ECOLOGY AND EPIDEMIOLOGY OF DENGUE VIRUSES IN DIN DAENG DISTRICT, BANGKOK

Principal Investigators : Douglas M. Watts, Ph.D.
Bruce A. Harrison, LTC, MSC
David E. Johnson, MAJ, MC
Terry A. Klein, CPT, MSC

Associate Investigators : Donald S. Burke, LTC, MC
Ananda Nisalak, M.D.
Michael C. Callahan, SFC

Assistant Investigators : Panor Srisongkram, B.Sc.
Ming Choohong
Sirinipa Srilikit, R.N.
Sajee Pinnoi, R.N.
Sukree Tumrongrachaniti, R.N.
Panee Srangsomwong, R.N.
Nongnuj Maneechai
Chumnong Noigamol
Vichit Phunkitchar
Inkam Inlao
Prajim Boonyakanist
Rampa Rattanarithikul
Kol Mongkolpanya

OBJECTIVE : The overall objectives were given in a previous annual report (1). The objectives applying to this report are : (a) to determine the population density of the wild *Ae. aegypti* population on a seasonal basis; and (6) to determine the seasonal availability and utilization of artificial containers by this species for oviposition.

BACKGROUND : These studies are a continuation of projects that were initiated in 1978 and outlined in previous reports (1, 2). Dengue continues to be a very important disease in Bangkok, primarily due to the association of the vector host to the human population. Prevailing environmental conditions, e.g., the accumulation of water in artificial containers that are highly suitable for immature development and the lack of sufficient control measures, are instrumental in the continuation of periodic and seasonal dengue epidemics.

Data throughout this study have been consistent with earlier findings in this study, i.e., there is a slightly marked increase in the *Ae. aegypti* population during the hot rainy season. These data, however, do not explain the seasonal differences in observed human dengue cases in Bangkok. Slight *aegypti* seasonal population density increases only serve as an enhancement to other undefined parameters which are instrumental in seasonal and the yearly variation in observed dengue cases.

METHODS : The study area (a section of the Din Daeng slum and government housing development area), mapping, and census of the population have been described

in previous reports (1, 2).

Surveys to determine the seasonal availability and utilization of containers have been continued at 6 week intervals as for the previous year (1). The use of the emergence trap to determine the seasonal changes in the emergence rate, and the floating larval trap to estimate the larval density, have been continued. Additional sampling techniques and devices to estimate the population density of adult *Ae. aegypti*, i.e., oviposition traps and suction traps had minimal success in field trials. Therefore, efforts to estimate the adult populations were largely discontinued.

RESULTS : Adult and larval traps : The use and development of various larval and adult traps were reported in the previous report (1). The emergence trap (Figure 1) and floating larval trap (Figure 2) were both highly successful in laboratory tests and field tests.

Artificial container surveillance : Investigations of the seasonal availability and utilization of artificial containers by *Ae. aegypti* in the Din Daeng study were initiated in April 1978 (2) and have been continued to the present. The frequency and percentage of artificial containers with water are shown in Figure 3. There was no observed change in the percentage of artificial containers with water from the previous surveys (1).

The frequency and percentage of artificial containers positive for *Ae. aegypti* are shown in Figure 4. The percentage of artificial containers positive for *Ae. aegypti* continued to be higher for outside residences during all trapping periods. Increase in the percentage of positive inside containers were observed during the hot rainy season for all 3 years. This phenomenon was less pronounced for outside containers due to the small number of containers in the sample. The percentage of artificial containers positive for *aegypti* was higher outside than inside residences during all trapping periods. However, since slum residences contribute over 90 percent of all outside containers, this phenomenon appears to be based on residence-type rather than outside versus inside containers.

Data from previous surveys, as well as during this reporting period, indicate that the mosquito population density, in terms of positive containers, is influenced by both mean monthly temperatures and precipitation (Figure 5). Changes in the percentage of artificial containers are reflections of changes in the mean monthly temperatures, i.e., as the mean monthly temperatures increase, the percentage of positive containers increase, and conversely, decreases in the mean monthly temperatures result in lower numbers of positive artificial containers. Increases in the percentage and frequency of positive containers also appear to be associated with the onset of the rainy season as discussed in the previous report (1).

Table 1 summarizes the frequency and percentage of different types of containers positive for study residences. Ceramic-clay water (ong) jars continued to be the primary source of *aegypti* larvae. Ant traps were found to have the next highest percentage while bath tanks, usually only associated with the high-rise flats and shop houses, were third (Figure 6).

The positive container index, a more reliable indication of the infestation rate, is summarized in Tables 2, 3, 4 and 5 for the three different house types. The data for all types of houses continue to show a high incidence of positive ong jars in relation to other types of containers (Figure 7). In addition, seasonal fluctuations are also observed, i.e., increases in the mean number of positive ong jars in relation to increases in temperature and conversely. Differences in the positive container index for the different house types are illustrated in Figures 8, 9 and 10. The high-rise flats continue to maintain a low level of infectivity, while the slums continue to show a high incidence of infestation, especially for ong jars.

The percentage of residences positive for *aegypti* also varied with seasonal changes (Table 6, Figure 11). High-rise flats were seldom positive, whereas slums and shops were often observed to be positive, especially during the hot rainy season. Figures 12, 13, 14 and 15 illustrate the percentage of different residence types positive for different types of containers. Ong jars are the primary positive container found in slum houses, whereas in shop houses, 3 types of containers, ong jars, bath tanks and ant traps, are all primary positive containers.

The emergence trap (1) has provided useful data on the seasonal emergence rate of *Ae. aegypti*. Although the number of positive traps (Table 7) for different seasons is highly variable, the number of adults emerging is distributed in the same manner as the positive container index, i.e., with higher mean temperatures.

Surveillance of larval densities using a floating larval trap (Figure 1) was initiated January 1979 (1). Nearly 100 percent of all positive ong jars were sampled throughout the study. There were no seasonal changes observed in the average number of immatures trapped per ong jar, however, since the number of positive ong jars increased with rising mean monthly temperatures, the total number of larvae collected during the trapping phase also corresponded to the increases in mean monthly temperatures. Furthermore, the average number of pupae collected per ong jar appears to increase during the hot dry and hot rainy season in the same manner as the emergence rate (Table 8).

The Din Daeng dengue project has been ongoing for nearly three years. All field aspects of the project were concluded in December 1980. Data are presently being tabulated and analyses will continue through 1981.

REFERENCES :

1. Watts, D.M., B.A. Harrison, D.E. Johnson, and T.A. Klein. 1979. Ecology and epidemiology of dengue viruses in Din Daeng district, Bangkok. AFRIMS Annual Progress Report, October 1978 to September 1979. pp. 73-112.

2. Watts, D.M., B.A. Harrison, and D.E. Johnson. 1978. Ecology and epidemiology studies of dengue viruses in Din Daeng, Bangkok, Thailand. AFRIMS Annual Progress Report, October 1977 - September 1978. pp. 66-79.

Table 1. Frequency and percentage of inside and outside containers[1] with water positive for immature *Aedes aegypti* in study residences by surveys, Din Daeng, Bangkok, Thailand 1978-80.

Containers	Date of Survey															
	3-18 APR 78	30 MAY - 15 JUN 78	18-28 SEPT 78	6-15 DEC 78	5-22 MAR 79	16 APR - 4 MAY 79	29 MAY - 15 JUN 79	9-27 JUL 79	20 AUG - 7 SEP 79	1-19 OCT 79	12-30 NOV 79	2-18 JAN 80	11-29 FEB 80	24 MAR - 11 APR 80	6-23 MAY 80	16 JUNE - 4 JULY 80
Water jar	13.1 (31/236)	22.7 (57/251)	25.0 (77/308)	18.2 (54/297)	29.1 (97/333)	26.2 (83/317)	31.8 (101/318)	39.1 (124/317)	30.9 (99/320)	31.9 (98/307)	27.9 (85/305)	25.9 (79/305)	18.0 (57/316)	17.3 (54/313)	19.4 (61/315)	19.1 (57/299)
Bant & Foot tanks	9.8 (5/51)	32.5 (13/40)	27.7 (13/47)	14.0 (7/50)	8.9 (4/45)	10.6 (5/47)	23.4 (11/47)	22.9 (11/48)	14.6 (7/48)	27.7 (13/47)	31.3 (15/48)	14.6 (7/48)	12.0 (6/50)	14.0 (7/50)	8.2 (4/49)	20.4 (10/49)
Flower vase & clay pot base	2.7 (4/149)	3.3 (4/120)	1.4 (2/146)	2.1 (3/140)	2.4 (4/164)	2.2 (3/134)	0.64 (1/155)	1.9 (3/155)	2.2 (3/136)	2.0 (4/204)	2.2 (4/179)	3.5 (7/200)	2.2 (4/184)	1.6 (3/190)	1.7 (3/180)	1.1 (2/188)
Ant trap	28.2 (22/78)	52.4 (33/63)	20.8 (16/77)	26.1 (12/46)	34.7 (17/49)	38.1 (16/42)	50.0 (18/36)	48.7 (19/39)	39.0 (16/41)	20.0 (7/35)	28.1 (9/32)	25.0 (4/16)	11.5 (3/26)	17.9 (5/28)	34.6 (9/26)	41.5 (17/41)
Other[1]	26.7 (4/15)	9.1 (3/33)	0.0 (0/7)	33.3 (2/6)	50.0 (2/4)	100.0 (1/1)	25.0 (2/8)	66.7 (2/3)	20.0 (1/5)	33.3 (1/3)	50.0 (1/2)	33.3 (1/3)	0.0 (0/5)	0.0 (0/3)	0.0 (0/3)	0.0 (0/5)
Total	12.5 (66/529)	22.5 (110/489)	18.5 (108/585)	14.5 (78/539)	20.8 (124/595)	20.0 (108/541)	23.6 (133/564)	28.3 (159/562)	22.8 (126/552)	20.6 (123/596)	20.1 (114/566)	17.1 (98/572)	12.0 (70/581)	11.8 (69/584)	13.4 (77/573)	14.8 (86/582)

[1] Plastic containers, pails, wash pans and other containers emptied on a daily basis not included.

Table 2. Positive container index (mean) for immature *Aedes aegypti* per study residence (outside & inside), Din Daeng, Bangkok, Thailand, 1978-80.

Containers	Date of Survey															
	3-18 APR 78	30 MAY - 15 JUN 78	18-28 SEPT 78	6-15 DEC 78	5-22 MAR 79	16 APR - 4 MAY 79	29 MAY - 15 JUN 79	9-27 JUL 79	20 AUG - 7 SEPT 79	1-19 OCT 79	12-30 NOV 79	2-18 JAN 80	11-29 FEB 80	24 MAR - 11 APR 80	6-23 MAY 80	16 JUNE - 4 JULY 80
Water jar	0.31 (31/100)	0.57 (57/100)	0.77 (77/100)	0.55 (54/99)	0.98 (97/99)	0.86 (83/97)	1.05 (101/96)	1.94 (124/94)	1.03 (99/96)	1.02 (98/96)	0.89 (85/96)	0.83 (79/95)	0.60 (57/95)	0.57 (54/95)	0.65 (61/94)	0.61 (57/93)
Bath & Foot Tanks	0.05 (5/100)	0.13 (13/100)	0.13 (13/100)	0.07 (7/99)	0.04 (4/99)	0.05 (5/97)	0.11 (11/96)	0.12 (11/94)	0.07 (7/96)	0.14 (13/96)	0.16 (15/96)	0.07 (7/95)	0.06 (6/95)	0.07 (7/95)	0.04 (4/94)	0.11 (10.93)
Flower Vase & Clay Pot Base	0.04 (4/100)	0.04 (4/100)	0.02 (2/100)	0.03 (3/99)	0.04 (4/99)	0.03 (3/97)	0.01 (1/96)	0.03 (3/94)	0.03 (3/96)	0.04 (4/96)	0.04 (4/96)	0.07 (7/95)	0.04 (4/95)	0.03 (3/95)	0.03 (3/94)	0.02 (2/93)
Ant Trap	0.22 (22/100)	0.33 (33/100)	0.16 (16/100)	0.12 (12/99)	0.17 (17/99)	0.16 (16/97)	0.19 (18/96)	0.20 (19/94)	.17 (16/96)	0.07 (7/96)	.09 (9/96)	0.04 (4/95)	0.03 (3/95)	0.05 (5/95)	0.10 (9/94)	0.18 (17/93)
Other[1]	0.04 (4/100)	0.03 (3/100)	0.0 (0/57)	0.02 (2/99)	0.02 (2/99)	0.01 (1.97)	0.02 (2/96)	0.02 (2/94)	.01 (1/96)	.01 (1/96)	.01 (1/96)	0.01 (1/95)	0.00 (0/95)	0.0 (0/95)	0.00 (0/94)	0.00 (0/93)
Total	0.66 (66/100)	1.10 (110/100)	1.08 (108/100)	0.79 (78/99)	1.18 (117/99)	1.11 (108/97)	1.39 (133/96)	1.69 (159/94)	1.31 (126/96)	1.28 (123/96)	1.19 (114/96)	1.03 (98/95)	0.74 (70/95)	0.73 (69/95)	0.82 (77/94)	0.92 (86/93)

[1] Plastic containers, pails, wash pans and other artificial containers emptied on a daily basis not included.

Table 3. Positive container index for immature *Aedes aegypti* per high-rise flat (inside), Din Daeng, Bangkok, Thailand (1978-80).

Containers	Date of Survey															
	3-18 APR 78	30 MAY - 15 JUN 78	18-28 SEPT 78	6-15 DEC 78	5-22 MAR 79	16 APR - 4 MAY 79	29 MAY - 15 JUN 79	9-27 JUL 79	20 AUG - 7 SEPT 79	1-19 OCT 79	12-30 NOV 79	2-18 JAN 80	11-29 FEB 80	24 MAR - 11 APR 80	6-23 MAY 80	16 JUNE - 4 JULY 80
Water jar	0.10 (5/49)	0.16 (8/49)	0.27 (13/49)	0.16 (8/49)	0.10 (5/48)	0.15 (7/48)	0.17 (8/47)	0.25 (12/48)	0.27 (13/48)	0.25 (12/48)	0.16 (8/49)	0.10 (5/48)	0.10 (5/48)	0.17 (8/48)	0.15 (7/47)	0.13 (6/47)
Bath & Foot Tanks	0.02 (1/49)	0.02 (1/49)	0.06 (3/49)	0.02 (1/49)	0.02 (1/48)	0.0 (0/48)	0.0 (0/47)	0.08 (4/48)	0.02 (1/48)	0.02 (1/48)	0.02 (1/49)	0.0 (0/48)	0.0 (0/48)	0.02 (1/48)	0.0 (0/47)	0.04 (2/47)
Flower Vase & Clay Pot Base	0.0 (0/49)	0.06 (3/49)	0.0 (0/49)	0.0 (0/49)	0.04 (2/48)	0.0 (0/48)	0.0 (0/47)	0.0 (0/48)	0.0 (0/48)	0.0 (0/48)	0.0 (0/49)	0.0 (0/48)	0.0 (0/48)	0.0 (0/48)	0.0 (0/47)	0.0 (0/47)
Ant Trap	0.14 (7/49)	0.06 (3/49)	0.04 (2/49)	0.0 (0/49)	0.0 (0/48)	0.0 (0/48)	0.09 (4/47)	0.04 (2/48)	0.02 (1/48)	0.0 (0/48)	0.06 (3/49)	0.02 (1/48)	0.0 (0/48)	0.0 (0/48)	0.02 (1/47)	0.06 (3/47)
Other[1]	0.0 (0/49)	0.0 (0/49)	0.0 (0/49)	0.0 (0/49)	0.0 (0/48)	0.0 (0/48)	0.0 (0/47)	0.0 (0/48)	0.0 (0/48)	0.0 (0/48)	0.0 (0/49)	0.0 (0/48)	0.0 (0/48)	0.0 (0/48)	0.0 (0/47)	0.0 (0/47)
Total	0.27 (13/49)	0.30 (15/49)	0.37 (18/49)	0.18 (9/49)	0.17 (8/48)	0.15 (7/48)	0.26 (12/47)	0.38 (18/48)	0.31 (15/48)	0.27 (13/48)	0.24 (12/49)	0.13 (6/48)	0.10 (5/48)	0.19 (9/48)	0.17 (8/47)	0.23 (11/47)

[1] Plastic containers, pails, wash pans and other artificial containers emptied on a daily basis not included.

Table 4. Positive container index for immature *Aedes aegypti* per shop residence (outside-inside) Din Daeng, Bangkok, Thailand (1978-80).

Containers	Date of Survey															
	3-18 APR 78	30 MAY - 15 JUN 78	18-28 SEPT 78	6-15 DEC 78	5-22 MAR 79	16 APR - 4 MAY 79	29 MAY - 15 JUN 79	9-27 JUL 79	20 AUG - 7 SEPT 79	4-19 OCT 79	12-30 NOV 79	2-18 JAN 80	11-29 FEB 80	24 MAR - 11 APR 80	6-23 MAY 80	16 JUNE - 4 JULY 80
Water Jar	0.15 (3/20)	0.32 (6/19)	0.47 (8/17)	0.35 (6/17)	0.82 (14/17)	0.69 (11/16)	0.94 (16/17)	1.13 (18/16)	0.71 (12/17)	0.94 (16/17)	0.94 (17/18)	0.61 (11/18)	0.39 (7/18)	0.72 (13/18)	0.72 (13/18)	0.67 (12/18)
Bath & Foot Tanks	0.15 (3/20)	0.5 (10/19)	0.53 (9/17)	0.35 (6/17)	0.18 (3/17)	0.31 (5/16)	0.59 (10/17)	0.38 (6/16)	0.29 (5/17)	0.65 (11/17)	0.61 (11/18)	0.39 (7/18)	0.33 (6/18)	0.33 (6/18)	0.22 (4/18)	0.44 (8/18)
Flower Vase & Clay Pot Base	0.2 (4/20)	0.05 (1/19)	0.12 (2/17)	0.18 (3/17)	0.11 (2/17)	0.19 (3/16)	0.06 (1/17)	0.19 (3/16)	0.18 (3/17)	0.24 (4/17)	0.22 (4/18)	0.33 (6/18)	0.22 (4/18)	0.17 (3/18)	0.17 (3/18)	0.11 (2/18)
Ant Trap	0.2 (4/20)	0.79 (15/19)	0.29 (5/17)	0.18 (3/17)	0.35 (6/17)	0.44 (7/16)	0.24 (4/17)	0.38 (6/16)	0.29 (5/17)	0.18 (3/17)	0.22 (4/18)	0.06 (1/18)	0.17 (3/18)	0.11 (2/18)	0.28 (5/18)	0.28 (5/18)
Other[1]	0.0 (0/20)	0.0 (0/19)	0.0 (0/17)	0.0 (0/17)	0.0 (0/17)	0.0 (0/16)	0.0 (0/17)	0.0 (0/16)	0.0 (0/17)	0.0 (0/17)	0.0 (0/18)	0.0 (0.18)	0.0 (0/18)	0.0 (0/18)	0.0 (0/18)	0.0 (0/18)
Total	0.7 (14/20)	1.7 (32/19)	1.41 (24/17)	1.06 (18/17)	1.47 (25/17)	1.63 (26/16)	1.82 (31/17)	2.06 (33/16)	1.47 (25/17)	2.0 (34/17)	2.0 (36/18)	1.39 (25/18)	1.11 (20/18)	1.33 (24/18)	1.39 (25/18)	1.50 (27/18)

[1] Plastic containers, pails, wash pans and other artificial containers emptied on a daily basis not included.

Table 5. Positive container index for immature *Aedes aegypti* per slum residence (outside-inside) Din Daeng, Bangkok, Thailand (1978-80).

Containers	Date of Survey															
	3-18 APR 78	30 MAY - 15 JUN 78	18-28 SEPT 78	6-15 DEC 78	5-22 MAR 79	16 APR - 4 MAY 79	29 MAY - 15 JUN 79	9-27 JUL 79	20 AUG - 7 SEPT 79	1-19 OCT 79	12-30 NOV 79	2-18 JAN 80	11-29 FEB 80	24 MAR - 11 APR 80	6-23 MAY 80	16 JUNE - 4 JULY 80
Water Jar	0.74 (23/31)	1.34 (43/32)	1.65 (56/34)	1.21 (40/33)	2.09 (71/34)	1.97 (65/33)	2.41 (77/32)	3.13 (94/30)	2.39 (74/31)	2.26 (70/31)	2.07 (60/29)	2.17 (63/29)	1.55 (45/29)	1.14 (33/29)	1.41 (41/29)	1.39 (39/28)
Bath & Foot Tanks	0.03 (1/31)	0.06 (2/32)	0.03 (1/34)	0.0 (0/33)	0.0 (0/34)	0.0 (0/33)	0.03 (1/32)	0.03 (1/30)	0.03 (1/31)	0.03 (1/31)	0.10 (3/29)	0.0 (0/29)	0.0 (0/29)	0.0 (0/29)	0.0 (0/29)	0.0 (0/28)
Flower Vase Clay Pot Base	0.0 (0/31)	0.0 (0/32)	0.0 (0/34)	0.0 (0/33)	0.0 (0/34)	0.0 (0/33)	0.0 (0/32)	0.0 (0/30)	0.0 (0/31)	0.0 (0/31)	0.0 (0/29)	0.03 (1/29)	0.0 (0/29)	0.0 (0/29)	0.0 (0/29)	0.0 (0/28)
Ant Trap	0.35 (11/31)	0.47 (15/32)	0.26 (9/34)	0.27 (9/33)	0.32 (11/34)	0.27 (9/33)	0.31 (10/32)	0.37 (11/30)	0.32 (10/31)	0.13 (4/31)	0.07 (2/29)	0.07 (2/29)	0.0 (0/29)	0.10 (3/29)	0.10 (3/29)	0.32 (9/28)
Other[1]	0.13 (4/31)	0.09 (3/32)	0.0 (0/34)	0.06 (2/33)	0.06 (2/34)	0.03 (1/33)	0.06 (2/32)	0.07 (2/30)	0.03 (1/31)	0.03 (1/31)	0.03 (1/29)	0.03 (1/29)	0.0 (0/29)	0.0 (0/29)	0.0 (0/29)	0.0 (0/28)
Total	1.26 (39/31)	1.97 (63/32)	1.94 (66/34)	1.55 (51/33)	2.47 (84/34)	2.27 (75/33)	2.81 (90/32)	3.60 (108/30)	2.77 (86/31)	2.45 (76/31)	2.28 (66/29)	2.31 (67/29)	1.55 (45/29)	1.24 (36/29)	1.52 (44/29)	1.71 (48/28)

[1] Plastic containers, pails, wash pans and other artificial containers emptied on a daily basis not included.

Table 6. Percent seasonal changes in study residences having different types of containers positive for *Aedes aegypti*, Din Daeng, Bangkok, Thailand, 1978-80.

Containers	Date of Survey															
	3-18 - APR 78	30 MAY - 15 JUN 78	18-28 SEPT 78	6-16 DEC 78	5-22 MAR 79	16 APR - 4 MAY 79	29 MAY - 15 JUN 79	9-29 JUL 79	20 AUG - 7 SEPT 79	1-19 OCT 79	12-30 NOV 79	2-18 JAN 80	11-29 FEB 80	26 MAR - 11 APR 80	6-23 MAY 80	16 JUNE - 4 JULY 80
Water Jar	19.0 (19/100)	29.0 (29/100)	39.0 (39/100)	30.3 (30/99)	38.4 (38/99)	35.1 (35/97)	37.6 (36/96)	45.7 (43/94)	42.7 (41/96)	41.7 (40/96)	38.5 (37/96)	35.8 (34/95)	31.6 (30/95)	27.4 (26/95)	30.9 (29/94)	31.2 (29/93)
Bath & Foot Tanks	5.0 (5/100)	13.0 (13/100)	12.0 (12/100)	7.1 (7/99)	4.0 (4/99)	4.1 (4/97)	9.4 (9/96)	10.6 (10/94)	6.2 (6/96)	12.5 (12/96)	11.5 (11/96)	5.3 (5/95)	5.3 (5/95)	6.3 (6/95)	4.3 (4/94)	8.6 (8/93)
Flower Vase & Clay Pot Base	2.0 (2/100)	3.0 (3/100)	2.0 (2/100)	2.0 (2/99)	4.0 (4/99)	2.1 (2/97)	0.0 (0/96)	1.1 (1/94)	1.0 (1/96)	2.1 (2/96)	1.0 (1/96)	3.2 (3/95)	2.1 (2/95)	1.1 (1/95)	1.1 (1/94)	1.1 (1/93)
Ant Trap	10.0 (10/100)	9.0 (9/100)	8.0 (8/100)	5.1 (5/99)	5.1 (5/99)	7.2 (7/97)	6.3 (6/96)	8.5 (8/94)	8.3 (8/96)	3.1 (3/96)	5.2 (5/96)	3.2 (3/95)	1.1 (1/95)	3.2 (3/95)	4.3 (4/94)	6.5 (6/93)
Other[1]	3.0 (3/100)	3.0 (3/100)	0.0 (0/100)	1.0 (1/99)	2.0 (2/99)	1.0 (1/97)	2.1 (2/96)	2.1 (2/96)	1.0 (1/96)	1.0 (1/96)	1.0 (1/96)	1.0 (1/95)	0.0 (0/95)	0.0 (0/95)	0.0 (0/94)	0.0 (0/93)
Total[2]	29.0 (29/100)	43.0 (43/100)	53.0 (53/100)	38.4 (38/99)	42.4 (42/99)	42.3 (41/97)	46.8 (44/96)	53.2 (50/94)	49.0 (47/96)	47.9 (46/96)	47.9 (46/96)	42.1 (40/95)	36.8 (34/95)	31.6 (30/95)	33.0 (31/94)	39.8 (37/93)
Inside Containers	25.0 (25/100)	37.0 (37/100)	46.0 (46/100)	34.3 (34/99)	36.4 (36/99)	33.0 (32/97)	42.7 (41/96)	51.1 (48/94)	46.9 (45/96)	46.9 (44/96)	46.9 (45/96)	40.0 (38/95)	32.6 (31/95)	30.5 (29/95)	28.7 (27/94)	36.6 (34/93)
Outside Containers	8.0 (8/100)	14.0 (14/100)	15.0 (15/100)	10.1 (10/99)	17.2 (17/99)	17.5 (17/97)	13.5 (13/96)	16.0 (15/94)	25.0 (12/48)	20.8 (10/48)	23.4 (11/47)	25.5 (12/47)	11.6 (11/95)	5.3 (5/95)	10.6 (10/94)	9.7 (9/93)

1 Plastic containers, pails, wash pans and other artificial containers emptied on a daily basis not included.

2 Residences positive for more than one type of container or positive both inside and outside only counted once.

Table 7. Emergence Trap : Seasonal variation of positive emergence traps for AFRIMS ong jar[1] for houses, Din Daeng, Bangkok, 1979-80.

Date of Survey	Number Jars Surveyed			Number Jars Positive for *A. aegypti* Larvae & Pupae			Number of Emergence Traps Positive			Percent Traps Positive for Positive Jars		
	Inside	Outside	Total	Inside	Outside	Total	Inside	Outside	Total	Inside	Outside	Total
22 JAN - 15 FEB 79	75	6	81	24	5	29	9	5	14	37.5	100.0	48.3
5-21 MAR 79	76	7	83	17	3	20	10	1	11	58.8	33.3	55.0
16 APR - 4 MAY 79	74	6	80	16	3	19	4	0	4	25.0	0.0	21.1
9-27 JULY 79	79	1	80	24	1	25	13	0	13	54.2	0.0	52.0
20 AUG - 6 SEPT 79	76	1	77	26	0	26	7	0	7	26.9	0.0	26.9
1-18 OCT 79	74	2	76	19	1	20	6	0	6	31.6	0.0	30.0
13-29 NOV 79	73	3	76	19	1	20	7	0	7	36.8	0.0	35.0
2-18 JAN 80	74	3	77	15	1	16	3	0	3	20.0	0.0	18.8
11-29 FEB 80	72	6	78	13	1	14	1	0	1	7.7	0.0	7.1
24 MAR - 11 APR 80	73	4	77	11	1	12	2	1	3	18.2	100.0	25.0
6-23 MAY 80	74	4	78	10	2	12	1	2	3	10.0	100.0	25.0
16 JUNE - 4 JULY 80	75	6	81	13	5	18	6	3	9	46.2	60.0	50.0

[1] One standard size ong jar (40 cm x 80 cm) was placed in each household for trapping purposes.

Table 8. LARVAL TRAP: Average number of immature *Aedes aegypti* per positive ong (water) jar trapped for study residences, Din Daeng, Bangkok, Thailand, (1979-80)

Date of Survey	Average number of larvae per sampled ong jar			Average number of pupae per sampled ong jar			Average number of larvae & pupae sampled ong jar		
	Inside	Outside[1]	Total	Inside	Outside[1]	Total	Inside	Outside[1]	Total
24 JAN - 15 FEB 79	-	-	-	-	-	-	33.9 (1626/48)	39.3 (785/20)	35.5 (2411/68)
5-22 MAR 79	-	-	-	-	-	-	33.9 (1932/57)	25.4 (915/36)	30.6 (2847/93)
16 APR - 4 MAY 79	35.3 (1942/55)	16.6 (466/28)	29.0 (2408/83)	1.0 (54/55)	1.1 (30/28)	1.0 (84/83)	36.3 (1996/55)	17.7 (496/28)	30.0 (2492/83)
29 MAY - 15 JUN 79	38.6 (2778/72)	40.2 (1086/27)	39.0 (3864/99)	1.5 (111/72)	2.9 (78/27)	1.9 (189/99)	40.1 (2889/72)	43.1 (1164/27)	40.9 (4053/99)
9-27 JUL 79	33.2 (2720/82)	20.2 (788/39)	29.0 (3508/121)	0.88 (72/82)	0.62 (24/39)	0.79 (96/121)	34.04 (2792/82)	20.8 (812/39)	29.8 (3604/121)
20 AUG - 7 SEPT 79	37.7 (2712/72)	23.0 (576/25)	33.9 (3288/97)	2.2 (160/72)	0.8 (19/25)	1.9 (179/97)	39.9 (2872/72)	23.8 (595/25)	35.7 (3467/97)
1-19 OCT 79	41.9 (3139/75)	18.8 (413/22)	36.6 (3552/97)	1.2 (88/75)	2.9 (63/22)	1.6 (151/97)	43.0 (3227/75)	21.6 (476/22)	38.2 (3703/97)
12-30NOV 79	23.0 (1562/68)	34.7 (590/17)	25.3 (2152/85)	1.2 (79/68)	1.4 (23/17)	1.2 (102/85)	24.1 (1641/68)	36.1 (613/17)	26.5 (2254/85)
2-18 JAN 80	41.7 (2333/56)	19.8 (476/24)	35.1 (2809/80)	1.1 (60/56)	2.2 (52/24)	1.4 (112/80)	42.8 (2375/56)	22.0 (528/24)	36.3 (2903/80)
11-29 FEB80	35.9 (1435/40)	17.9 (305/17)	30.5 (1740/57)	0.2 (8/40)	0.4 (7/17)	0.2 (14/57)	36.1 (1443/40)	18.4 (312/17)	30.8 (1755/57)
24 MAR - 11 APR 80	18.6 (839/45)	19.2 (173/9)	18.7 (1012/54)	0.7 (32/45)	0.8 (7/9)	0.7 (39/54)	19.4 (871/45)	20.0 (180/9)	19.5 (1051/54)
6-23 MAY 80	24.6 (1009/41)	50.4 (1007/20)	33.0 (2016/61)	0.8 (32/41)	3.0 (59/20)	1.5 (91/61)	25.4 (1041/41)	53.3 (1066/20)	34.5 (2107/61)
16 JUNE - 4 JULY 80	36.2 (1410/39)	42.4 (763/18)	38.1 (2173/57)	1.5 (57/39)	2.2 (39/18)	1.7 (96/57)	37.6 (1467/39)	44.6 (802/18)	39.8 (2269/57)

1 Only includes slum & shop study residences.

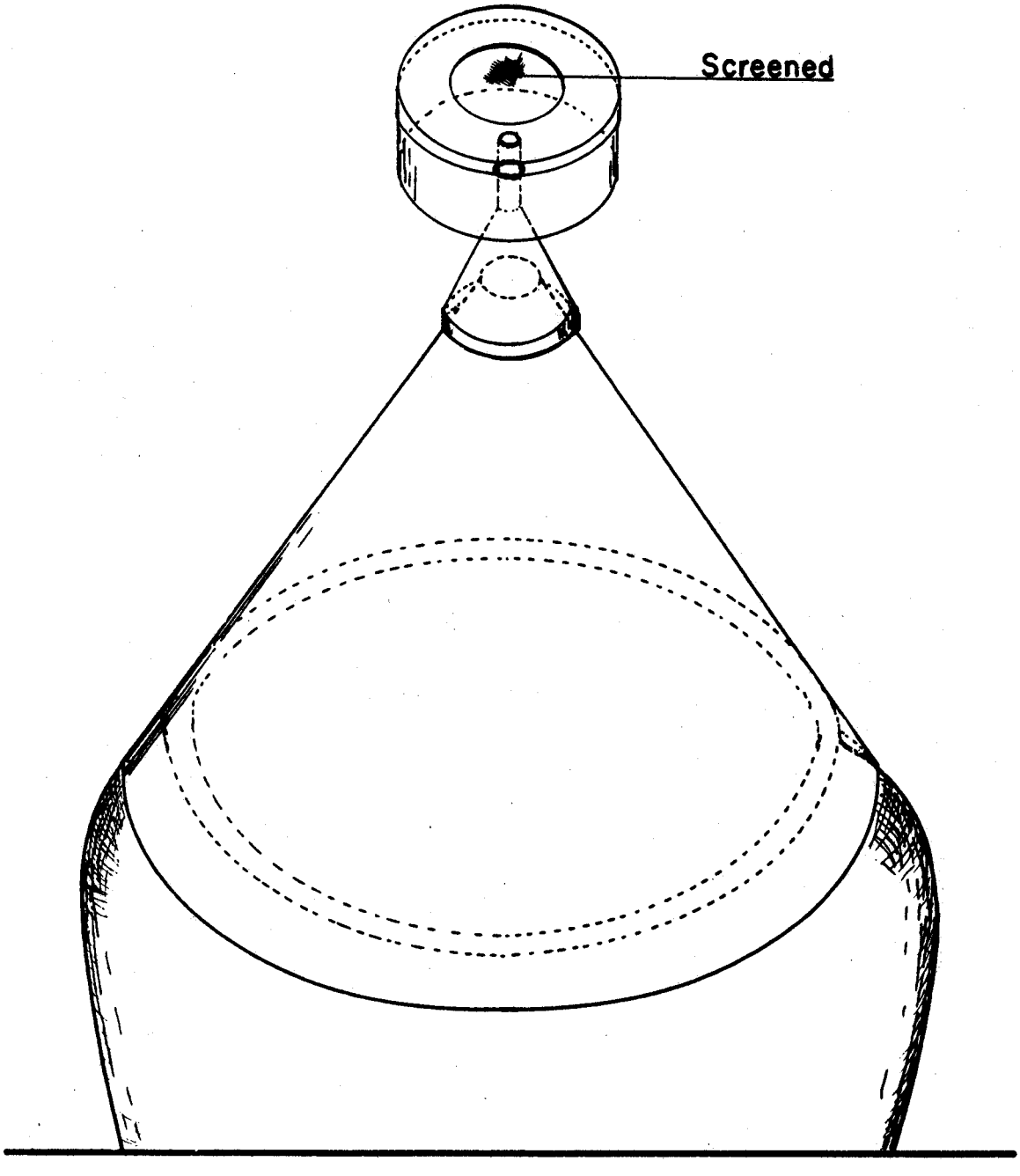

FIGURE I. EMERGENCE TRAP DESIGN

AFRIMS LARVAL TRAP

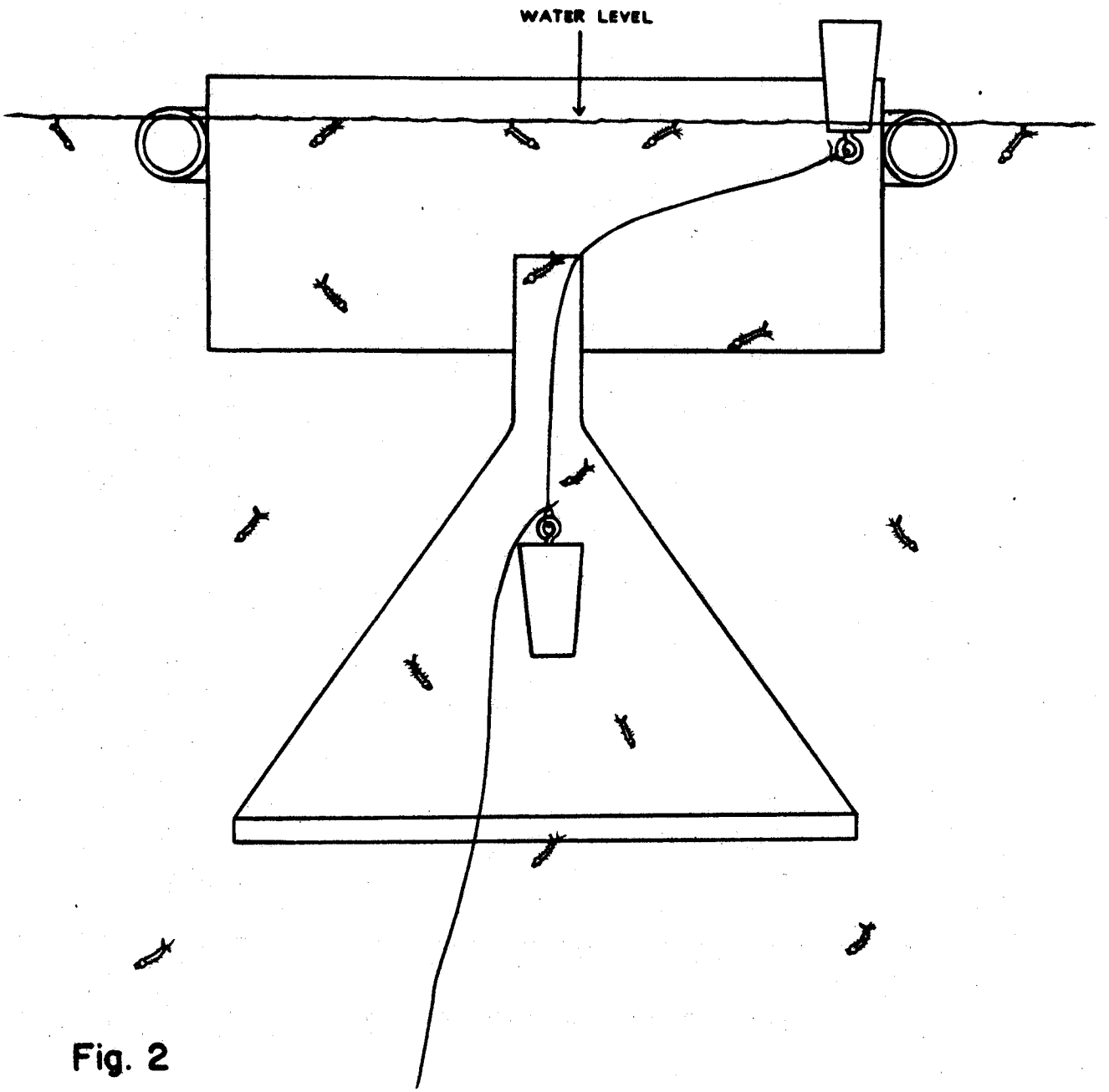

Fig. 2

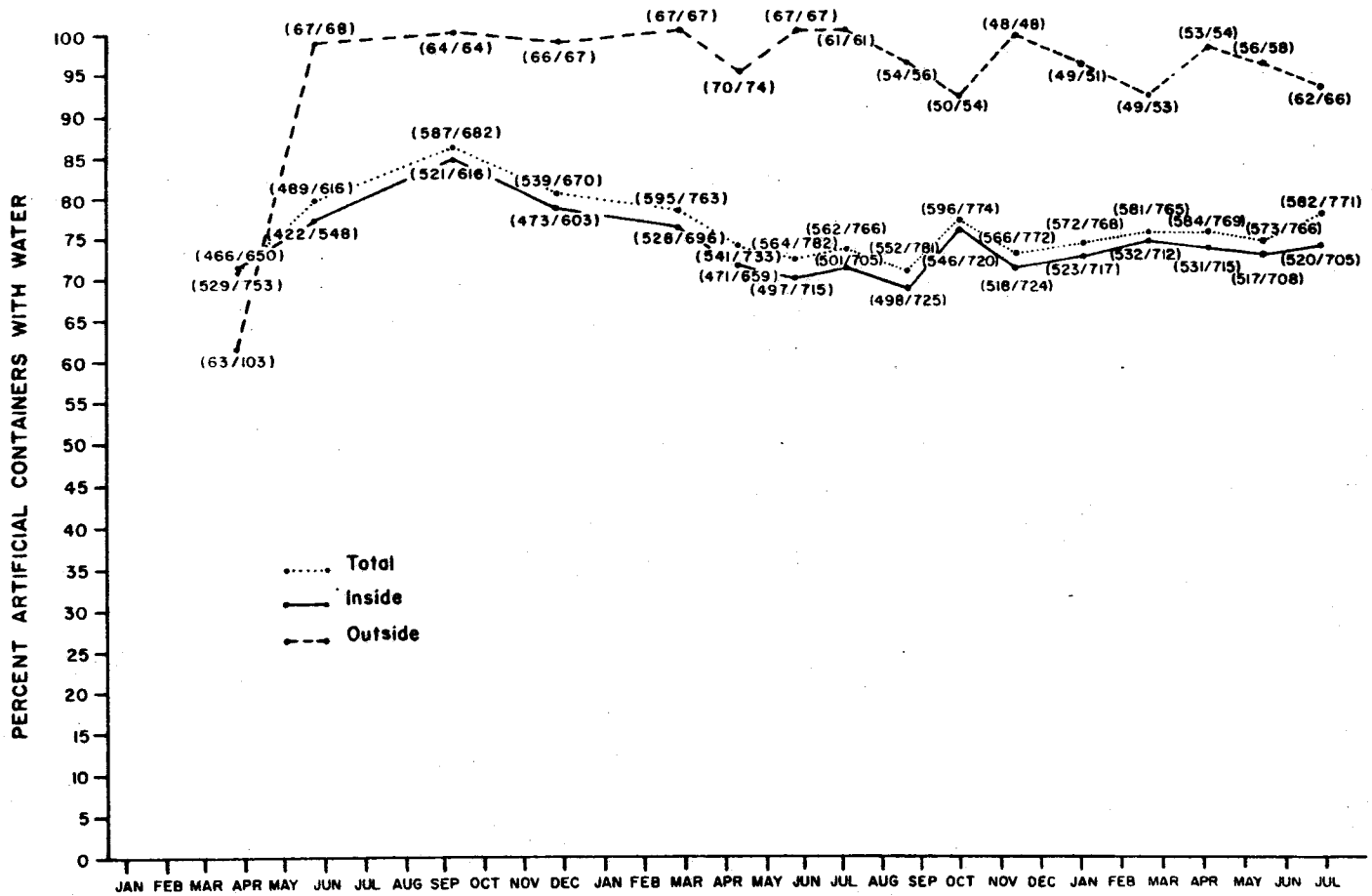

Figure 3 Percentage of artificial water containers[1] with water at study residences, Din Daeng, Bangkok, Thailand. (1978-80)

[1] Plastic containers, pails, wash pans and other artificial containers emptied on a daily basis not included.

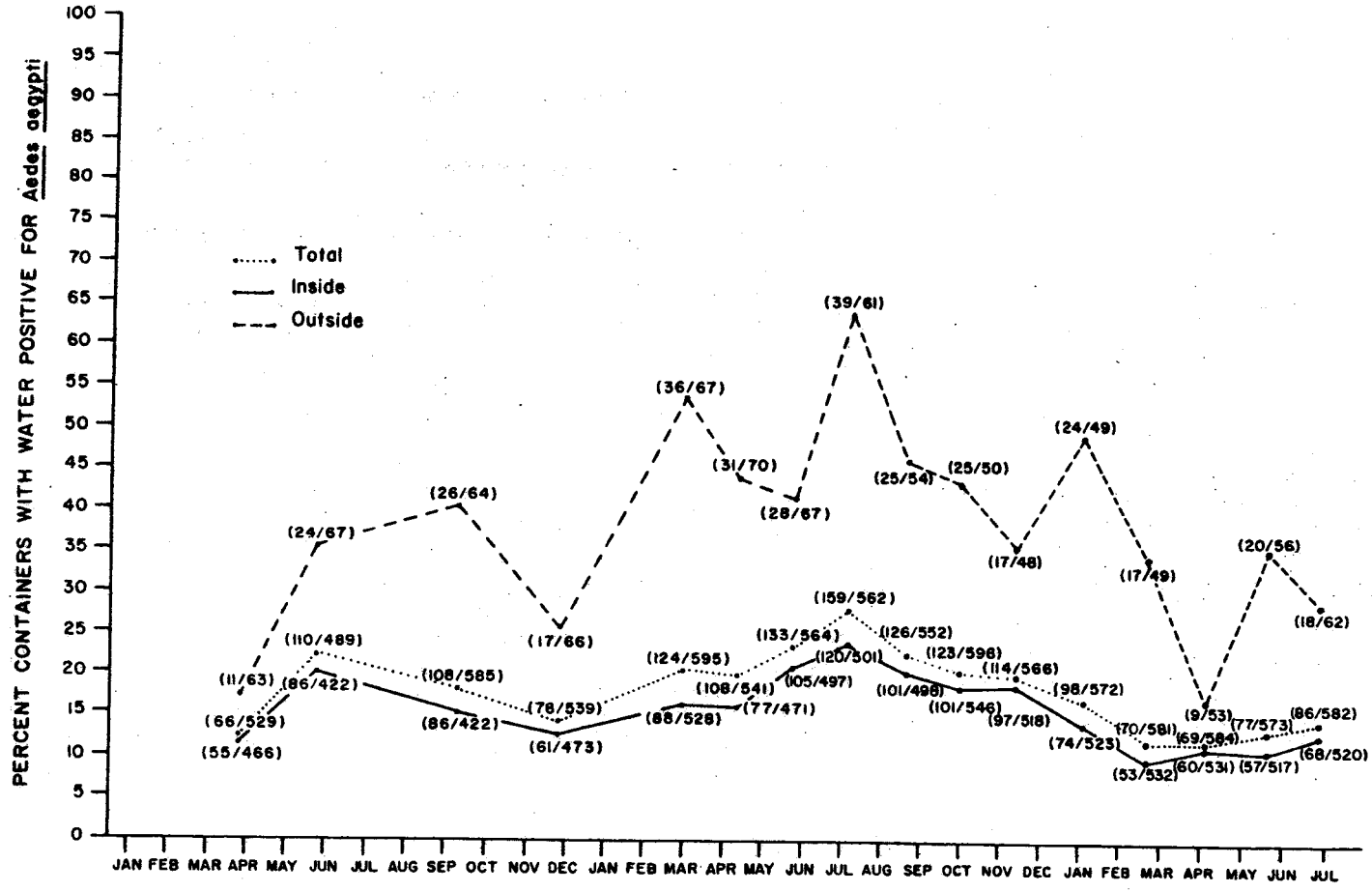

Figure 4 Percent artificial containers[1] with water positive for immature Aedes aegypti inside and outside residences by seasons, Din Daeng, Bangkok, Thailand. (1978-1980)

[1] Plastic containers, pails, wash pans, and other artificial containers emptied on a daily basis not included.

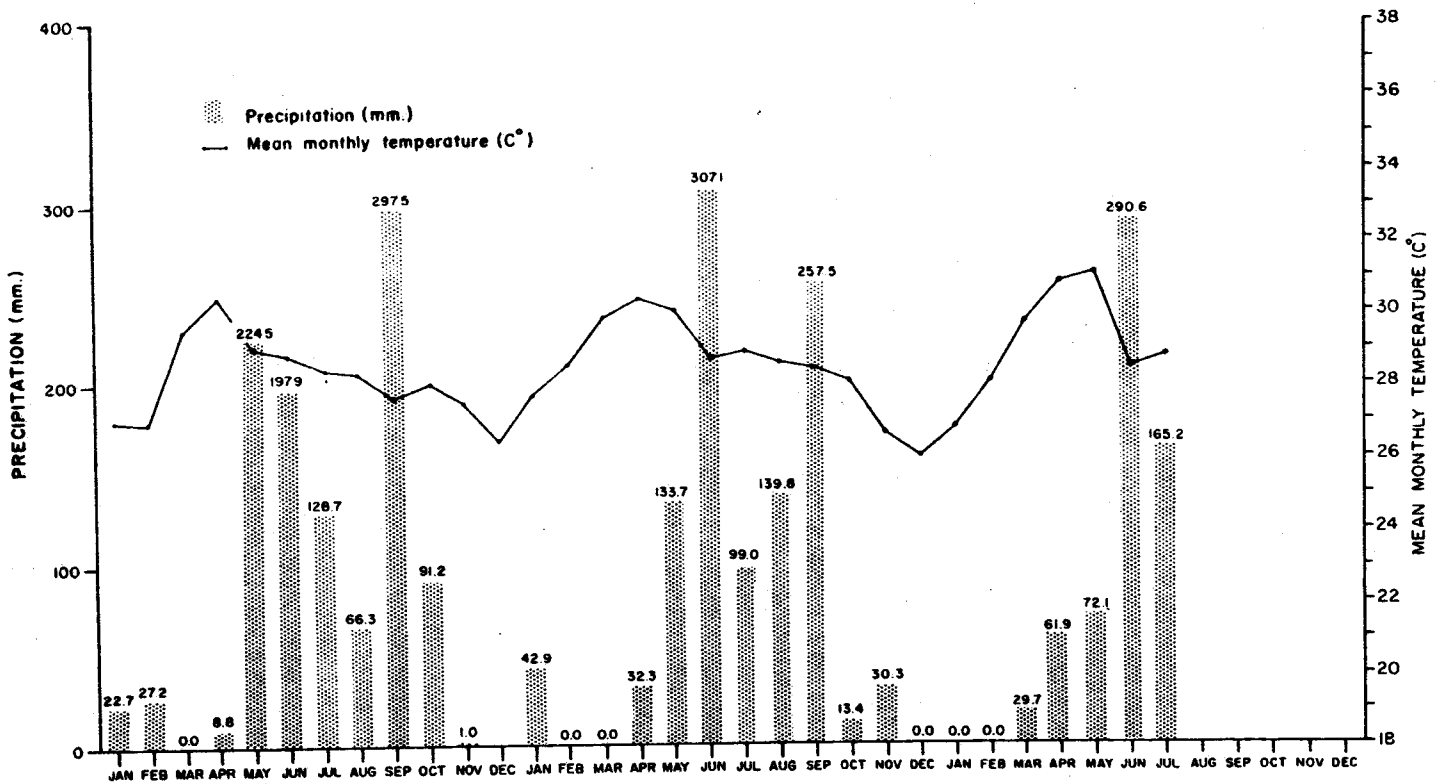

Figure 5 Precipitation[1] and mean monthly temperatures[2] recorded for January 1978 through July 1980.

[1] Engineering School, Meteorological Department, Ministry of Communications, Din Daeng, Bangkok, Thailand.

[2] Climatology Division, Meteorological Department, Ministry of Communications, Bangkok, Thailand.

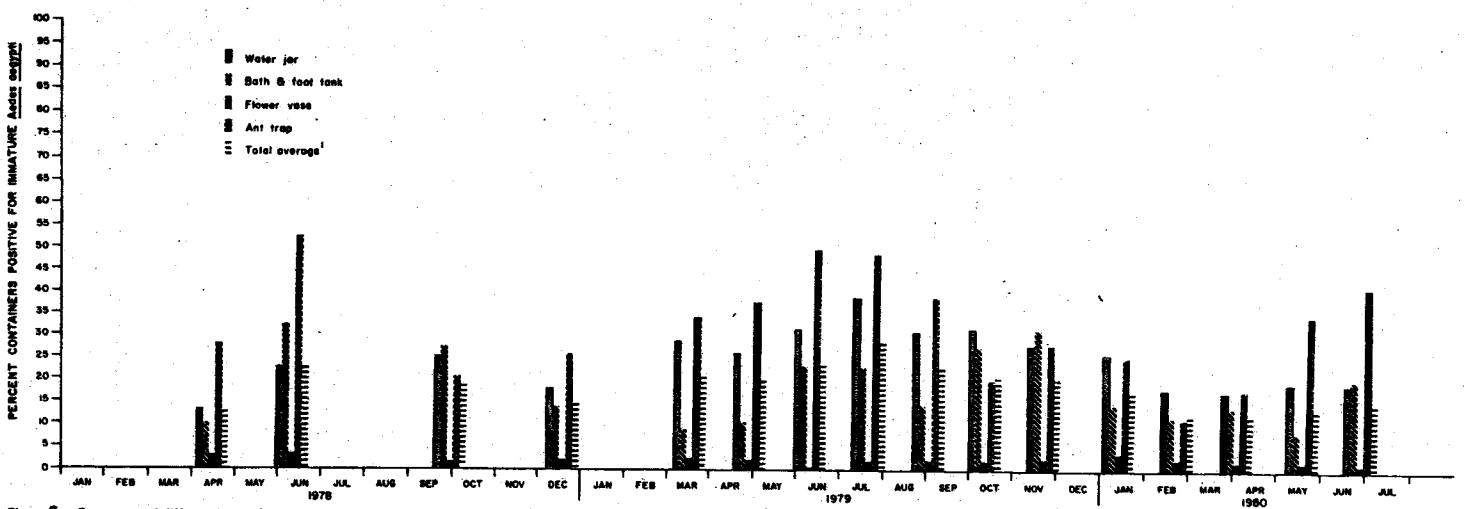

Figure 6 Percentage of different types of containers positive for immature Aedes aegypti inside & outside study residence, Din Daeng, Bangkok, Thailand (1978–1980).

[1] Includes other containers.

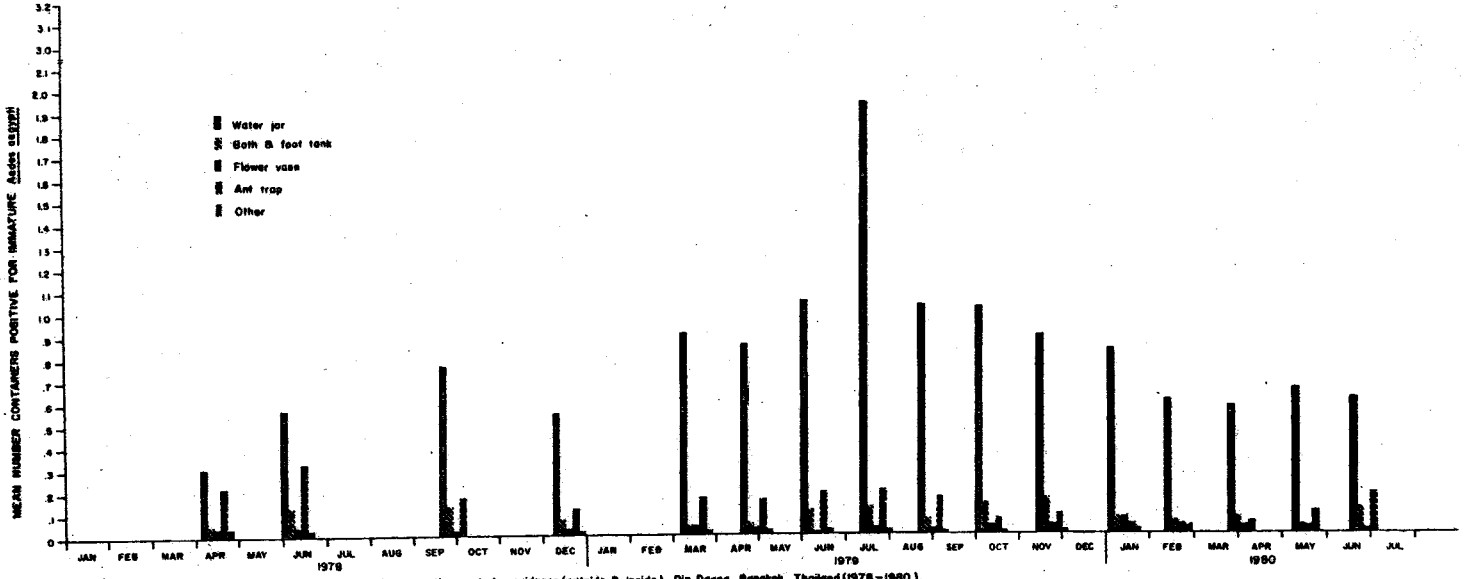

Figure 7 Mean number of containers positive for immature *Aedes aegypti* per study residence (outside & inside), Din Daeng, Bangkok, Thailand (1978–1980).

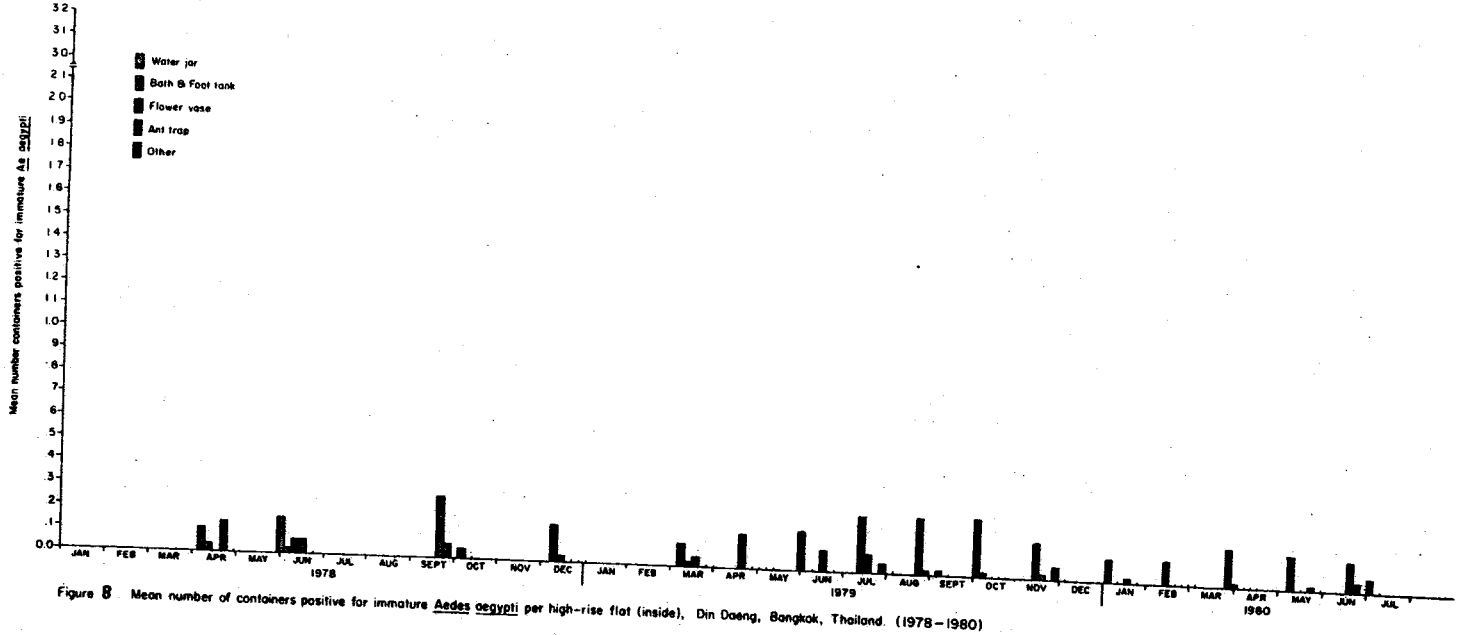

Figure 8 Mean number of containers positive for immature Aedes aegypti per high-rise flat (inside), Din Daeng, Bangkok, Thailand. (1978–1980)

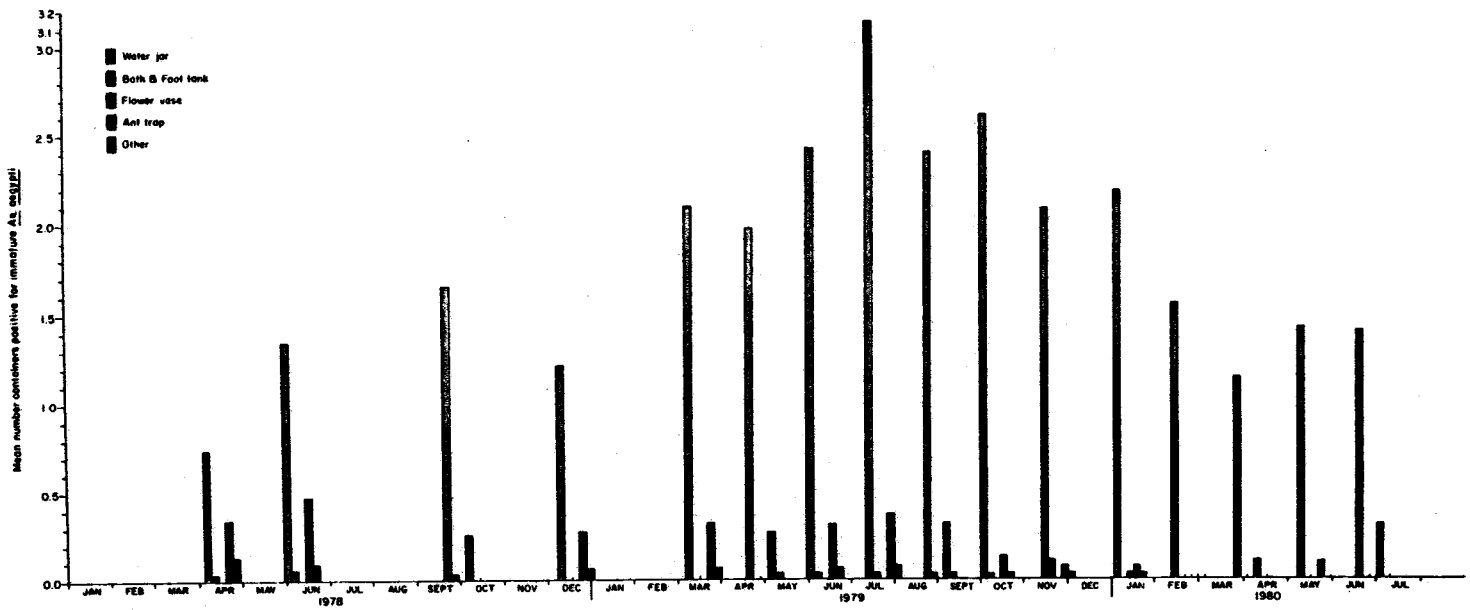

Figure 9. Mean number of containers positive for immature *Aedes aegypti* per slum residence (outside & inside), Din Daeng, Bangkok, Thailand (1978–1980)

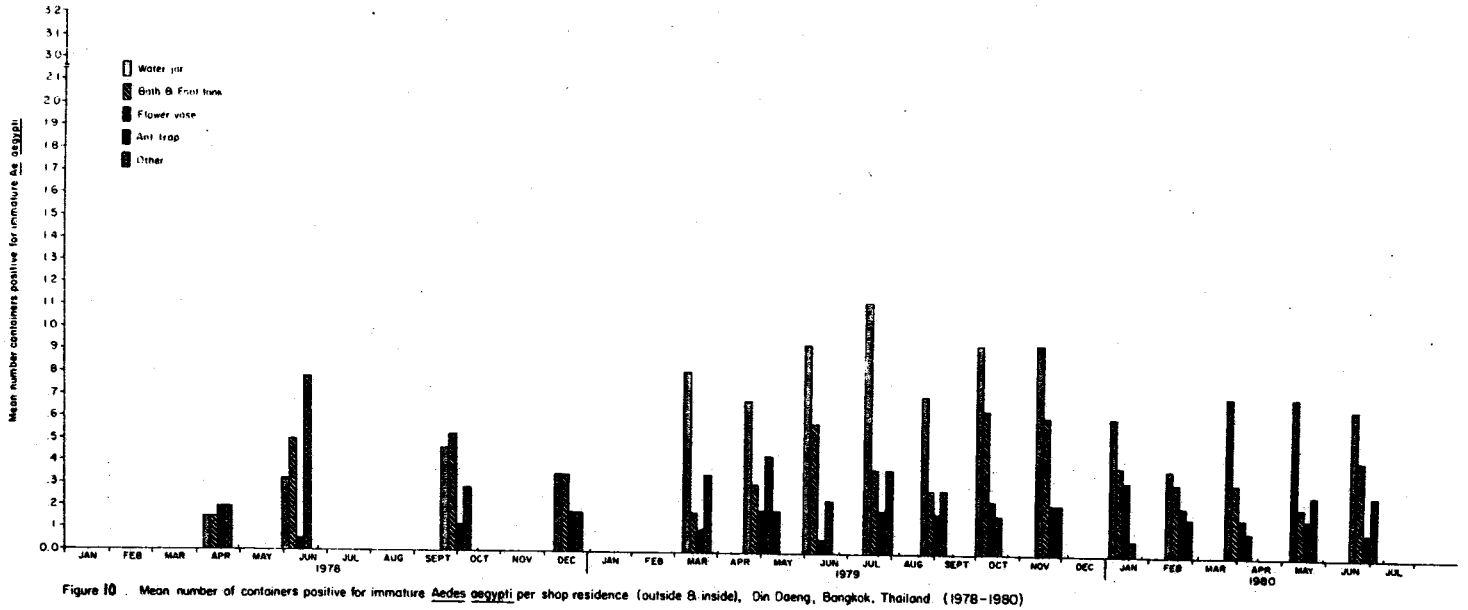

Figure 10 . Mean number of containers positive for immature Aedes aegypti per shop residence (outside & inside), Din Daeng, Bangkok, Thailand (1978-1980)

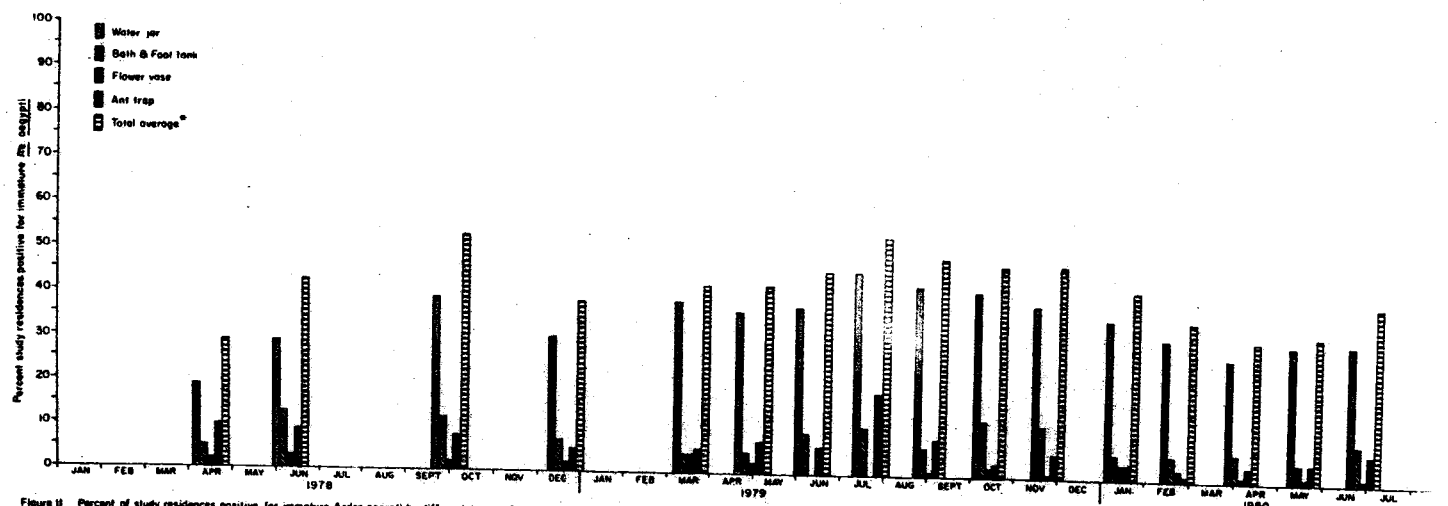

Figure II Percent of study residences positive for immature Aedes aegypti by different types of containers, Din Daeng, Bangkok, Thailand. (1978–1980)

*house positive for more than one type container only counted once

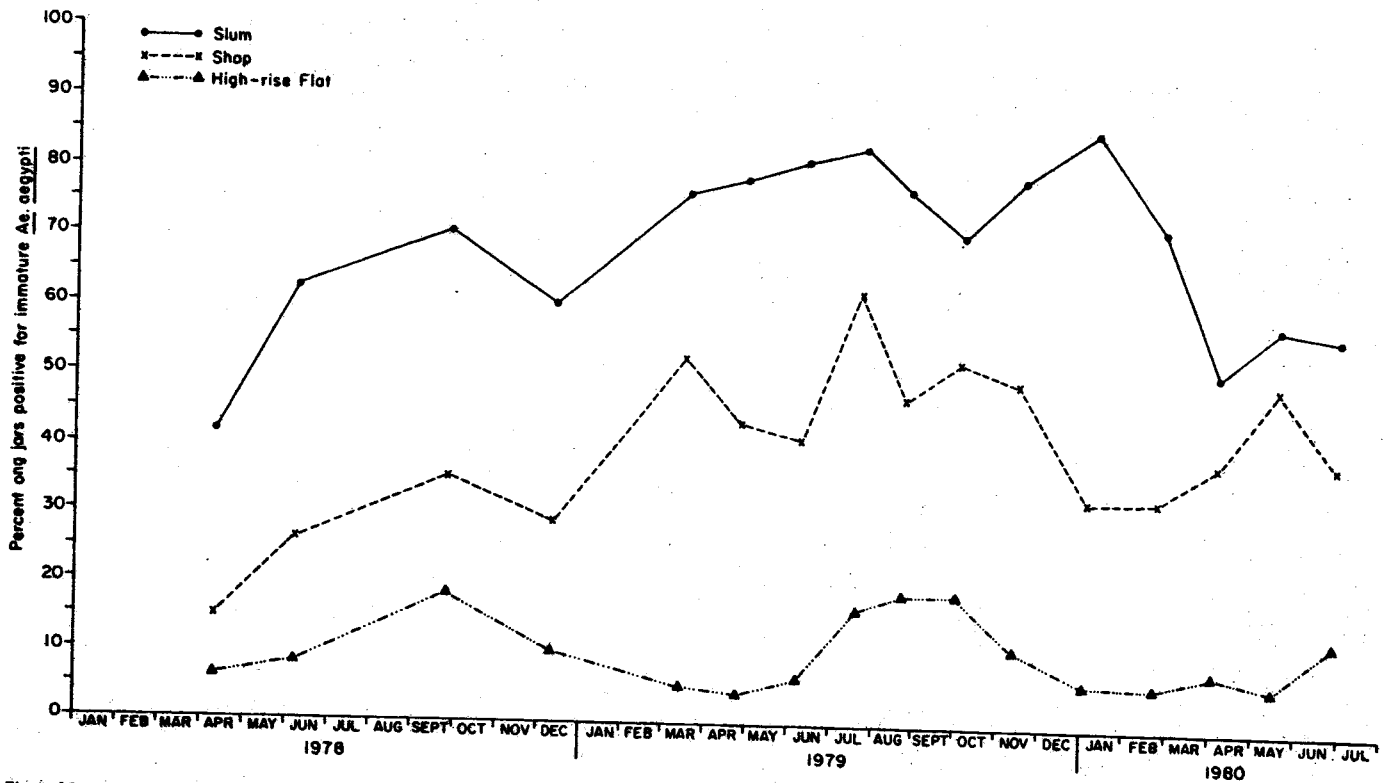

Figure 12 Percent of different type study residences positive inside & outside for immature Aedes aegypti for ong (water) jars, Din Daeng, Bangkok, Thailand. (1978-80)

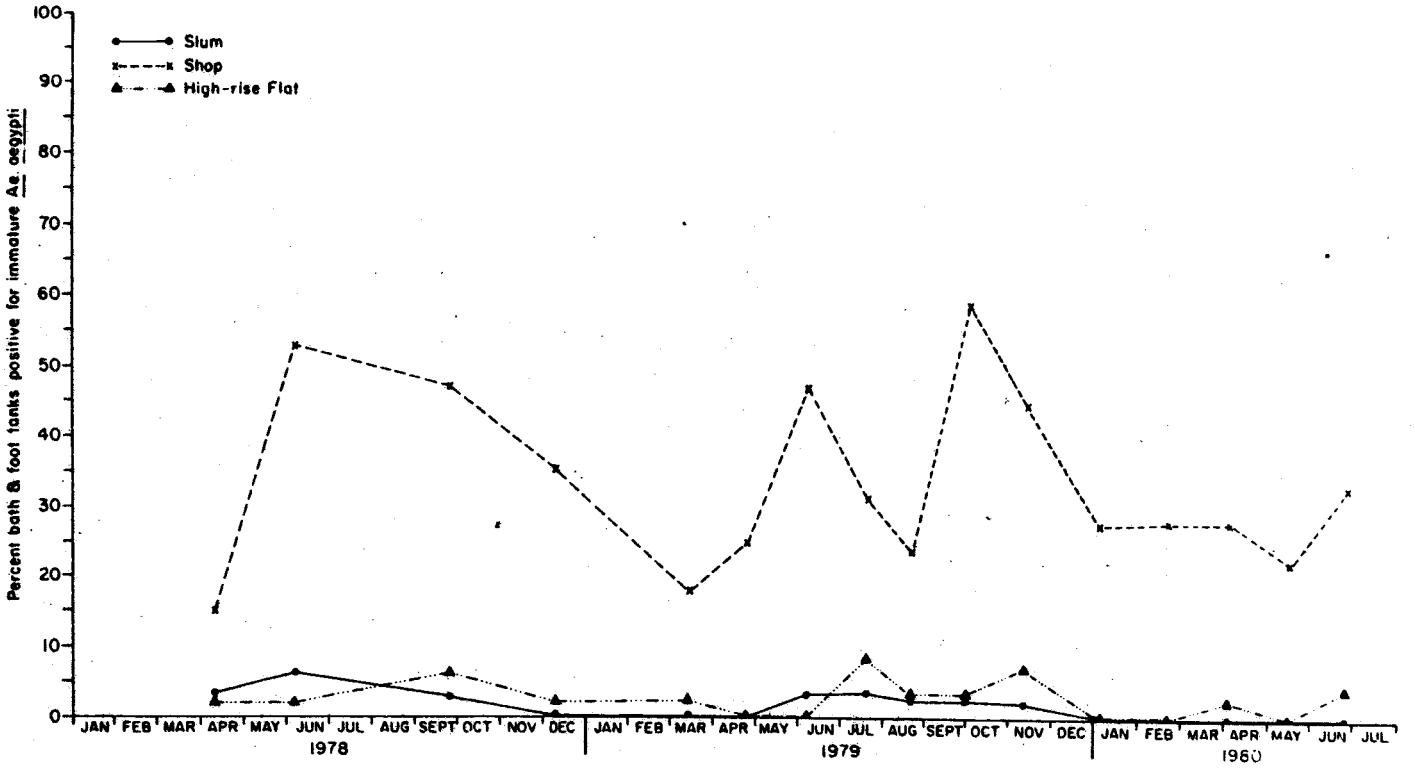

Figure 13 Percent of different type study residences positive inside & outside for immature Aedes aegypti for bath and foot tanks, Din Daeng, Bangkok, Thailand. (1978-80)

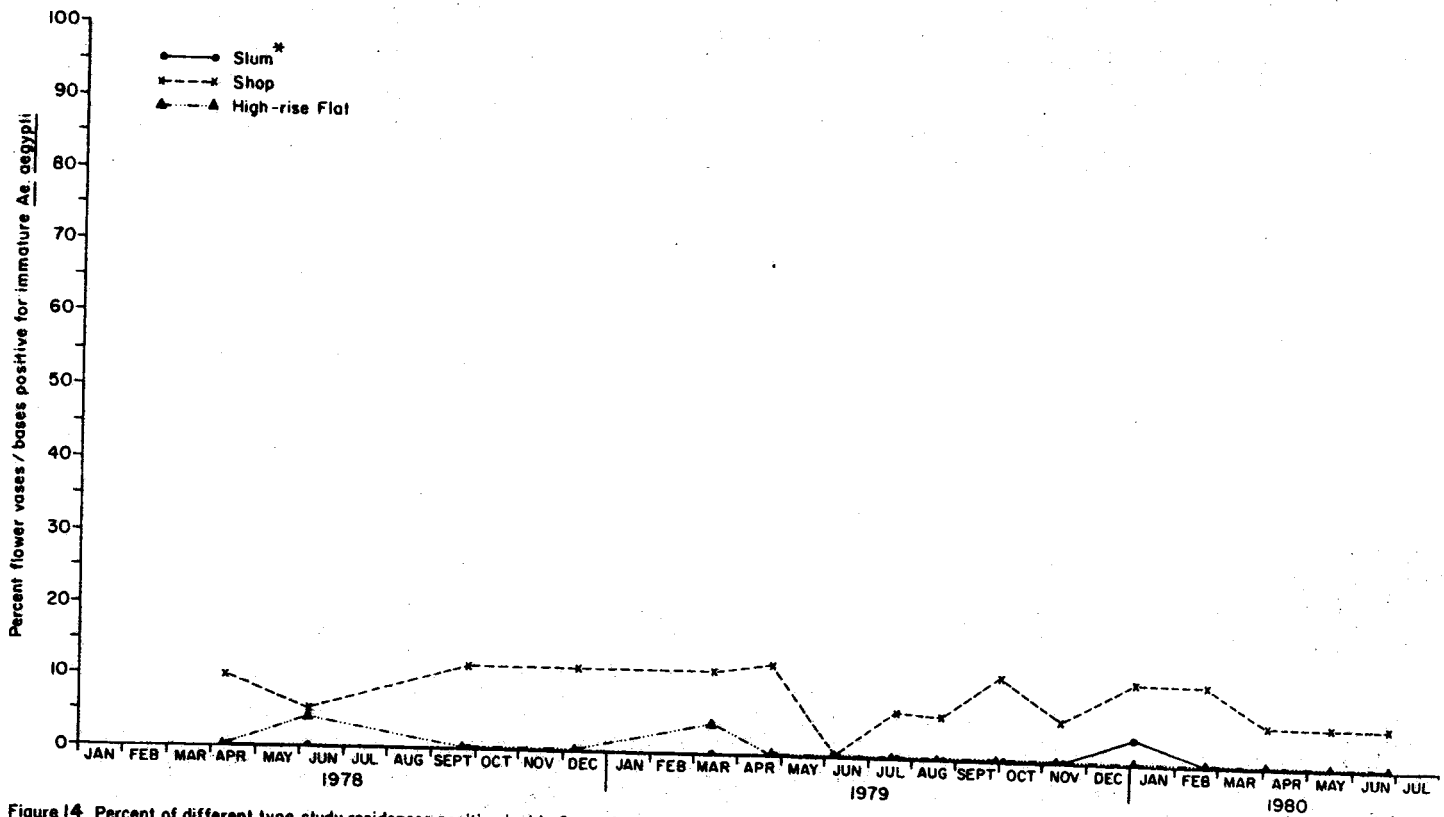

Figure 14 Percent of different type study residences positive inside & outside for immature Aedes aegypti for flower vases and flower pot bases, Din Daeng, Bangkok, Thailand. (1978–1980)

*All flower vases and pot bases observed were negative.

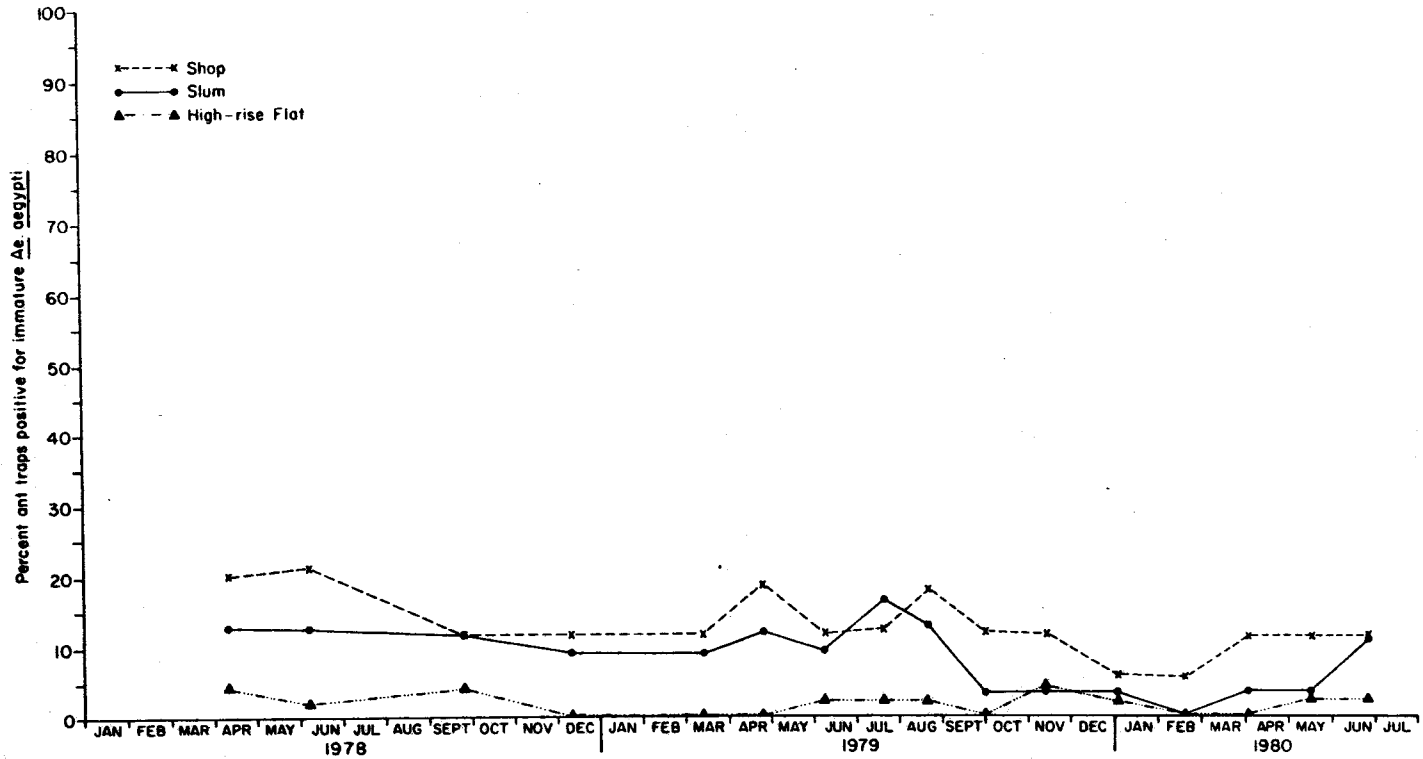

Figure 15 Percent ant traps positive for immature Aedes aegypti inside & outside different types of study residences, Din Daeng, Bangkok, Thailand. (1978-1980)