

A Pit Shelter for Sampling Outdoor Mosquito Populations

by R. C. MUIRHEAD-THOMSON, D.Sc., *WHO Malaria Assessment Team, Salisbury, Southern Rhodesia*

The widespread and rapidly increasing scale on which house treatment with residual insecticides is being carried out in malaria control and eradication schemes has made it imperative to devise new methods for studying anopheline mosquito populations in treated areas. The search for resting mosquitos in treated houses is now recognized as being of limited value in estimating the mosquito population; and even when the occasional house is left untreated as a catching-station in the controlled area, it may yield a very low catch of resting mosquitos at a time when a high population of mosquitos is known to exist. There is, therefore, increasing emphasis on the search for anopheline populations resting out of doors, with particular reference to those female mosquitos which have taken at least one blood meal—indoors or outdoors.

In order to sample the outdoor-resting population, as distinct from the biting population, various methods have been used depending on the particular anopheline, the type of country, and the beliefs and prejudices of the human observer. Direct day-time searching for outdoor haunts is the method which has probably been used for the longest time and on the widest scale. In some areas it has provided adequate mosquito material, and in a few cases—for instance, with *Anopheles aquasalis* and other species in Trinidad^a—it has been successful enough to provide the best routine sampling method in both treated and untreated areas. In general, however, this method is regarded as tedious, time-consuming, and frequently unrewarding.

The construction of specially attractive artificial outdoor shelters is a refinement which has proved exceedingly useful in many cases, perhaps the best example being the earth-lined shelter used by Russell & Santiago^b for studying *A. minimus* var. *flavirostris* in the Philippines, and its more recent development, the box shelter, used by Gillies^c for studying African anophelines. Other methods based on the provision of artificial shelters are exemplified by the "keg shelter" used in the study of *A. quadrimaculatus*^d and the use of small horizontal tunnels dug in shaded earth banks for attracting *A. gambiae* and *A. funestus* in Africa.^e For dealing with the special problem of sampling the population of resting mosquitos distributed

^a Senior White, R. A. (1951) *Indian J. Malar.*, 5, 465

^b Russell, P. F. & Santiago, D. (1934) *Proc. ent. Soc. Wash.*, 36, 1

^c Gillies, M. T. (1955) *Bull. ent. Res.*, 45, 361

^d Smith, G. E. (1942) *Amer. J. trop. Med.*, 22, 257

^e Muirhead-Thomson, R. C. (1951) *Bull. ent. Res.*, 41, 487

widely over savannah grassland, the portable cage used by de Zulueta^f in Colombia appears to have great potentialities in other countries as well.

While one or more of these methods has provided good samples of the resting mosquito population in many areas, there are places where even the most vigorous search by a combination of all known methods has failed to reveal more than an occasional resting anopheline in localities where high catches of biting mosquitos are being taken regularly on animal bait. This is particularly the case with *A. albimanus* in Jamaica^g and in Puerto Rico.^h

The following technique, which has been particularly successful in the case of some African anophelines, may therefore be worth trying out in other areas and with other species which have proved refractory so far.

The pit shelter was first developed during the course of work on *A. gambiae* and *A. funestus* in Dar-es-Salaam, Tanganyika, over ten years ago,^e but for various reasons its potentialities were not fully realized at that time. The basic method has been further developed in the course of the malaria assessment programme in Southern Rhodesia, and it now forms the most important standard sampling method in all treated areas.

A shaded site under a tree or large bush is selected close to a village, and a rectangular pit is dug about 5-6 feet (150-180 cm) deep, 4-5 feet (120-150 cm) long and 3-4 feet (90-120 cm) wide. In each of the four vertical sides, about 1½-2 feet (45-60 cm) from the bottom of the pit, a little cavity is dug about 1 foot (30 cm) deep with a horizontal roof. These four little dark cavities or niches form most attractive resting-sites for mosquitos entering the pit shelter. It is important to make sure that the mouth of the main pit is shaded from above, either naturally by an overhanging tree or bush, or, failing that, artificially by means of a framework covered with a thatch awning. While many other types of artificial shelter require a ravine or vertical bank as a basis or background, the pit shelter has the advantage that it can be constructed on quite flat ground, and even in the absence of any natural shelter. It can also be sited close to human habitations or even in the centre of the village.

As villages and animal enclosures are normally sited on well-drained ground, the danger of pits flooding is less than might be imagined. There has been very little trouble of this kind in the Southern Rhodesian assessment, but there are low-lying areas where flooding might prove troublesome, or where unusually heavy rain could put the pits temporarily out of action. In such places arrangements might have to be made to drain the water off or to protect the pit from heavy rain. On occasions rocky or stony ground can prove troublesome, but this has not yet proved an insuperable obstacle in any locality.

In the present assessment the main advantage of these pits has been to provide a rapid and efficient method of sampling the outdoor population of *A. gambiae*, particularly in those areas where house catches have been very low, and where outdoor resting in natural haunts has been so diffuse

^f Zulueta, J. de (1952) *Amer. J. trop. Med. Hyg.*, 1, 314

^g Muirhead-Thomson, R. C. & Mercier, E. C. (1952) *Ann. trop. Med. Parasit.*, 46, 103

^h Rehn, J. W. H., Maldonado Capriles, J. & Henderson, J. M. (1950) *J. nat. Malar. Soc.*, 9, 268

as to necessitate tedious and time-consuming searches. The pits have also proved to be very attractive to the *A. funestus* group and to *A. demeilloni*. *A. rufipes*, *A. pretoriensis*, *A. marshalli* and *A. coustani* have also been taken in these pits, but not in sufficient numbers to judge their degree of attraction. Indeed, the numbers of *A. coustani* taken in this way have been small in comparison to those attracted to live bait in the same area at night, and it appears likely that with this particular species the pit shelter may be of rather less value.

The use of pit shelters as a routine sampling method was first developed in the Shamva district in the north-east of Southern Rhodesia. Since then these shelters have been tried out with encouraging results in the Sabi Valley of south-eastern Southern Rhodesia by other field teams.

Further work is being done to determine the best conditions for siting and operating these pits, but already a stage has been reached where the construction of pit shelters is regarded as an essential preliminary to the survey of new areas, and they are expected to play an important part in the entomological assessment of anti-malaria activities in this region.

Notes on Exophily in Anophelines in South-East Asia

by W. BÜTTIKER, Ph.D., *Entomologist, Advisory Team for Malaria Eradication No. 3, World Health Organization*

The study of exophily in anopheline vector species is one of the most important problems which face the malariologist, and in recent years increasing attention has been paid to the occurrence of outside-resting populations of anophelines in many parts of the world. Various searching methods have been employed: direct searching in the Philippines by Russell,^a in the Transvaal by de Meillon,^b in Southern Rhodesia by Leeson,^c in Ceylon by Rajendram and co-workers,^d in Malaya by Wharton,^e and in Trinidad by Senior White;^f portable net-traps were lowered over the vegetation on the savannahs of Colombia by de Zulueta;^g and collections of mosquitos have been made with the aid of artificial resting-shelters near river banks in the Philippines by Russell & Santiago.^h Other shelters for the purpose of investigating outside-resting populations of anophelines have been used in the United States of America by Smith.ⁱ

^a Russell, P. F. (1931) *Philipp. J. Sci.*, **46**, 639

^b Meillon, B. de (1934) *Publ. S. Afr. Inst. med. Res.*, **6**, 241

^c Leeson, H. S. (1930) *Proc. roy. ent. Soc. Lond.*, **5**, 26

^d Rajendram, S., Cader, M. H. M. A. & Visvalingham, T. (1950) *Nature (Lond.)*, **166**, 486

^e Wharton, R. H. (1951) *Med. J. Malaya*, **4**, 260

^f Senior White, R. A. (1951) *Indian J. Malar.*, **5**, 465

^g Zulueta, J. de (1950) *Amer. J. trop. Med.*, **30**, 325

^h Russell, P. F. & Santiago, D. (1934) *Proc. ent. Soc. Wash.*, **36**, 1

ⁱ Smith, G. E. (1942) *Amer. J. trop. Med.*, **22**, 257