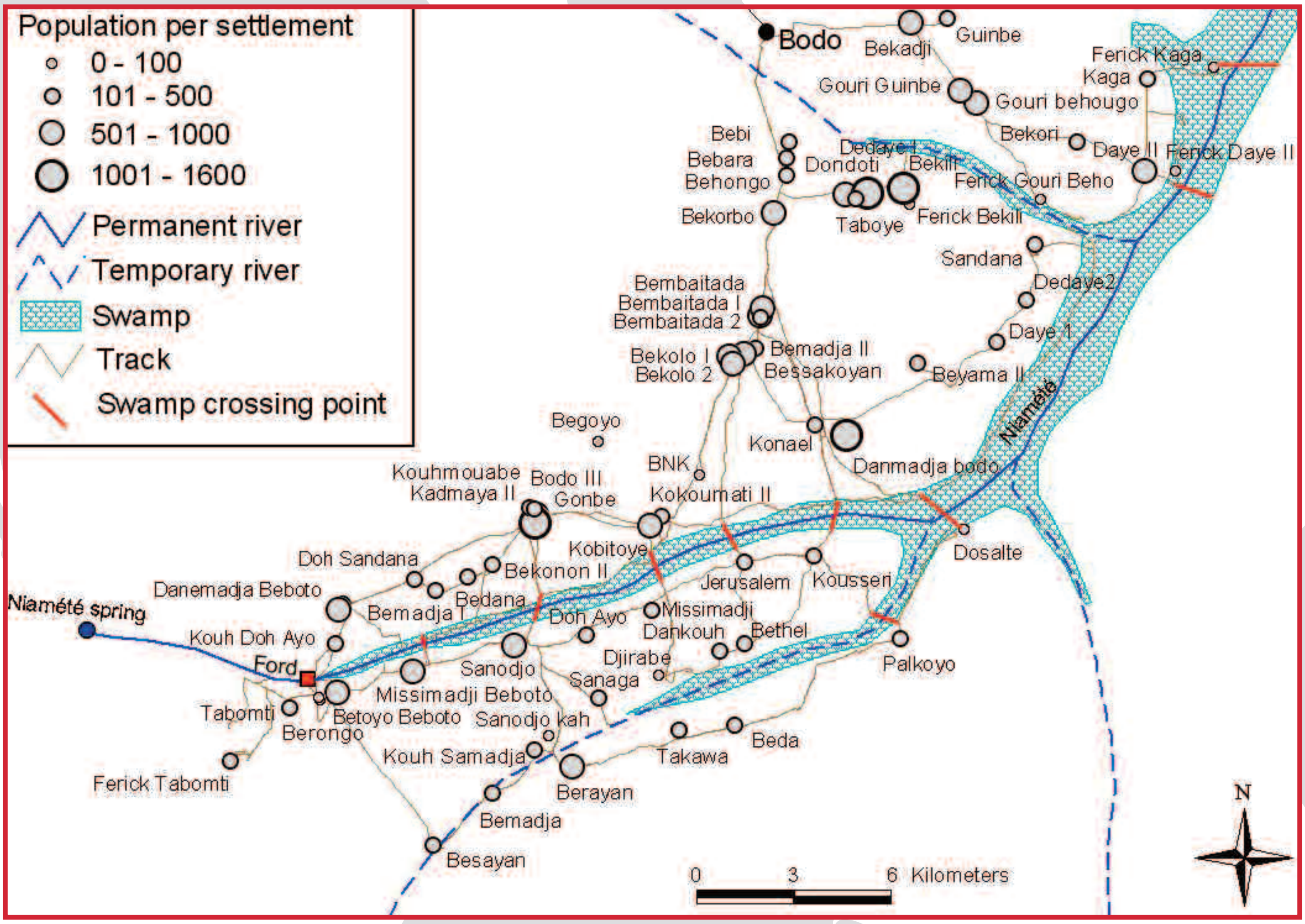
Figure 2: Spatial distribution of trypanosomes in humans, animals and tsetse in the Boffa focus of Guinea in 2012.



Geographical data to select the intervention area

It is essential to map the river systems, tributaries, swamps etc. in the area because tsetse flies that transmit trypanosomes to humans are normally restricted to the regions immediately adjacent to water bodies. Consequently these are the locations for target deployment during control. In addition good maps will help teams determine where people live and how to access the intervention area (Fig. 3). It is also valuable to try to determine sites of maximum human fly contact. Satellite imagery (LANDSAT, SPOT, etc.) can help with this through the identification of crops, fishponds, paths connecting villages, river crossings etc. which are likely to be close to tsetse habitat. Some activities will be difficult to assess with the satellite imagery, and thus remote sensing should be combined with field activities. For example, fishing cannot be detected from the satellite imagery, and only field visits will determine location and extent.

Figure 3: The settlement of Mandoul HAT focus (South, Chad)



Source: IRD/IRED/PNLTHA, 2012.

Entomological data to select the intervention area

A pre-intervention entomological survey is essential and will provide the information on tsetse distribution within the focus. In addition, this "T0" entomological survey will also provide all the baseline data to monitor the success of the control campaign. No control campaign should be started without performing a well-designed T0 survey before deploying the targets. A list of equipment required is given in annex 1. The planning of the pre-intervention entomological survey will depend on the tsetse habitat. For example, in areas crossed by one or a few main waterways only (e.g. Mandoul, Chad), the pre-intervention survey can be organised by testing the apparent density of tsetse at fixed distances along the waterway(s), e.g., every 2 km of swamp bank in this case. In other areas, (e.g. West Nile in Uganda, Côte d'Ivoire, DRC, etc.), tsetse habitat might occupy complex river systems, with many tributaries flowing into the main river systems. Note that some tsetse species (e.g. G. palpalis palpalis) can also be found away from the main river system, including villages, sacred woods, near pig breeding places so all suitable tsetse habitats need to be checked for tsetse presence. In these circumstances, the pre-intervention survey can be organised using 10 x 10 km boxes, henceforth referred to as a "block" (Fig. 4).

The entomological survey in habitats with complex river systems can be planned as follows:

- Select the "blocks" to be tested for the density of tsetse. These should contain a significant number of HAT cases as well as the river courses likely to sustain tsetse or any other habitat likely to harbour tsetse.
- Tsetse density will then be determined in at least 10 different sites in each block – each site being immediately adjacent to a waterway. When the survey in the 10 sites is complete the survey can continue in a different block, until all the blocks in the entire area are surveyed.

Swamps (e.g. Mandoul, Chad) and mangrove forests (e.g. Guinea) represent particular cases of riverine habitat. In these circumstances, the pre-intervention entomological survey will be limited to accessible areas likely to contain tsetse.

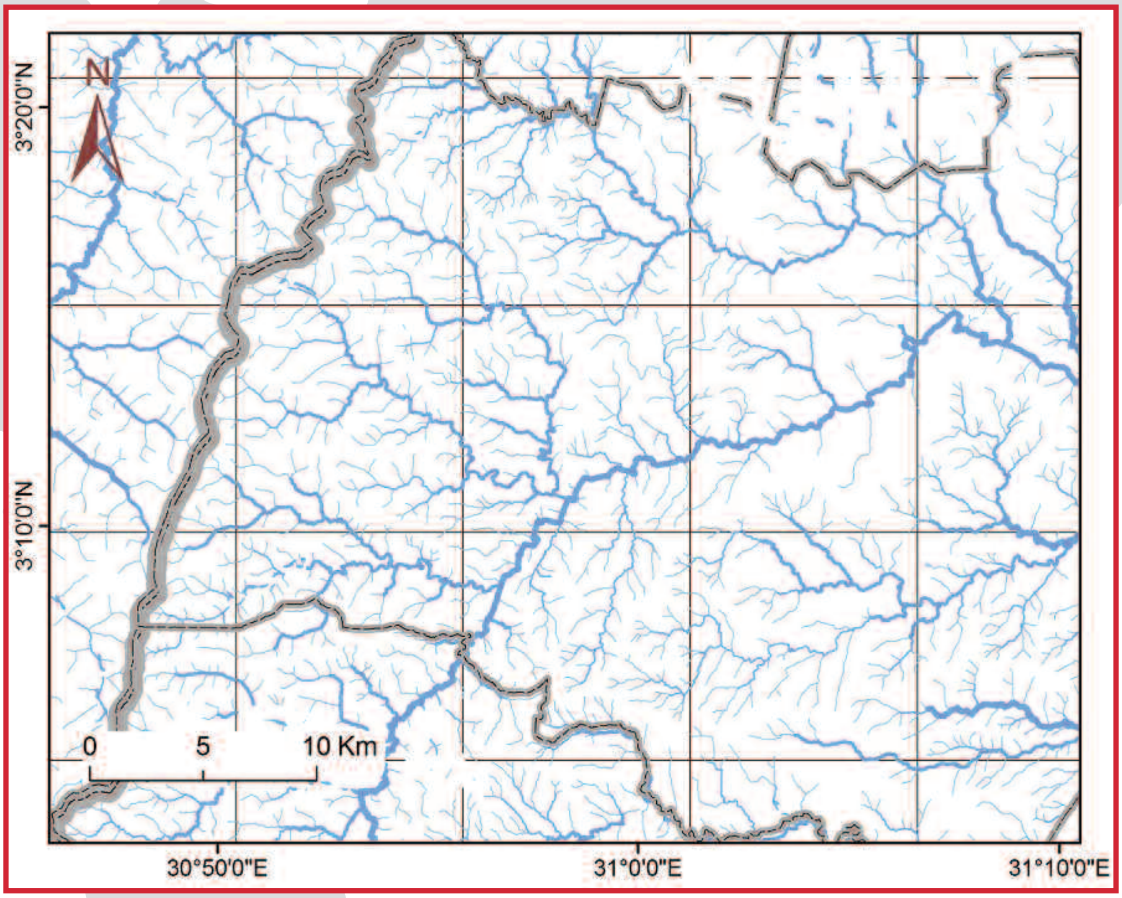
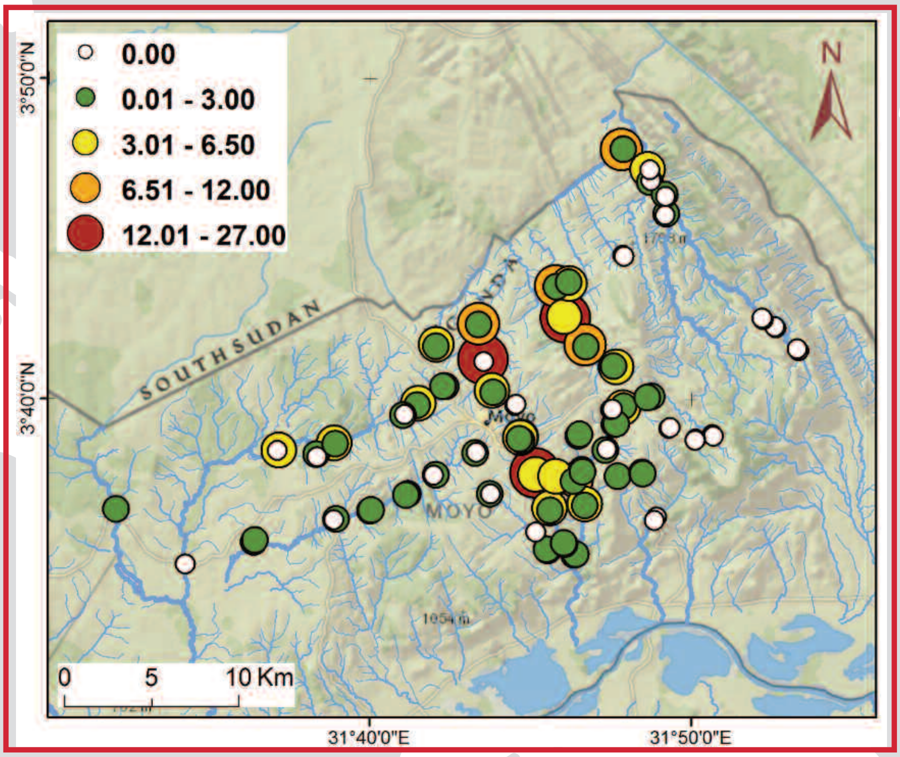


Figure 4. Map of West Nile in Uganda, showing a 10x10 Km grid.

The survey will be carried out using pyramidal, biconical or monoconical traps depending on the tsetse species and the habitat (be consistent and only use one type of trap during the programme to ensure catches are comparable throughout the entire programme). The steps in trap deployment are as follows:

- Approximate locations of trapping sites in the block should be identified before going to the field. This is achieved from the maps already prepared using GIS software, Google Earth or physical maps. Enter the co-ordinates of potential sites in hand held GPS devices. Sites should be inside the block and ideally they should be in accessible locations (near roads or navigable rivers and lakes) and near main rivers where tsetse are likely to be present. All traps should be within 5 km of a road or river and preferably closer. Special attention will be required to select potential sites in the mangrove habitats (e.g. Guinea) where accessibility is likely to be determined by tides – deploy traps above the high water mark.
- The field team will use the pre-marked points in the GPS device to find actual sites. Good sites are close to the water course (1-5 m from the water), with a defined canopy (providing a good habitat) but with some sunlight falling directly on the upper part of the trap (to encourage tsetse to fly up into the cage at the top of the trap).
- The field team will deploy one or two traps in each site, ~100 m apart.
- If using a pyramidal trap it should be hung from a branch, if there is no suitable branch then one can be cut nearby and thrust into the ground. If using monoconical or biconical traps, the support poles will be inserted in the trap and driven into the ground. The lower part of the trap should be 20 cm above ground level.
- Vegetation within 2 m of the trap must be cleared to improve visibility. This will also help prevent ants accessing the trap and eating any caught tsetse.
- For pyramidal traps suspended from a tree branch a 5 cm grease barrier will be spread around the branch before and after the point where the trap hangs; for monoconical and biconical traps the grease should be spread at the base of the pole. Grease helps prevents ants accessing the cage and eating the flies.
- Trap sites will be recorded in the hand held GPS and each trap given a unique code.
- A waterproof label (pencil works well) with the trap code and date will be placed in the trap cage.
- The characteristics of the site will be recorded in a notebook in the field and later transferred into a spreadsheet (see annex 2).
- One day after the deployment (day 2), the field team return to the sites to identify and count tsetse in the cages. After counting the flies, the date on the trap label will be updated and replaced in the cage, the traps are left in place for a further 24 hours. (see annex 3 for a suitable recording sheet)
- The team will again return to the same sites 24 h later (day 3) to count and record fly numbers.
- After the collection on day 3 the catch data for this site will be complete and traps will be removed.
- The field team will move to new sites and repeat the three day catch cycle.
- When the field team has collected the catch data in 10 different sites in one particular block (2 traps per site) it will move to a new block and repeat the sequence.
- Epidemiological and entomological data will serve to define the intervention area. To visualise the data, mean catches should be plotted on a map using suitable software such as ArcGIS or Q-gis (http://www.qgis.org/en/site/) (Fig. 5).

Figure 5. Example of a map showing catch data (flies per trap per day) during a preintervention entomological survey in Moyo, Uganda



4. Sensitization

The main goal of sensitization is to achieve community acceptance of a tsetse control operation. It aims to promote behaviours that will optimize trap and target performance in the field. Sensitization activities must be developed in a culturally sensitive manner and through the use of locally available means of communication. General guidelines on different sensitization techniques and information distribution channels have to be carefully tailored into the local cultural context. Specific strategies will depend on various factors related to the target communities, such as literacy levels, previous exposure to sleeping sickness control operations, religious background and communication channels already introduced by other disease control programs. SOPs therefore only provide some guidelines for potential strategies.

The following steps may be used to organize a sensitization campaign:

1.Liaison with the stakeholders

- Meetings with administrative authorities, village chiefs, religious leaders, representatives of NGOs;
- Introduction of the project objectives and planning of sensitization activities.
- Design sensitization messages with target communities

2. Preliminary assessment

- The maps produced for the operational activities can be used to identify target villages.
- Assessment of information-distribution channels: assessment of the local mass media (radio stations, newspapers, TV); communication with NGOs/national disease control programs on the commonly used sensitization practices; assessment of feasibility to use community and religious leaders through meetings with them; community questionnaire on communication channels that reach them (the most popular radio station, availability of radios in the villages, the pick radio listening times; traditional information distribution practices: such as speeches at the markets, funerals, weddings, etc.)
- Assessment of cultural norms/profile of target communities using communication with organizations working in the area and ethnographic approaches. For instance, analysis of the demographic data (literacy rates, ethnic groups, religion); communications with NGOs/government run disease control programs; informal observations / communication with the local communities (dress code, gender relations).

3. Planning sensitization

- Development of sensitization materials: (any text ideally translated to the local languages; pictures adjusted to the cultural context, designing, printing); An example is given in annex 6.
- Contact with sensitization channels (face-to-face information distribution through sensitization teams; mass media, other institutions: schools, health centres, religious institutions, etc.), development of implementation time-frame, training)
- Implementation could include training of the volunteers for house-to-house sensitization activities, recording of the radio spots, meetings with religious and administrative leaders, distribution of printed materials and mentoring sessions with the community members to transfer knowledge.

4. Monitoring of success

- To assess sustainable community acceptance of tsetse control tools household questionnaires and community based focus group discussions could be held. Feedback from field assistants and district entomologists on the condition of targets, cases of vandalism or cases of protective behaviour are useful indicators; systematic recording is recommended.

5.Evaluation

- If low acceptance of the program occurs (for instance: cases of vandalism, rumours associated with tsetse control tools) this needs to be assessed. Communication with the beneficiary community and leaders is recommended to improve the understanding of the situation.

Indicators of success

Below are some suggested indicators of effective sensitization campaign:

i) Community knowledge on the link between vector and the disease.
ii) No occurrence of community members vandalizing tsetse control tools.
iii) An average person knows the purpose of traps and targets and is able to explain how they work.
iv) Incidences of community members "protecting" the targets (e.g. replacing broken parts, raising them up if they have fallen).
v) Other communities in the neighbourhood requesting a tsetse control operation.
vi) General community satisfaction with the program.

Training

Training the field team now focuses on target deployment requirements, GPS device use and data recording. We would suggest the following to ensure the competency of the field team:

- <u>A two-day training workshop for field team candidates.</u> This work should be organised by a trained person already familiar with the techniques. It could be a member of Central management or an ATL or may need the use of external advisors. We suggest that these trainers use this SOP as the basis of the training course.

- <u>Recruitment of field team.</u> Start the programme with an excess of candidates. The performance of the participants in the training workshop can then be used to select the best candidates. Candidates that do not make selection to be part of the team can be kept as reserves. The number of people in the field team should be enough to cover the whole area to be controlled in about a month. Depending on experience and distance to travel to starting points each day, each member can deploy ~20-30 targets per day (completing 2-3 km of river bank for example).

- <u>Guidance and follow-up.</u> At the beginning of the operations, trainers should accompany the FT in the field. During these visits, the FT will be guided to ensure standardisation of the procedures discussed during the training workshop.

- <u>Training for CE.</u> Should it be required an external advisor should be used to run a training workshop for the ATL and Central management team paying special attention to data management, data analysis and report writing, financial reporting and logistics including procedures for ordering, importing and distributing targets and traps.

Preparations for the control operation

- The entomological survey will allow the team to decide which areas are to be covered in the control operation. The team will then know how many targets are required and the size of the team necessary to deliver them efficiently. So the full costs of the operation can be estimated at this stage.
- To ensure they arrive in good time it is necessary to order targets at least six months before the start of deployment. Targets are available from Vestergaard Frandsen (Switzerland). As a rough guide we have respectively used ~4,000, ~2,600 and ~2,800 targets to cover 320, 520 and 500 km2 per deployment in the mangrove of Guinea, the swamps of Chad and the riverine habitat of Uganda. Deployments are usually once or twice per yearat the beginning of a dry season.
- In Central and East Africa the 0.5 x 0.25 m black/blue target-design are used to control G. fuscipes. Each of these targets requires 2 to 4 wooden sticks, depending on whether it will be driven into the ground (4 sticks) or hung from surrounding branches (2 sticks). Sticks are used as the frame to maintain the shape of the targets. Sticks of 80 cm length with a diameter of 1.5-2 cm, should be collected locally 2-3 months prior to deployment, to allow them to dry properly.
- In East and Central Africa only, targets can be prepared by gluing the upright sticks into position (this is to avoid the cloth from slipping off in the field). This should be done one month before deployment starts. Prepared targets are then packed into bundles of 25 each (Fig. 6)

Figure 6: Target preparation: gluing the upright sticks into position, laying targets out to dry and packed in bundles ready for use.

- The target-design used in West Africa against G. palpalis is slightly larger (black/blue/black, 0.75 x 0.50 m). Two wooden sticks of approximatively 85 - 90cm in length and of 2-3cm diameter (in Guinea bamboo is used) are used as frames. The target is thereafter hung from surrounding branches, or driven into the ground, using two other sticks.
- The full equipment list for each field team member is given and illustrated in annex 1 and Figure 7. Adequate time should be allocated for the purchase and preparation of this equipment.

Equipment for deployment
Slasher & Panga
GPS & Batteries
Gumboots & Overall
Notebook & Pen & Markerpen
Targets for Planting
Horizontal Sticks
Targets for Hanging
String

Figure 7: Equipment for tiny target deployment per man per day.

Deployment

The details of assembly and use of tiny targets and traps are described in Annex 7. Tsetse fly control with targets is done as early in the dry season as possible. It usually commences when the vegetation (and therefore good tsetse habitat) becomes restricted to areas very close to the rivers. This concentrates flies in these areas and maximises the killing efficiency of the targets. Efficient logistics are the key to efficient deployment, and so careful planning is required.

- Consider which areas to start with, how many people will be needed, which access routes to use, how much is expected of each person/team depending on geography, where are convenient points to drop the targets, etc.
- Divide the field team into smaller groups to cover as much area as possible.
- Use hard maps or Google Earth imagery of the areas and plan logistics for easy access and target supplies to the field team. Deliver and store adequate numbers of targets at pre-selected depots (e.g. store or clinic) in each area, so that the field teams can continue independently

The deployment will vary slightly depending on the type of habitat:

Linear riverine habitat (e.g. NW Uganda, northern Côte d'Ivoire, etc.) Targets should be placed as close to the river edge as possible (remember flies are often only found within 4-5 meters of the river itself). But also consider loss of targets to flooding. Placement of targets is a compromise between these two factors. Slash the surrounding vegetation to 1.5m radius around the target to make sure the target is visible all the way to the river. Ideally, targets should be partially shaded by the vegetation canopy and have good visibility for 10-100m in two or more directions. Sites should be easily accessible but that is not always possible in which case considerable fortitude may be needed from the field team to place targets successfully. Some places may seem ideal for target placement, such as river crossing points, or where people and animals move. But heavy losses of targets may occur at such sites. If these sites are used targets need to be carefully positioned or they will be knocked over and become ineffective very quickly. Record the GPS position and target number on the GPS device and in the notebook. Also record the date and site condition in the notebook for later transfer to the datasheet. Sites are marked with unique numbers. Each GPS device is named and labelled with a letter (A, B, C, etc.) and the name of each target site starts with the corresponding GPS device number. This letter is followed by a four digit number, named consecutively as targets are deployed, e.g. A0001, A0002, etc. If the river is 5 m wide or more then targets should be deployed 100m apart on each bank in a staggered fashion. If the river/stream is less than 5 m wide, deploy on one side only, every 50 m (see Fig. 8).

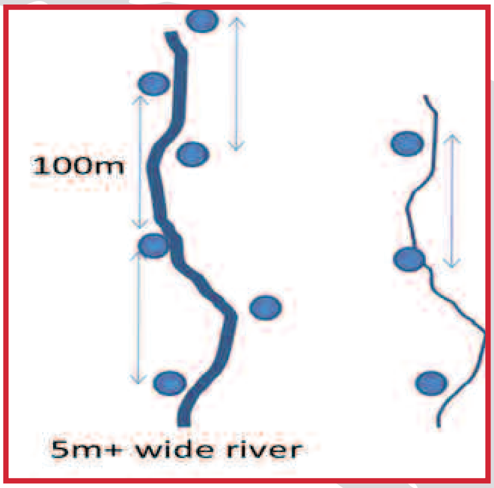


Figure 8: Deployment of targets in riverine habitats. Blue irregular lines represent the course of the river; on the left, river 5 m wide; on the right river <5 m wide.

Deploy the target, ensuring the sticks are inserted firmly into the soil. If the target is hung from a branch, ensure it is low enough to the ground (bottom edge no more than 20-40cm above the ground). Label the target with indelible black marker pen in the top right corner of the blue material, using the same recorded letter and number as on the GPS device. In West Africa where G. palpalis is the vector of HAT, targets are baited with synthetic odours. One sachet containing 2 ml of octenol and para-cresol (1:2) should be placed in the inbuilt pocket which is provided in the target.

Inaccessible swamps (e.g. South Chad). In some areas tsetse occupy swamps which can be inaccessible. Those in the Mandoul focus of Chad are several hundred metres wide and inaccessible. We have achieved good control there by deploying targets every 20 m around the entire edge of the swamp but not in the swamp itself.

For all locations data is recorded in the field notebooks in such a way that it can be accurately transferred to the data sheets given in annex 3. The GPS data will be gathered at regular intervals by the ATL and transmitted to General Management for analysis. Summaries of target deployment progress and conditions will be made by the ATL from the field notebooks and GPS devices as required.

Target maintenance

Routine target maintenance may be required to replace lost or damaged targets. The same procedure is followed as for target deployment, i.e. slashing and redeployment or fixing of sites and recording. Proper record keeping of these activities are needed to highlight problem areas, such as poor initial site clearing, areas prone to flashfloods etc. Make sure there are enough targets and sticks available to compensate for losses.

Quality control

Regular field inspections are needed from the ATL to ensure that targets are deployed correctly and are still in position. In addition unannounced inspections in the field should be carried out by the ATL or general management on a regular basis. Tiny targets have an expected lifespan (target in good upright position) of 4-16 weeks once deployed with about 50% still in an upright at 6 months (to date this has only been rigorously assessed in West Nile, Uganda). This loss rate has not impaired the success of the programme in West Nile. Insecticidal activity tapers off after 6 so that ideally targets are deployed twice a year.

6. Monitoring and Evaluation

An entomological evaluation is used to assess the impact of tsetse control. Baseline entomological data should be obtained before the intervention starts (as described above) and monitoring could usefully continue for at least 12 months after the intervention ends. Sites for the entomological evaluation are fixed and are known as sentinel sites. At each sentinel site, the catch from traps are used to measure the apparent density of tsetse (ie, the average number of tsetse caught per day). The impact of the intervention is assessed by analysing the changes in tsetse density before, during and after the intervention.

The criteria used to select entomological evaluation (sentinel) sites are:

- Sentinel sites should be evenly distributed across the intervention area.
- 10-20 Sentinel sites will be pre-selected in total. These should be inside the intervention area, around the edge of the intervention area and outside the intervention area (>2km from the edge of the intervention). These latter, uncontrolled, sites give the baseline against which the effect of tiny targets can be measured.
- The pre-intervention survey will identify sites with high catches and these are ideal as sentinel sites.

- The GPS devices will be used in the field to find the pre-selected sites, and their suitability will be validated during the first visit to the field. If necessary, and according to accessibility and habitat, trap locations should be amended. Two traps should be deployed at each site, 100 m apart.
- We suggest trap locations are given unique names made up of two capital letters (i.e. to identify the administrative area) followed by a two-digit number.

Trap deployment during the entomological evaluation will follow the steps described above for the entomological evaluation in selecting the intervention area. Annex 4 shows a suitable data recording sheet. After three days, traps will be moved to other sites, so all the sentinel sites will be completed in the required period of time (see below).

Ideally the entomological evaluation should start at least 3 months prior to tiny target deployment.

During the first three months all the sites should be visited monthly (by ATL or General Management). We would recommend quarterly visits thereafter (by the area ATL or field team). Entomological evaluation needs to continue throughout the period of control activities.

To ensure good quality control we suggest members of the General Management should perform announced and unannounced visits to the field to supervise the activities and to perform their own entomological evaluations at exactly the same sites using the same methods as above.

Health and safety issues are addressed in annex 5.

7. Further reading

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Annex 1

Field equipment check list.

It is the responsibility of the ATL to ensure that the equipment is provided before the field activities start. The general management need to ensure that the ATL has enough funds to purchase those items that can be found locally. The general management will arrange for the importation and distribution of traps and targets in a timely fashion.

	Item	Acquired by	Check
1.	Batteries (AA)	ATL	
2.	Field-books	ATL	
3.	GPS devices	General management	
4.	Grease	ATL	
5.	Machetes (pangas) and Slashers	ATL	
6.	Pens	ATL	
7.	Rucksacks	ATL	
8.	Safety gear	ATL	
9.	Traps	General management	
10.	Targets	General management	
11.	String for hanging targets	ATL	

Annex 2: Example form to record site characteristics

RECNUM	CODE	Zone	Latitude	Longitude	ALT	RIVER NAME	DISTRICT	SUB-COUNTY	PARISH	VILLAGE	Remarks
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											

Annex 3: Example form to record tsetse captures during pre-intervention survey

Ref	Site	Longitude	Latitude	DATE_SETUP	DATE_COLLECT	Operation	#Days	Males	Females	Unknown	Total	Remarks
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												

Annex 4: Example form to record tsetse captures during entomological monitoring.

This form includes a field to indicate the relative position of the site within the intervention area (e.g., Centre, West Edge, etc.) and another field to indicate if the site is located inside or outside the limits of the intervention area

Ref	Site Id	In/Out Interv.	Relative position	Latitude	Longitude	Date Set	Date Collect	Num. Days	Males	Males	Femal.	Unkn.	Total	Remarks

Annex 5

Health and Safety

Field activities described in this document imply spending long hours operating along rivers where tsetse flies live and where HAT transmission is active. Vaccines or prophylactic treatments for HAT are not available, and physical barriers against tsetse bites are the only possible protection in endemic areas. Also, there are other epidemiological, biological, and physical risks associated with the environment. In fact, other vector borne diseases can also occur in these same habitats. In addition there are biological hazards include animals (i.e., snakes, crocodiles, hippopotamus, bees, wasps etc.) and thorny or urticating plants. Physical hazards such as floods or high water flow in the rivers, steep slopes, mud of mangroves etc. should be considered in some habitats. In case of accident, traditional medicine is not recommended. Special attention should be paid to country borders (e.g. in Uganda the country borders with DRC and South Sudan, in Chad with CAR) or other conflict prone areas; these areas should be avoided. Recommended measures to reduce the risks in the field include:

- Wear protective gear (i.e. overall, wellington/gum boots, hat, etc.).
- Snake antivenom serum and kit for injection should be available
- Make sure that the country management knows where the field team is going to be working at all times.
- Bring mobile phones to the field (ideally with different networks); in areas with poor phone network, the use of radios or satellite phone can be considered.
- Ensure that mobile phones are fully charged and with enough credit/airtime to make an emergency call.

- Wear protective gear (i.e. overall, wellington/gum boots, hat, etc.).
- Ensure that everybody involved in the programme has the relevant phone numbers recorded in the phones.
- Identify the closest village where help could be found in case of necessity.
- In case of accident, inform the CE and seek medical care.
- Bring enough portable water.
- Avoid conflict prone areas.
- Avoid steep slopes as much as possible.

Activities in some countries may occur in or on the water (e.g. rivers, lakes, swamps, mangroves etc.). Whenever that is the case, members of the field team should be able to swim, and wear lifejackets.Sub-Saharan Africa accounts for the highest regional road traffic death rate in the world. The use of vehicles will require a protocol to minimise the risk, including:

- Candidate drivers should provide a legal driving licence before being hired. Knowledge in basic mechanics would be highly recommended.
- The driver will be responsible to fill the car logbook. A logbook should be in the car at all times.
- The driver is requested to drive at a moderate speed, suitable to the traffic density, presence of pedestrians and animals, road conditions, weather, etc.
- Vehicles should have a valid full coverage insurance policy.
- Alcohol in the workplace will be strictly forbidden.
- Before each trip, the driver will make sure that the vehicle is in good condition, repair tools are in the car, the tanks contain enough fuel, and there is enough cooling water and engine oil.
- Driving in the dark (e.g. between 18h and 06h) should be avoided.
- Seat belts should always be used.
- Exceptionally, passengers not directly involved in the project may be granted permission to travel in the car. In that case, the driver will ask them to sign a consent, renouncing any compensation (other than the legally statutory accepted by the insurance policy) in case of accident.

Fieldwork is often very difficult and tiring. Availability of food, water, dry cloths and appropriate accommodation should be secured. A basic first aid kit is advisable.

Annex 7

Tsetse fly monitoring and control.

A quick manual for assembly and use of a trap and tiny target.

Figure 1.
A Tiny target (left) for killing tsetse flies and a Pyramidal trap (right) for the capture of tsetse flies.

1. Tsetse fly monitoring: How to assemble and use a Pyramidal trap for capturing tsetse.
Traps should be placed in good tsetse habitat close to water and visited regularly (every 24 to 48 hours) to collect and remove flies. Each trap samples an area of about 50m radius, so traps can be placed 100m apart. Remember, these traps are not treated with insecticide and are only used to capture flies for monitoring purposes.

Step 1.
Each trap requires wooden sticks for assembly. Cut two sticks which are long enough to reach across the width of the trap.

Step 2.

Place the first stick through the open part in the centre of the trap, and insert the point into the corner pocket.

Step 3.

Place the other end of the stick into the opposite corner pocket so that the trap is stretched out.

Step 4.

Insert the 2nd stick into the other two corner pockets, so that the trap is stretched open by the crossing sticks.

Step 5.

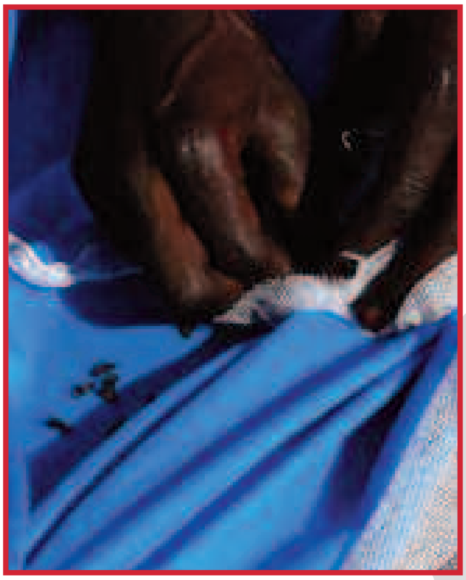
Tie the trap to a branch or stick in good tsetse habitat with the bottom of the trap about 30cm above the ground or water surface.

Step 6.

Close the collection cage inside the white netting with a small knot (ensuring you can untie it later). This is where flies will be collected.

Step 7.

Undertake regular monitoring of the trap every 24 hours and record the position (GPS), date and number of flies caught. To remove the flies, place the trap flat on the ground and open the collection cage. Flies will die due to exposure to the sun and dehydration. If there are still live flies in the cage, gently squeeze the flies' thorax (chest) between thumb and index finger, which will crush the flight muscles so that the fly can be handled easily. Record the data and replace the trap.



Sometimes ants may climb into the trap collection cage and remove flies. To avoid this, place some grease or Vaseline around the branch on which the trap is tied.

Tsetse fly control: How to assemble and use a Tiny target for killing tsetse.

Tiny targets are designed for deployment at regular intervals of 50m to 100m in areas where the tsetse flies are present and can locate the targets, e.g. along river banks, edges of swamps or lakes and areas where tsetse hosts are present, e.g. paths and drinking places. These targets remain active in killing tsetse flies for up to 6 months, but it is necessary to keep the area around them cleared of vegetation and ensure that the targets remain upright, so that the tsetse flies can find them.

Step 1.

Each target requires 4 sticks. Two strong sticks to use for uprights and two smaller sticks for horizontal supports.

Step 2.

Insert the strong sticks into the seams along the edges of the target..

Step 3.

Insert the smaller sticks into the top and bottom loops and corners.

Step 4.

Plant the target upright, firmly pushing the sticks into the soil. The target should face the water, and the area around it cleared of vegetation that may obscure the target. Deploy targets every 50m – 100m along the edge of the river or swamp.

In areas with many trees, targets can also be hung from branches. Make sure the bottom of the target is not higher than 50cm from the ground level.

Related publications

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