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### A FIELD TRIAL OF EXPANDED POLYSTYRENE BALLS FOR THE CONTROL OF *CULEX* MOSQUITOES BREEDING IN PIT LATRINES

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Pit latrines are frequently a prolific breeding site for *Culex quinquefasciatus* Say. In many countries the construction of large numbers of latrines, often as a component of public health programs, has contributed to the burgeoning problem of urban filariasis (Southgate 1984, WHO 1984).

Mosquito-infested latrines present a difficult control problem. Conventional methods, using insecticides or larvicidal oils, have given good results, but are expensive, require frequent application on a routine basis, and may be hampered by problems of resistance (World Health Organization 1984). As an alternative, Reiter (1978) suggested that a layer of expanded polystyrene balls (EPB) could be used as a floating "blanket" to prevent mosquitoes from breeding in these sites. Recent field-trials of the idea have given encouraging results in Tanzania and Kenya (Curtis and Minjas 1985) and in Zimbabwe (Morgan and Mara 1982). In this note I report on a small trial which I conducted in Kisumu, Kenya, in 1977.

The trial area included low-lying parts of the Nyalenda and Nyamasaria neighborhoods of Kisumu (0° 06'S, 34° 45' E), on the shores of Lake Nyanza (formerly Lake Victoria). During the rainy season, the water table in these districts is higher than the bottom of many of the latrine pits, providing ideal conditions for *Cx. quinquefasciatus* and other sewage-breeding Diptera.

Mosquito production was monitored by trapping the departing adult insects in a window exit-trap (Service 1963) which was placed over the drop-hole before sunset and left there overnight. A skirt of denim cloth sewn around the entrance of each trap formed a seal between the trap and the latrine platform. Captured insects were killed in the traps with a pyrethrum spray and transferred to cartons for transport to the laboratory. On trap-nights, owners agreed to use latrines belonging to neighbors.

Sixteen latrines were chosen for the trial. Eight of these were randomly selected for treatment, and the remainder used as untreated controls. Expanded polystyrene balls with a mean diameter of about 0.4 cm (manufactured by BASF GmbH, and donated by Booth's Manufacturing (Africa) Ltd., Nairobi)<sup>3</sup> were scattered by hand to a depth of 5 cm (2 inches) in each treatment latrine. All latrines were monitored on 31 nights from mid-May through mid-August.

For 2 to 4 nights after the treatment, large numbers of mosquitoes continued to emerge from the treated latrines. Following this, however, there was a dramatic change; on 28 collection nights from day 7 to day 86, the mean count (female, non-gravid) for treated latrines was less than 2% of the mean for the controls (Table 1). The highest number of nongravid mosquitoes per treated latrine per night was 52, whereas from the untreated latrines it was 5,325.

Laboratory observations (Reiter 1978) had

Table 1. Treatment of pit latrines with expanded polystyrene balls. Mean numbers of adult mosquitoes (female, nongravid) per trap-night. Twenty-six trap nights from night 6 through night 86 after treatment.

Latrine number	Mean mosquitoes per trap night ( $\pm$ s.e. of mean)	
	Treated	Untreated
1	1.2 (0.2)	324.3 (63.6)
2	7.4 (1.4)	123.8 (24.3)
3	3.4 (0.7)	168.4 (33.7)
4	2.3 (0.6) <sup>1</sup>	177.3 (34.8)
5	6.5 (1.3)	236.3 (46.3)
6	4.5 (0.9)	161.9 (31.8)
7	6.6 (1.3)	836.4 (164.0)
8	— <sup>2</sup>	642.8 (126.1)
Mean	6.1	33.9

<sup>1</sup> Latrine collapsed on day 56.

<sup>2</sup> Latrine collapsed on day 15.

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<sup>3</sup> The use of trade names or commercial sources is for identification only and does not constitute endorsement by the Public Health Service or by the U.S. Department of Health and Human Services.

demonstrated that *Cx. quinquefasciatus* pupae can force their way upward through several layers of EPB. Many of the mosquitoes collected in the initial nights after treatment had probably survived in this way. The small number of insects captured after this period may have been derived from larvae which exploited minor gaps in the EPB, but most had probably arrived from neighboring, untreated latrines and were using the treated latrine as a daytime resting site. It was assumed that gravid mosquitoes had entered the pit in search of an oviposition site.

Latrine contents were inspected one week after the treatment and at monthly intervals thereafter. There was little disturbance of the EPB layer except directly under the drop-hole, where a small gap was occasionally seen, and around the perimeter, where the fluctuating water table moved over irregularities of the pit wall. Some EPB adhered to the walls as the water table fell, but there was no evidence that the material was bound by scum or surface growths, nor of destruction by cockroaches (Blattidae) or other animals. The trial was terminated at the end of August, when some latrines became dry. The 12-week immersion ap-

peared to have had no effect on the EPB, except for a slight surface discoloration.

From August through October the latrines remained dry. The EPB below the drop-hole became mixed with fecal material, and partly buried by it. However, in late November, when the water table rose again, EPB floated to the surface and the protective blanket was reassembled. At that time, we were unable to continue trapping, but there seemed no reason to doubt that control was still effective.

The transport of large volumes of EPB over long distances would be prohibitively costly. For this reason, we tested expansion using locally available resources. We dropped unexpanded beads, which have a particle size similar to that of granulated sugar, onto 40 liters of boiling water in a large earthenware pot over a wood fire (Fig. 1). Expansion to the required diameter was achieved within 5 minutes, with occasional stirring. The product was similar to that obtained from the Nairobi supplier (who used steam for expansion), although it contained more underexpanded balls. This rustic method of preparation was satisfactory, but would be more efficient if a larger vessel, such as a metal water tank, were used.

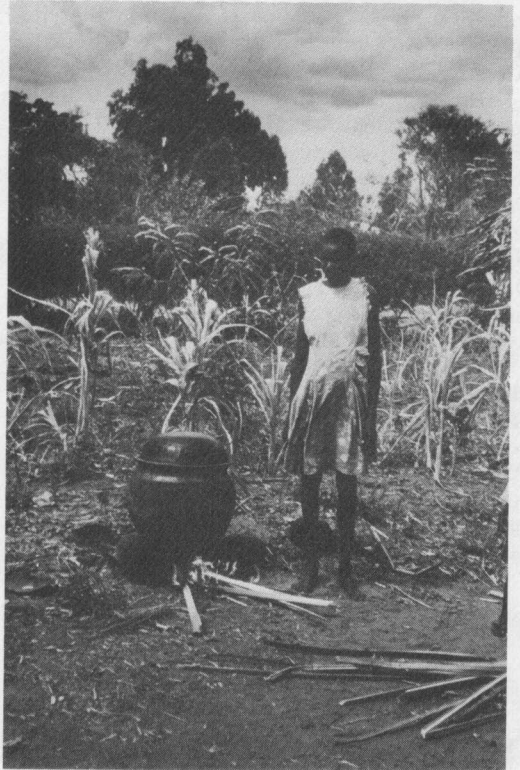


Fig. 1. Field preparation of expanded polystyrene balls for mosquito control.

Application of EPB by hand is not a pleasant job and requires diligence for effective coverage. A hand-cranked dust-blower, designed for the application of granular pesticides, proved useful, although it sometimes clogged at high speed. A venturi-type blower would definitely be more satisfactory.

In summary, the trial demonstrated that the EPB treatment gave effective and persistent control of mosquitoes in pit latrines. The material is cheap, inert, nontoxic, and unlikely to give rise to resistance problems. In all these features it offers clear advantages over conventional control methods, such as oils and chemical larvicides. It could probably be used to control breeding in other sheltered, still-water habitats, such as cesspools and water-storage cisterns, providing that it is protected from the wind and not removed by drainage or flooding.

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### SPECIES COMPOSITION AND RELATIVE ABUNDANCE OF ANTHROPOPHILIC MOSQUITOES IN SUBARCTIC QUEBEC

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Much of the published information on mosquitoes of northern Canada has been generated as a result of the Canadian Northern Insect Survey initiated in 1947. Since then there have been rather general studies of mosquitoes, and ecological studies in specific subarctic or high arctic localities. Recently, the Groupe de Recherche sur les Insectes Piqueurs (Université du Québec à Trois-Rivières), demonstrated that mosquito species select their larval habitats, and as a result of habitat vegetation analyses, suggested that there is a typical mosquito community for a particular vegetal unit. Whereas many of the studies of arctic and subarctic mosquitoes have considered, at least peripherally, the pest species of humans, few studies have been conducted to examine the seasonality and abundance of anthropophilic species. The purpose

of this investigation was to determine the species composition and relative abundance of anthropophilic mosquitoes in a subarctic Québec locality.

The study was conducted in the vicinity of Schefferville (54°47'N; 66°50'W), Québec, better known by earlier investigators as Knob Lake. Adult mosquitoes were collected weekly for 12 weeks commencing the second week of June during 1983 and 1984. Five sites were selected in which landing counts, biting counts and aerial net collections were made in succession. Three sites were outside the town of Schefferville (9 km east, 4 km north, 4 km south), one was adjacent to the town, and the fifth was actually in the town. Landing counts were obtained by counting the number of mosquitoes landing on a square blue cloth (0.09 m<sup>2</sup>) placed on a subject's lap during a 2-min interval. Biting counts were the number of mosquitoes biting a subject's exposed, left forearm during a 2-min interval (most of these were

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