[redacted]

The trials took place in the dry season when foliage is reduced and *G. tachinoides* is confined to the riverine vegetation where it is most easily controlled by insecticides. Spraying was limited to the morning and evening, when temperatures were below 30°C and wind speeds less than 0.5 m/s, in order to reduce loss by drift and convection. As a result, the helicopter was restricted to treating about 30 km of river per day (Baldry *et al.*, 1981). The spray swath was estimated to have a width of 30 m and was applied 15 m from the river bank.

Data on the resting sites of *S. damnosum* s.l. are very sparse. However, recent studies (Bellec and Hebrard, 1980) indicate that resting flies may be found at all levels in the vegetation up to at least 100 m from breeding sites in rivers. At Vea Dam in northern Ghana, gravid *S. sirbanum* Vajime & Dunbar collected in large numbers on the riverine vegetation about one hour before oviposition, and some gravid females were taken on a sticky trap at a height of 9.2 m in a tree 106 m from the water's edge (Walsh, 1972). That the Vea Dam observations are not exceptional is supported by the trapping of flies on sticky traps placed in trees at heights above 6 m at three other sites by the White Volta river and one on the Red Volta river, both in Ghana. Davies (1962) working in northern Nigeria had earlier described how, about one hour before sunset, gravid flies were found resting on riverine vegetation in a manner very similar to that seen at Vea. Before that, Crisp (1956) collected large numbers of *S. damnosum* by sweep netting riverine vegetation at the confluence of the Kamba and Black Volta rivers in Ghana. These catches included males, which suggests that they did not just consist of potential biting flies attracted to the collectors. It is probable that migrant flies do rest in the vicinity of oviposition sites both before and after oviposition. The build-up of peaks of immigrant biting flies over two or three days suggests that these flies are in the area for some time before they begin to bite (Garms *et al.*, 1979), and Bellec (personal communication) caught large numbers of gravid flies on aluminium plaque traps before the peak in numbers occurred on human bait.

A recent but as yet unpublished study by G. Zerbo and S. A. Sowah (personal communication) has shown that the majority of immigrant, invading *S. damnosum* are found biting less than 100 m from the river bank, and at 1 km densities may still be of the order of 10% of those at the river. This estimate was based on catches of biting females.

Garms *et al.* (1979) and Walsh *et al.* (1981) have shown that in the rainy season part of the Onchocerciasis Control Programme (OCP) area is invaded by the 'savanna' cytospecies of *S. damnosum* s.l., already infected with *Onchocerca volvulus* (Leuckart) in sufficient numbers to ensure the transmission of onchocerciasis in spite of the elimination of local populations by larviciding. The areas particularly at risk are sections of the rivers of Mali and Ivory Coast adjacent to the frontier of Guinea. The same situation may exist along part of the eastern boundary of Benin, although there is some evidence that fly movements occur in a predominantly westerly direction. These authors have also shown that at such sites *Onchocerca* transmission by invading flies reaches unacceptable levels for about three months during each wet season. An adulticiding regime that ensured a high mortality of invading *S. damnosum* before they had a chance to feed, and thus preventing disease transmission, would therefore be a very attractive proposition and might be considered for areas of particularly close man-fly contact. It is envisaged that in such areas the larviciding regime would continue as normal and that adulticiding would be carried out whenever transmission was shown to be reaching dangerous levels.

Although older flies, and in the dry season all flies, seem reluctant to bite at long distances from river banks (Le Berre, 1966; Duke, 1975), their movements along rivers are likely to be substantial (Thompson, 1976; Davies *et al.*, 1981). Therefore, further trials should be made using not only wider swath widths, or several swaths on each bank, but also on experimental blocks of 30 km or more in length in order to minimise immigration from untreated areas. Blocks of this size would almost certainly preclude the possibility of spraying from the ground, if persistence is short.

The frequency of application would depend on the persistence of the insecticide used. In the wet season, suitable meteorological conditions for spraying would probably exceed one hour in the morning and evening but, even so, adulticiding would probably need to be limited to the beginning and end of the day. Evening spraying is likely to be more efficient, given the concentration of oviposition activity towards dusk. However, most daylight hours could be used for normal anti-*Simulium* larviciding, which is not affected by air temperature. In this way, a single helicopter could possibly fulfil a dual role.

The authors are aware that such a dual role depends on the selection of an insecticide that is persistent against adult *Simulium*, and is acceptable environmentally. It may also be necessary, as indicated above, to develop special techniques for spraying against *S. damnosum* s.l., remembering that if such techniques should also prove to be effective against tsetse a double objective would be achieved.

Baldry *et al.* (1981) reported that insecticide applications caused considerable mortality of the vertebrate and invertebrate river fauna. It may prove possible to reduce the adverse effects of the insecticides by moving the spray swath further away from the river bank. Otherwise, it will have to be decided whether such non-target mortality over comparatively short lengths of river, which could be rapidly repopulated from up- or down-stream, is acceptable.

Conclusion

It is concluded that the results of the anti-tsetse adulticide trials described in this series of papers were sufficiently encouraging to warrant further trials directed specifically against *S. damnosum* s.l.

To ensure that the results will not be confused by the mortality of aquatic stages, the trials should be conducted in an area in which larval control is effective but where the numbers of invading flies are sufficient to ensure a constant influx of adults to test the residual effect of the insecticide deposits. Such areas already exist in the OCP area.

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