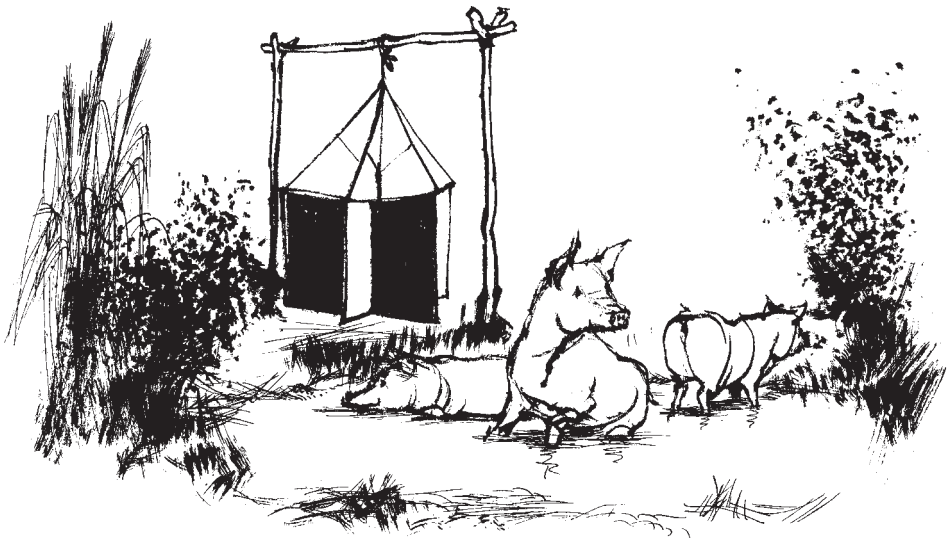

Fig. 2.16
Flies are attracted to domestic animals and can be caught by a trap near the site where the animals are kept.

Villages surrounded by forest

Tsetse flies rest in the vegetation surrounding villages and attack people and domestic animals near the forest edge at swampy areas, sources of water, water standposts, toilets, bathing places and so on. Around villages, traps should be used rather than screens, and should be placed where the tsetse flies are likely to attack (Figs. 2.15 and 2.16). Traps with a collection bag will allow the villagers to evaluate the effectiveness of control efforts.

Routes and paths along a forest edge

Tsetse flies often attack people on paths along a forest edge. Screens can be used because they can be easily re-impregnated when placed along a path. They should be placed at right angles to the path to be easily visible to flies flying along the path (Fig. 2.17).

Plantations

Tsetse flies also attack people working in their gardens and on coffee or cacao plantations. They can be protected by traps or screens placed along the boundaries of plantations and forests (Fig. 2.18). Screens are preferable to traps in plantations because the necessary large numbers are more affordable and there is no problem of access for re-impregnation.

Water collection points in forested areas

Water is collected not only from rivers and streams but also from isolated wells, pools, pits and ponds. When such places are in a forest environment they provide a favourable habitat for the tsetse fly. One or two screens or traps should be installed near these points (Fig. 2.19).

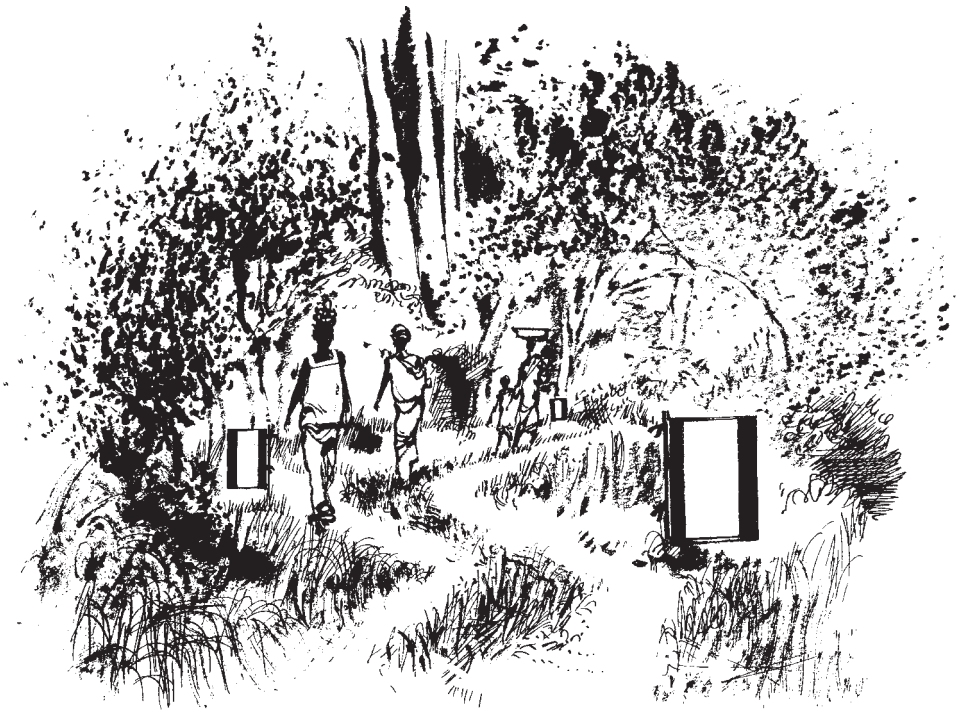

Fig. 2.17
Screens should be placed along forest paths at intervals of 200 m.

Fig. 2.18
People working in gardens and on plantations can be protected by traps or screens placed near forest edges and along trails inside plantations.

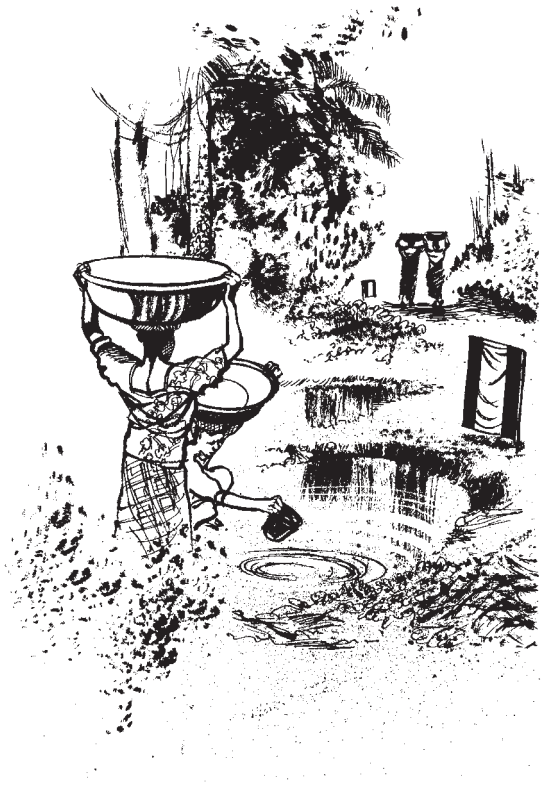

Fig. 2.19
Tsetse flies often attack people near water collection points surrounded by dense vegetation.

Maintenance

It is important to clear the area surrounding traps and screens of emerging vegetation to allow clear visibility for the flies (Fig. 2.20). Where vegetation grows rapidly, frequent clearing is needed. Lost traps or screens have to be replaced; those that become torn or damaged have to be repaired.

Re-impregnation

After the initial impregnation, screens have to be re-impregnated every 3–4 months or so. Since traps continue to function after the insecticide has lost its effect, re-impregnation may not be necessary. Traps often last 6–10 months. Screens may last up to two years, and are impregnated several times before being replaced. Old traps should be replaced by new and freshly impregnated traps after a period of, for example, eight months. In areas where the tsetse fly problem is limited to one season the traps or screens should be installed or re-impregnated at the beginning of the season.

Assembly

Materials needed (*8*)

Blue cloth

Blue cloth made of 33% cotton and 67% polyester, of about 200 g/m^2, is recommended. This material is very resistant to wear. All blue colours will work to some

Fig. 2.20
Vegetation has to be cleared from the site of the trap in order to maintain good visibility for tsetse flies.

extent but best results are obtained with electric or royal blue. A cheaper but probably less effective alternative is plastic sheeting of the same colour.

Black cloth

The best type of black cloth for application of insecticide is 100% nylon sheeting of about 44 g/m^2.

Mosquito netting

The netting used in traps has to be of good quality, because it supports the whole structure. Synthetic materials are generally stronger and cheaper than cotton and are also preferable for impregnation. The best material is 100% nylon netting of about 30 g/m^2, which lasts longer than 100% polyester netting when exposed to the sun. A suitable durable alternative which can easily be obtained at local markets is the fabric used for making pockets in trousers.

Capture bag

Capture bags are made of mosquito netting.

The pyramidal trap (Fig. 2.21)[1]

- Cut two blue and two black pieces of sheeting with the dimensions shown in Fig. 2.21a.
- Cut four strips of cloth measuring 60 × 5 cm (b).

[1] Based on a model used in Uganda in 1989 by J. Lancien.

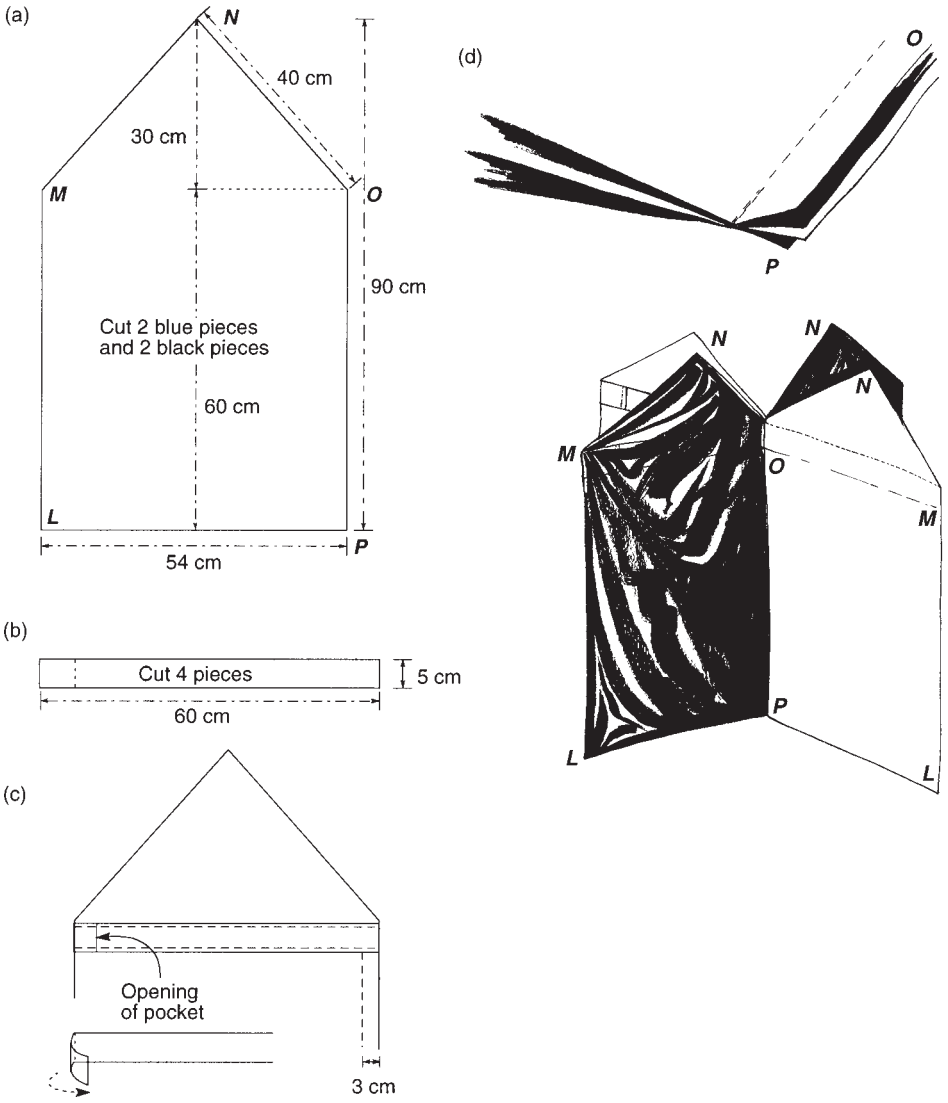

Fig. 2.21
Assembly of a pyramidal trap.

- Sew the four strips to the four pieces of sheeting as indicated. Fold back the extra 6 cm and stitch to form a pocket with the opening facing the middle of the piece of sheeting (c).
- Place the pieces on top of each other in alternate colours: black, blue, black, blue. Stitch the pieces together 3 cm from the edge opposite the pockets (d).
- Cut out the netting material in one piece with the dimensions shown in Fig. 2.21e, and mark the points A, B, C and D (shown as * in the drawing).
- Stitch a seam of 2 cm in the lower edge of the pyramid and close it by stitching side TV against side TU (f). Attach a 1–2 m strip of cloth or a string

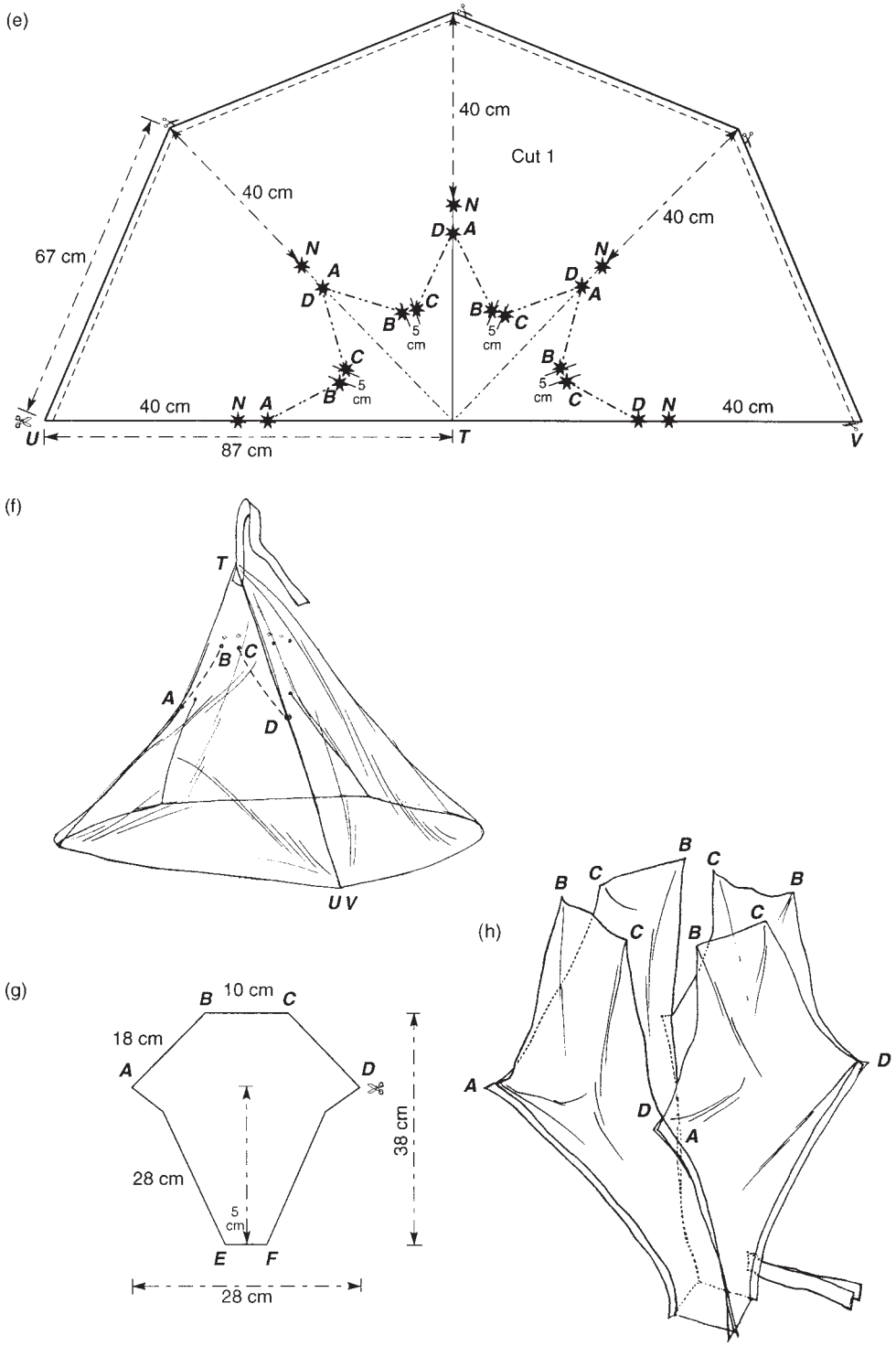

Fig. 2.21 (*continued*)

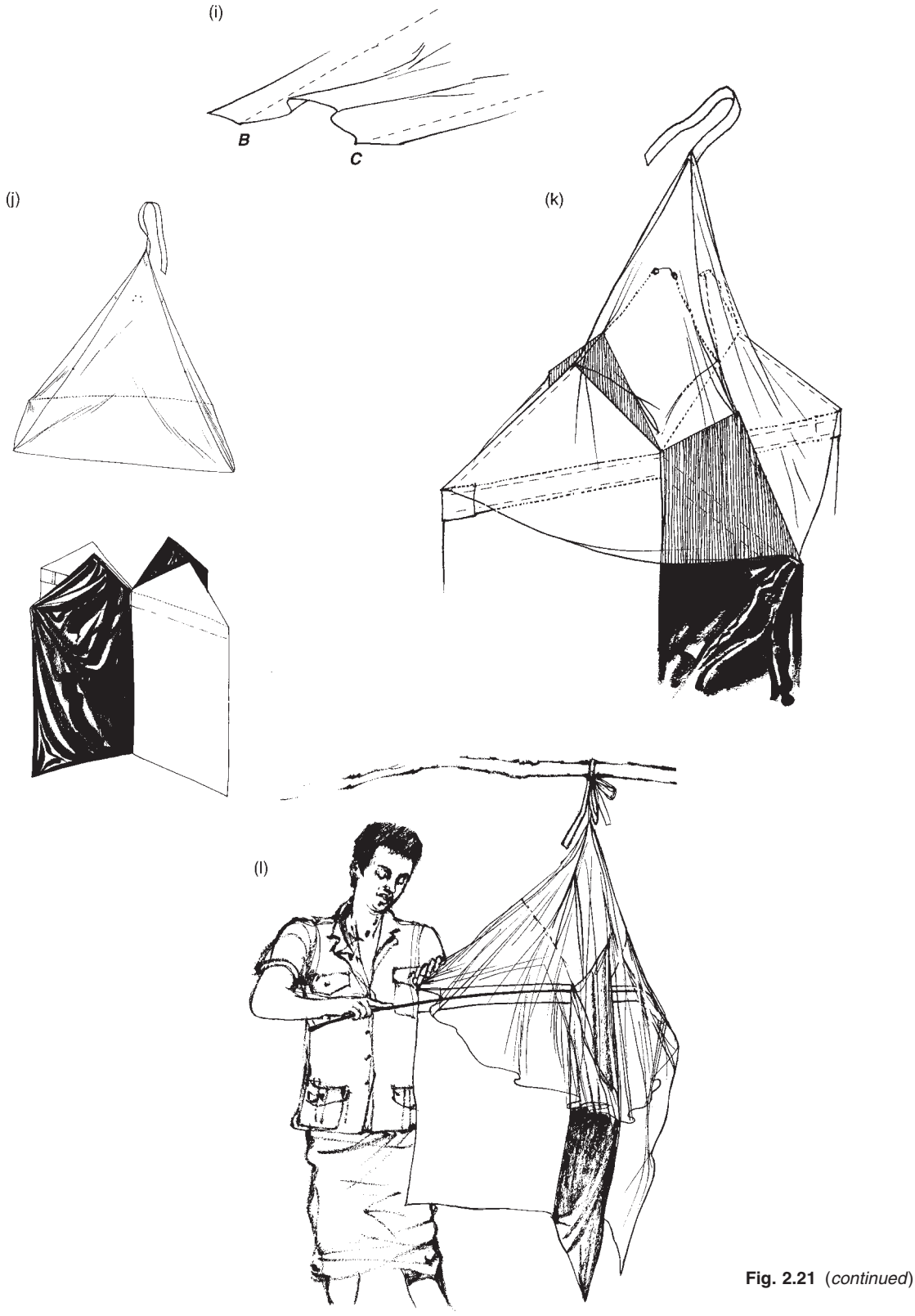

Fig. 2.21 (*continued*)

to the top of the pyramid. (The strip is for attaching the trap to a support in the field.)

- Cut four pieces of mosquito netting material with the dimensions shown in Fig. 2.21g.
- Stitch the four pieces together along lines BE and DF. Attach a thin strip of cloth or a string near opening EF (h). This strip can later be used to close the bag.
- Attach the catching bag to the pyramid of mosquito netting. Stitch the bag with sides AB and CD to the corresponding lines (Fig. 2.21e) on the pyramid. Make sure that an opening is formed between A and C (Fig. 2.21i). (This allows tsetse flies to enter.)
- Attach the pyramid to the blue and black pieces (j). Fold the pyramid and place it over the four pieces of fabric as shown (k). Stitch the netting to sides OP of the pieces of fabric.
- The trap is given its final shape in the field after suspending it from a suitable support. The four sides are expanded by inserting two flexible sticks or laths measuring about 120 cm in length in the four pockets on the blue and black pieces (l). The two sticks cross each other at right angles and expand the two pieces of the same colour. In order to be able to insert a stick in the second pocket a hole has to be pierced in one of the pieces at right angles to it.

The Vavoua trap (Fig. 2.22)[1]

- Cut out three pieces of black and three pieces of blue material with the dimensions shown in Fig. 2.22a and mark points A, B, C and D on the black pieces.
- Put one black piece on top of another and stitch along line AB.
- Fold the upper piece along line AB and put the third piece on top. Stitch along line CD.
- Stitch pieces 2 and 3 together along line CD on piece 2 and line AB on piece 3 (b).
- Stitch the three blue pieces to the three black pieces as shown in Fig. 2.22c. Allow a seam of 1 cm. Make a seam on the lower edge of each of the three black-blue parts.
- Cut out three pieces of mosquito netting with the dimensions shown in Fig. 2.22d. Join the three pieces together in the shape of a cone and attach the cone to the black-blue material by stitching lines EF on the cone to lines GH on the blue material (e).
- Take a piece of metal wire measuring 250 cm in length, bend it to form a circle with a diameter of 80 cm, and twist or solder the ends together. Fold the edge of the netting cone over the wire hoop, pin in place and stitch a hem around the wire (e).
- The trap can be put up in the field by inserting a metal rod 150 cm long and 1 cm in diameter in the tube of material in the middle of the black screens. Place a ball of cotton in the top of the cone to prevent the metal rod piercing the cone (e).

[1] Based on a model used in Côte d'Ivoire by Dr C. Laveissière.

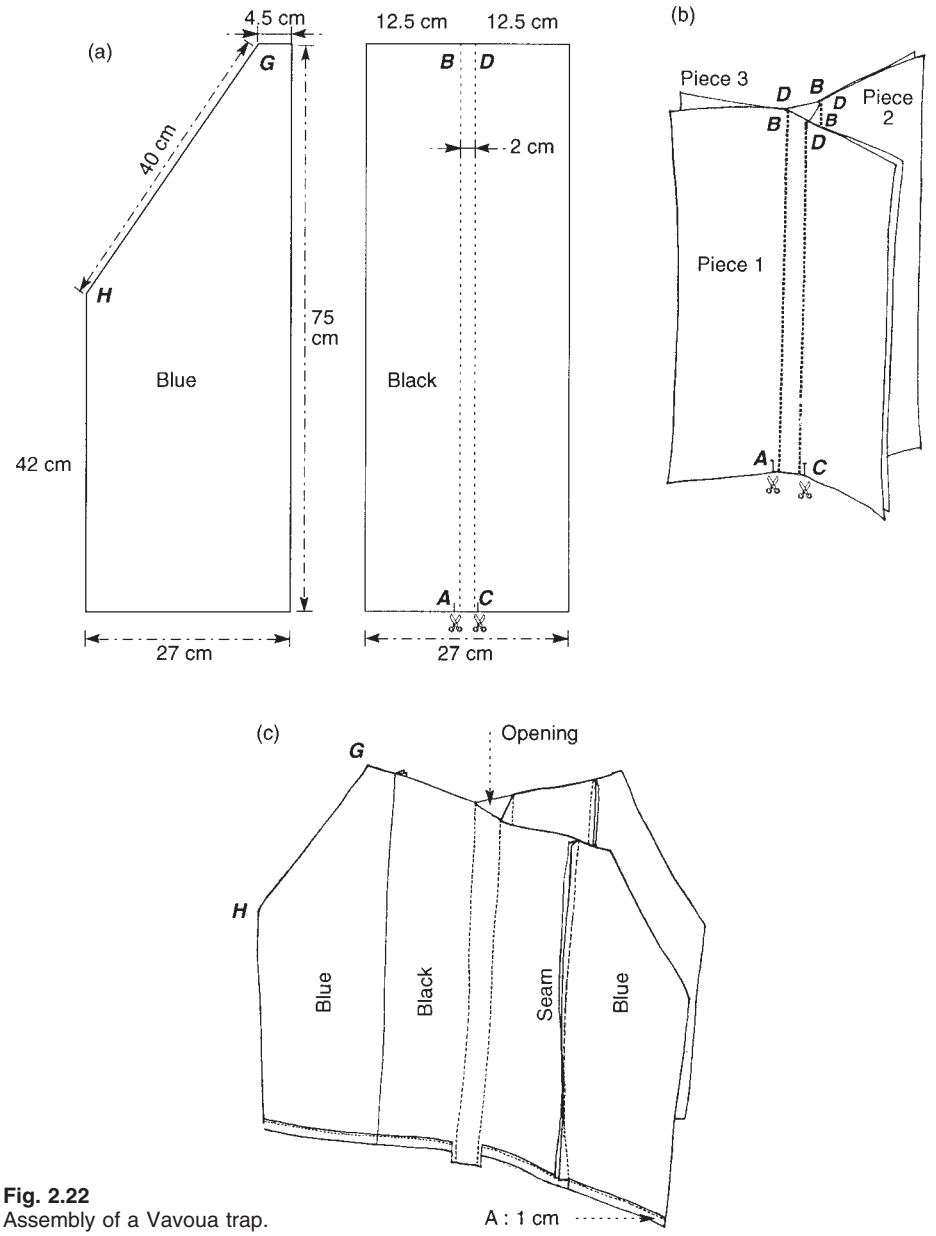

Fig. 2.22
Assembly of a Vavoua trap.

The screen (Fig. 2.23)[1]

- You will need (see Fig. 2.23a):
  - — an iron bar, 150 cm long and 1 cm in diameter;
  - — an iron bar, 85 cm long and preferably 0.8 cm in diameter;
  - — blue cloth, 110 × 50 cm;
  - — two strips of black cloth, 110 × 17.5 cm;
  - — two strips of cloth, 25 × 2 cm.

[1] Based on a model used in Côte d'Ivoire by Dr C. Laveissière.

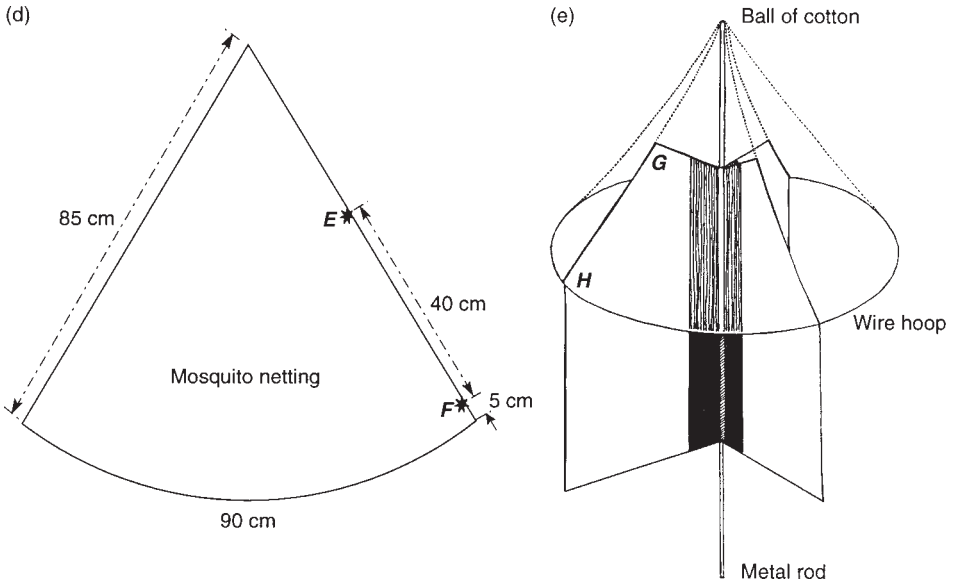

Fig. 2.22 (*continued*)

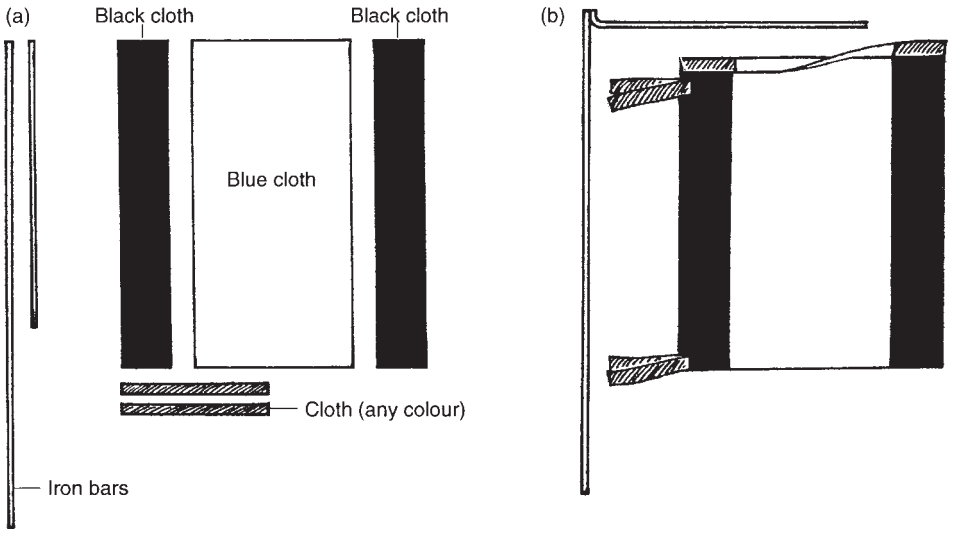

Fig. 2.23
Assembly of a screen.

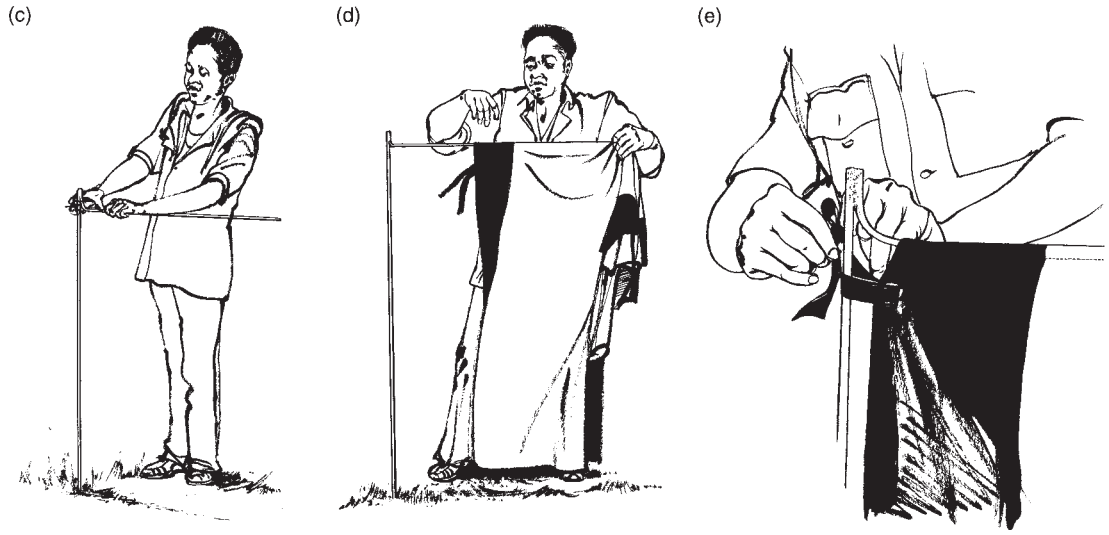

Fig. 2.23 (*continued*)

- Weld the two bars together at the final 2 cm as shown in Fig. 2.23b. Bend the shorter bar out at right angles to the longer bar. Sharpen the other end of the longer bar to make it easier to stick into the earth.
- Sew the strips of black cloth to either side of the blue cloth (b). With the seams the total width is 83 cm.
- Make a hem of 3 cm along the top of the cloth (b).
- Fold the tapes in half and sew them to the top and bottom of the long side of the screen (b).
- Install the screen in the field by hammering the long bar firmly into the ground (c), slipping the screen on to the short bar (d), and securing the screen by tying the tapes to the vertical bar (e).

Impregnation

Insecticides

The best insecticides for impregnation of traps and screens are the pyrethroids, especially deltamethrin, alphacypermethrin, lambdacyhalothrin, cyfluthrin and betacyfluthrin. They combine a long residual effect with quick killing of tsetse flies after only brief contact. Other insecticides e.g., DDT, are too slow in killing the insect, and much higher dosages would be needed.

The insecticides degrade as a result of exposure to sun, rain and wind. In general the residual effect of the insecticide increases with higher initial dosage. The persistence is influenced by the type of cloth used. With 200 mg of deltamethrin per m^2 or 380 mg of alphacypermethrin per m^2, effective activity is obtained for three months on cotton/polyester mix material and for up to six months on nylon. The pyrethroids are available in several formulations but soluble concentrates and emulsifiable concentrates provide the best results.

Procedure

In order to impregnate a trap or screen with a certain dosage of insecticide, the following information is needed:

— the approximate surface area in m^2 of the trap or screen (*a*);
— the amount of water required to saturate the trap or screen (*b*);
— the target concentration of insecticide (in grams per m^2) in the trap or screen material (*c*);
— the quantity of active ingredient per litre of insecticide concentrate (g/litre) (*d*).

The volume of emulsifiable concentrate in litres needed for the impregnation of one trap or screen is equal to:

$$(a \times c)/d$$

Fig. 2.24
The insecticide emulsion is measured with a measuring cylinder.

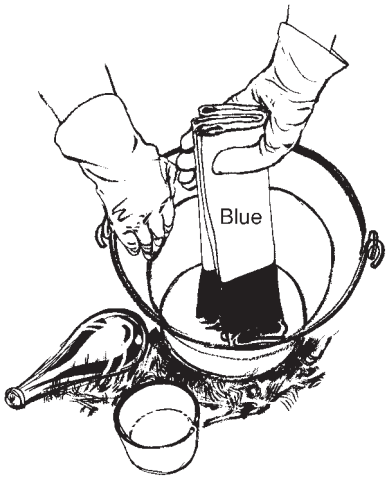

Fig. 2.25
The black part of the screen is soaked in the insecticide mixture.

Fig. 2.26
After impregnation, the trap or screen is spread out on grass or a plastic sheet to dry.

Mix the concentrate with the quantity of water *b* (Fig. 2.24). Put the mixture into a bucket or container big enough for the trap or screen to be soaked in it. Squeeze the trap or screen in the solution until it is completely wet and has absorbed all the solution (Fig. 2.25). The wet trap or screen is then allowed to dry on a surface of plastic or grass (Fig. 2.26). During the whole procedure, gloves should be worn to protect the hands from insecticide.

If the blue and black material of a trap is made of plastic, only the top part, made of mosquito netting, should be soaked. Screens may be folded in such a way that only the black part is soaked.

Delivering insecticide to the community

In large-scale tsetse control programmes with community participation the insecticide can be delivered to individuals as follows:

- Record the number of traps and/or screens to be impregnated by the person. Calculate the quantity of insecticide concentrate required and put it into a standard bottle that is available at low cost.
- Using a template (Fig. 2.27), mark the bottle to indicate the level to which it should be filled with water to obtain the appropriate dilution of insecticide.

The advantage of this system is that people can take the insecticide home and do not have to apply it immediately. Once the insecticide concentrate is diluted in water it must be used within a few hours.

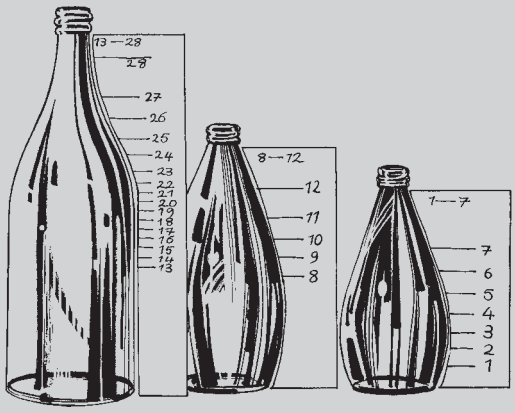

Fig. 2.27
Templates can be made from cardboard or plastic for some commonly available types of bottle.

Fig. 2.28
Traps can be re-impregnated with a spray-on application.

Spraying

In large-scale tsetse control programmes it may be preferable to re-impregnate traps by spraying them in the field (Fig. 2.28). Hand-compression sprayers are suitable for this purpose.

Insecticide spraying

During acute epidemic outbreaks of sleeping sickness it may be preferable to control tsetse flies by ground or aerial spraying of insecticides. Spraying is not generally recommended for routine use because of the high costs, the need for specialized equipment and suitably trained personnel, and pollution of the environment. However, where appropriate, specialized health workers may organize ground spraying with the participation of the community. Pressurized knapsack sprayers are used by farmers in some countries for the control of crop pests and can easily be adapted for use in tsetse fly control.

The aim of spraying is to apply residual insecticide to the daytime resting places of the flies, such as tree trunks, twigs and roots. The insecticide must remain active for at least two months, the duration of the pupal stage, to kill all the emerging flies. Small doses of non-residual insecticides can be sprayed from aerosol cans to kill resting or flying tsetse flies directly.

Ground spraying

Normally only the known resting places are sprayed, to limit the quantity of insecticide used and the amount of work needed. A stretch of vegetation measur-

ing 10 m in width is sprayed from ground level to a height of 0.75–4 m, depending on the species and the location of the treated areas. Applications are carried out during the dry season so that the insecticide is not washed away by rain. The most widely used insecticides have been wettable powder formulations of DDT, dieldrin, endosulfan and, more recently, the synthetic pyrethroids. The pyrethroids have the advantages that they quickly break down in the environment and have a very low toxicity to mammals and humans; they include deltamethrin, alphamethrin, cyfluthrin, cypermethrin and permethrin. DDT, diluted to 50 g/litre, and endosulfan, 30 g/litre, are sprayed on to the vegetation until the point of run-off is attained.

Equipment

Hand-compression knapsack sprayers (Fig. 2.29), portable motorized sprayers and motorized spray pumps transported on a tractor may be used. The first two sprayers are in use for other purposes by farmers in some countries and can be adapted for sleeping sickness control.

Fig. 2.29
Residual spraying of tsetse resting and breeding sites in vegetation using a hand-compression sprayer.

To avoid wasting insecticide and time it is recommended that advice be sought on dose and timing.

Aerial spraying

Helicopters and fixed-wing aircraft have been used mostly for the control of animal trypanosomiasis. On very few occasions, during outbreaks, they have also been employed for the control of human sleeping sickness. Helicopters are used to apply residual insecticides or non-residual aerosols at selected places. Small aircraft are also used for aerosol spraying at regular intervals.

Because the insecticide particles have to move downwards, spraying can normally not be carried out between 09:00 and 17:00, when there is an upward movement of air. Only in the early morning hours or the late afternoon are atmospheric conditions suitable for aerial spraying. Dense forests should not be sprayed from the air because the insecticide will not reach the lower levels.

Aerial spraying is quicker than ground spraying, but has the important disadvantages of high cost and the need for specialized equipment; another disadvantage is that non-residual aerosol applications have to be repeated five times at intervals of about 10 days. This control method should therefore only be used in emergency situations.

References

1. Green CH. The effect of colour on trap- and screen-orientated responses in *Glossina palpalis palpalis* (Robineau-Desvoidy) (Diptera: Glossinidae). *Bulletin of entomological research,* 1988, 78: 591–604.

2. Green CH. The use of two-coloured screens for catching *Glossina palpalis* Robineau-Desvoidy (Diptera: Glossinidae). *Bulletin of entomological research*, 1989, 79: 81–93.

3. Challier A, Laveissière C. Un nouveau piège pour la capture des glossines (*Glossina:* Diptera, Muscidae): description et essais sur le terrain. [A new trap for catching glossina (*Glossina*: Diptera, Muscidae): description and field trials.] *Cahiers d'ORSTOM, entomologie médicale et parasitologie*, 1973, 11: 251–262.

4. Laveissière C, Grebaut P. Recherches sur les pièges à glossine (Diptera: Glossinidae). Mise au point d'un modèle économique: le piège "Vavoua". [Research on glossina traps (Diptera: Glossinidae). Development of an economical model: the Vavoua trap.] *Tropical medicine and parasitology*, 1990, 41: 185–192.

5. Lancien J, Gouteux JP. Le piège pyramidal à mouche tsetse (Diptera: Glossinidae). [The pyramidal tsetse fly trap (Diptera: Glossinidae).] *Afrique médicale*, 1987, 258: 647–652.

6. Laveissière C, Couret D, Grebaut P. Recherche sur les écrans pour la lutte contre les glossines en région forestière de Côte d'Ivoire. Mise au point d'un nouvel écran. [Research on screens for glossina control in a forested region of Côte d'Ivoire. Development of a new screen.] *Cahiers d'ORSTOM, entomologie médicale et parasitologie*, 1987, 25: 145–164.

7. *Epidemiology and control of African trypanosomiasis. Report of a WHO Expert Committee*. Geneva, World Health Organization, 1986 (WHO Technical Report Series, No. 739).

8. Laveissière C, Couret D, Manno A. Importance de la nature des tissus dans la lutte par piégeage contre les glossines. [Importance of fabric type in glossina control by trapping.] *Cahiers d'ORSTOM, entomologie médicale et parasitologie*, 1987, 25: 133–144.