COMPARATIVE TESTS OF FOUR MOSQUITO TRAPS

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ABSTRACT. Comparative tests of four types of mosquito traps were conducted in a Trinidadian rain forest. The suction trap emerged as the best trap, catching more than twice as many mosquitoes of all species combined as the TRVL No. 17 trap, and approximately four times and eight times as many as the CDC Light and Double-baited cage traps, respectively. An analysis of variance of these traps when calculated for the catches of four species (*C. portesi, C. taeniopus, C. vomerifer* and *C. declarator*) showed that the differences between the traps were highly significant for the first three species ($p<0.001$), but not for *C. declarator*. There was no significant difference between trapping sites.

The Trinidad Regional Virus Laboratory (TRVL) was established in 1953 and had, as its primary objective, the study of arthropod-borne viruses. Collecting and processing of haemotophagus Diptera was a necessary and important part of the program. In the early years collecting was limited to those species which were attracted to human bait. Then, in 1957 Bellamy and Reeves (1952) lard-can trap was tried, but did not appear to be successful (Aitken, personal communication). In 1958, a modified Shannon dawn trap (Shannon, 1944) baited with chickens was found to be highly successful, but it was large and cumbersome. Nevertheless, it was used until 1961 when it was replaced by the portable double-baited cage trap (Worth and Jonkers, 1962), which then became adopted as the main mosquito trapping device, supplemented occasionally by the CDC Miniature Light Trap (Sudia and Chamberlain, 1962). In the meantime, the need arose for a still more portable trap and the TRVL No. 17 Trap (Davies, 1971) was developed. Its portability, simplicity, ease of operation, and low cost made it very popular, so that the double-baited cage trap was almost phased out. Another trap constructed and used successfully, was the suction trap (Davies, 1970). Although originally designed to catch *Culicoides*, large numbers of mosquitoes were caught as well, so that this trap was also used in our program from time to time.

With several types of traps in use for collecting mosquitoes it became necessary to compare the efficacy of four of these traps under standardised conditions. To do this, a series of trapping experiments was undertaken between March and November 1970, in one of the seasonal swamp forests bordering the Aripo Savannah in North Eastern Trinidad. This paper presents the results of this series of trappings.

MATERIALS AND METHODS. The four traps chosen are shown in Figure 1. They were a CDC miniature light trap, a No. 17 trap, a double-baited cage trap, and a suction trap. The last three traps were each baited with two adult white mice. The light and suction traps were fitted with a fine nylon gauze net to retain *Culicoides*, whilst the nets of the other two traps were constructed out of a Terylene net with 22 meshes to the inch.

The traps were located 3 feet above the ground, at four stations (Nos. I, II, III & IV), separated by distances of 50 to 70 feet.

The traps were usually set at about midday on one day and cleared at the same time the following day. Normally the traps were operated for one night per week.

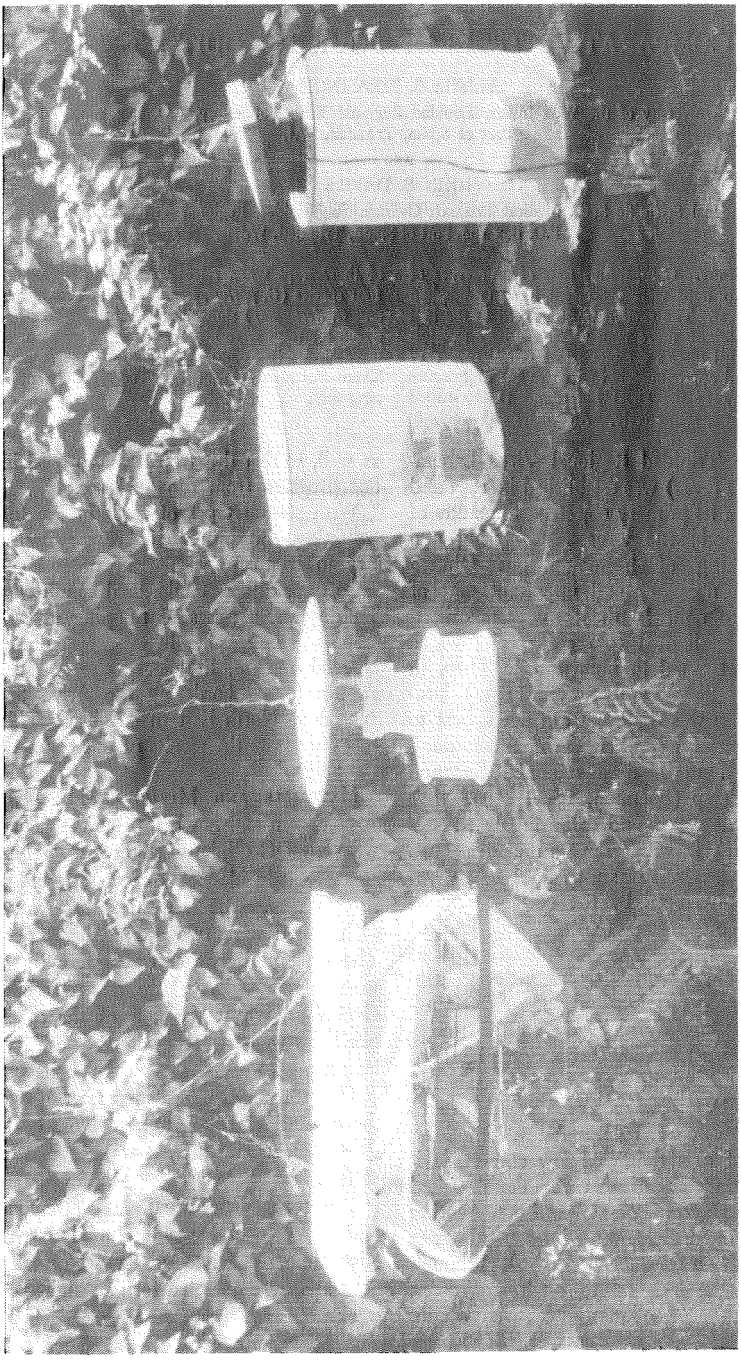

FIG. 1.—The four traps used in this study (from left to right): Double-baited cage trap (In this case baited with four adult mice and with the front portion of the net raised to permit viewing of the internal arrangements of the trap); C.D.C. light trap; Trinidad No. 17 trap; Suction trap.

In order to reduce the effect of trap sites on the catches, the traps were set at a different station each week, so that each type of trap sampled each station once every four nights. If either of the two mechanical traps (light or suction) failed, the catches for that night were rejected, and the operation was repeated at the first opportunity. The experiment continued until four replicates of all trap/position combinations had been obtained, giving observations on 16 nights' catching. The catches of the more abundant species were then subjected to an analysis of variance to determine whether apparent differences between traps were actually significant.

RESULTS. Total catches of all species of mosquitoes amounted to 5488 specimens representing 33 species. Of all mosquitoes, the suction trap caught 3086 (56.23 percent), the No. 17 trap 1330 (24.23 percent), the light trap 715 (13.03 percent) and the double-baited cage trap 357 (6.51 percent). In number of species caught, the suction and No. 17 traps were again superior with 27 and 23 species respectively.

One species, *Culex* (*Melanoconion*) *portesi* Senevet and Abonnenc, 1941, was predominant in all traps, representing about three-fifths of all the specimens caught.

On all but 5 of the 16 nights, the suction trap was responsible for the greater part of the catch, and on the night of 22nd to 23rd October this trap at Station III caught the exceptional number of 075 *C. portesi,* compared with 129 from all the other traps combined. If this unusual collection is omitted from the totals, the individual trap means for *C. portesi* become: suction trap 69.78; No. 17 trap 42.13; double-baited trap 11.25; light 22.43.

There were six other species in which more than 100 mosquitoes were collected. Of these six, four species, *Culex declarator* Dyar and Knab, 1906; *C spissipes* Theobald, 1903; *C. taeniopus* Dyar and Knab, 1907; and *C. vomerifer* Komp, 1932, were collected in greater numbers in the suction trap than the other traps. The No. 17 trap caught more (59.95 percent) *Culex* sp. No. 11 (taxonomic status uncertain) than the other traps, while the CDC light trap caught more *Culex* sp. No. 17, (56.44 percent).

STATISTICAL ANALYSIS. Sufficient numbers of *portesi, taeniopus, declarator,* and *vomerifer* were collected for the traps to be compared by an analysis of variance.

In making the analysis the exceptionally high catch of *Culex portesi* on 22nd to 23rd October was replaced by an estimated figure calculated by the missing plot technique (Bailey, 1959, p. 112) by which an estimate of 89 was obtained to replace the 975 mosquitoes caught in the suction trap that night. This was done to remove any unnecessary bias that such an exceptional observation might have on the results.

Only one specimen of *declarator* was caught during the first cycle of catches. Therefore, the analysis for this species was restricted to the last three cycles which took place between 13th May and 6th November.

Analyses of variance for these four species show that there were significant differences between nights for *portesi, vomerifer* and *declarator,* but catches of *taeniopus* remained constant over the catching period. There was no significant difference between sites for any of the species.

Differences between traps were very highly significant ($p = < 0.001$) for *portesi, taeniopus* and *vomerifer,* but not significant for *declarator* ($p = > 0.05, < 0.1$). This appears to be strange as the suction trap caught almost half of the total of this species, and twice the number for the CDC light trap, the next "best" trap. However, when the catches of individual nights were examined, it was found that of the 12 nights analysed, the suction trap was superior on only 4, the No. 17 trap on 4, and the light trap on 3. No *declarator* were caught in any of the traps on the one remaining night; hence the apparent superiority of this trap when

judged by total catches was misleading.

The catches of *portesi, taeniopus, declarator* and *vomerifer* were compared using the standard error of the differences between the mean catches at the 5 percent level of probability. The results are set out qualitatively below (=indicates no significant difference).

Species	Rank Order of Traps
C. portesi	Suction > No. 17 > light > double-baited
C. taeniopus	Suction > No. 17 = light > double-baited
C. declarator	Suction = Light = No. 17 = double-baited
C. vomerifer	Suction > No. 17 > light = double-baited

DISCUSSION. This study produced some surprising results. Of particular interest was the apparent inefficiency of the CDC miniature light trap. This trap is reported to be a highly successful device in North America and elsewhere, but appears not to be so good in the area where these studies were conducted. The relatively dense undergrowth in this secondary tropical rain-forest may have shielded the light thereby reducing its attractiveness. Of the four species studied in detail it may be significant that the only species to be caught equally in all traps belonged to the subgenus *Culex* (*Culex*). The other three *Culex* (*Melanoconion*) species preferred the mouse-baited traps.

It is known that when CO_2 is used in combination with the light trap that catches are greatly increased (Newhouse *et al.*, 1966), but it was not the intention of this experiment to compare the various combinations in which a particular trap can be used for effective results. Similarly, when the double baited cage trap was first operated by the staff of this laboratory, four adult mice were used as sources of attraction. In the present study, only two adult mice were used to make it consistent with the other two-mouse baited traps. Preliminary observations had indeed suggested that the double-baited cage trap caught twice the number of mosquitoes as the No. 17 trap when four adult mice were used in the former, as compared to two in the latter. Later observations, however, revealed that catches from No. 17 traps in general were higher than the double-baited cage trap, but this was at once attributed to the differences in the type of netting used in the construction of the traps. It was these observations which led to the present study in which the type of netting and the number of mice used, together with a rotation of the traps to eliminate site differences, were standardized.

The suction trap emerged as an excellent catching device, but it is a rather bulky trap when compared to the No. 17 trap. In addition, it was found that the suction trap and the light trap, both mechanical traps, did not always operate properly due to faulty contact points. It is possible that the high humidity in the forest may have caused rapid corrosion at these vital parts. Many of the mosquitoes collected in the suction trap were found to be dead when the traps were cleared on the following day. The powerful fan motor may have caused the mosquitoes to strike forcefully against the hard ply-board on top of the trap and may have killed them. For these reasons, the authors are of the opinion that the No. 17 trap emerges as the trap "par excellence" when one considers cost, ease of operation, portability and simplicity.

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EVALUATIONS OF ABATE® FOR MOSQUITO CONTROL IN POLLUTED WATER [1]

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Control of mosquitoes becomes more difficult each year due to continuing development of insect resistance to insecticides. This results in a seemingly never-ending search for new insecticides. Partial control of mosquitoes appears to encourage man's desire for higher levels of control. Pest mosquitoes (those not normally involved in human disease transmission) continue to be a major target in mosquito control work because of their abundance in metropolitan and residential areas. However, since many pest mosquitoes typically breed in man-made mosquito breeding sites such as water in ditches, artificial containers, sewage outflows, etc., their potential for finding a breeding site in close proximity to man is great.

One insecticide that has shown considerable promise for mosquito control in both urban and rural areas is Abate (Bang and Tonn, 1969a; Bang and Tonn, 1969b; Bang and Tonn, 1969c; Barnes, *et al.*, 1967; Barnes and Webb, 1968; Bowman and Orloski, 1966; Brooks, *et al.*, 1966; Brooks, *et al.*, 1967; Brooks and Schoof, 1965; Gahan, *et al.*, 1966; Glancey, *et al.*, 1968; Lofgren, *et al.*, 1967; Mulla, *et al.*, 1969; Parker, 1970; Schober, 1967; Taylor, 1968; and Whitlaw and Evans, 1968). The various physical forms of the insecticide (liquid, dust, granules, and gelatinous capsules, "Tossits") all have advantages and disadvantages. The purpose of this study was to assess the value of two types of Abate, granules and Tossits, for control of mosquito immatures in highly polluted waters.

METHODS AND MATERIALS. Several sites in Yang Ming Shan (a suburb of Taipei) were used for this study. Two types of mosquito breeding sites were utilized, septic tanks and ditches. The septic tanks and ditches were found not only to con-

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