LARVAL HABITAT OF *ARMIGERES SUBALBATUS* (COQ) AND ITS CHARACTERISTICS IN PONDICHERRY

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Abstract. Larval habitats of *Armigeres subalbatus* were delineated in urban and rural areas of Pondicherry. Survey of various potential mosquito breeding habitats revealed that septic tanks were the typical breeding habitat in both areas and the proportion was significantly higher in urban areas. The productive status of septic tanks differed in different months and the overall proportion breeding *Ar. subalbatus* was significantly higher in urban areas (0.0447) compared to rural areas (0.0181). Sporadic breeding observed in receptacles holding water admixed with cow-dung, was however insignificant. Among the various physico-chemical factors of septic tank habitat analysed in relation to breeding, only ammonia nitrogen was found to be significantly correlated with immature density.

INTRODUCTION

The ability of mosquitos to exploit all available water bodies is well known. Consequently, the breeding habitats of mosquitos are of many kinds and classification of these has been carried out by Mattingly (1969) and Laird (1988). Some species exhibit considerable plasticity in their selection of breeding places while others are more restricted in their choice (Service, 1976). Preference for foul water by the genus *Armigeres* has been documented (Senior White, 1926; Chang, 1957; Barnish, 1984). Such foul water habitats exist in different types and hence this study on *Armigeres subalbatus,* a prime nuisance mosquito due to its vicious biting habit, was conducted to ascertain its larval habitat and the distribution of the same in urban and rural area of Pondicherry and to assess the temporal variation in the productive status of the habitat. Physico-chemical characteristics of the typical larval habitat were also determined. Such delineation of the larval habitat and its characteristics is also a pre-requisite for control of this species, particularly when the control strategy is aimed at immatures.

MATERIALS AND METHODS

Classification of rural and urban areas was based on land use pattern. The ratio of agricultural to built up area and the population was taken into consideration based on which a locality was classified as rural if over 50% of the land is under agriculture and population was below 5,000. Using this criterion two localities viz, Thengathittu and Nainarmandapam were identified as rural, the proportion of land used for agriculture being 0.97 and 0.90 respectively and five localities viz, Muthialpet, Kottakuppam, Mudaliarpet, Kosapalayam and Reddiarpalayam were identified as urban, the proportion of land under agriculture being less than 0.50. These formed the study localities.

All types of potential mosquito breeding sources in these localities were examined at random, to determine the typical breeding habitat of *Ar. subalbatus.* This included cesspits, cesspools, drains, septic tanks and containers either man made or natural.

Cess pit: This is a pit of about 1 meter diameter, dug in the ground to receive sullage from the household in areas where drainage system is either inadequate or totally lacking. When the condition of soil does not allow rapid percolation, permanent stagnation in these pits results, leading to mosquitogenic condition.

Cesspool: These are natural depressions of larger dimensions which accumulate rain water. Some of these water bodies are polluted by sullage discharged from neighboring households.

Drains: These are of two kinds, unlined drains commonly termed as "kutcha drain" and lined drains that are described as either "U" drains or "L" drains depending on their contour. Lined drains are also mosquitogenic due to improper gradient, silting and indiscriminate dumping of garbage which blocks the flow of sullage leading to stagnation.

Septic tanks: Septic tanks are rectangular chambers of different capacities, comprised of two or three compartments and usually sited just below ground level. Sewage is received in the first compartment of the tank where solids are retained in the bottom and anaerobic digestion takes place. The liquid effluent that flows out has to be properly disposed by means of soakage pit, but invariably in most of the cases it is just allowed to flow either in the open or into a nearby drain. The sludge accumulating in the tank must be removed periodically, atleast once in three or five years. A vent pipe is provided for the escape of obnoxious gases.

Containers: These can be listed endlessly, since in tropical situations rainwater accumulation results in all possible types of containers. Tree holes, coconut shells, earthen pots and other man made receptacles form the important container habitats supporting mosquito breeding.

To assess the distribution of major breeding habitats, a survey was conducted in the seven study localities. A total of 700 premises, 100 at random in each locality were inspected for the presence or absence of the habitat. The number of premises positive for its presence was recorded.

Temporal variation in the productive status of septic tanks as well as receptacles (containers) was assessed through surveys carried out for a period of one year during 1988. Random sampling of the habitats at monthly intervals was done in both urban and rural areas. Presence or absence of breeding of *Ar. subalbatus* in septic tanks was checked by dipper sampling of immatures and by direct observation in receptacles, from which percentage of these habitats positive for breeding at each month was calculated.

Ten septic tanks which supported *Ar. subalbatus* breeding were chosen at random for determining the habitat characteristics. Water samples were collected in the morning (09.00 hours) using a dipper, in one liter plastic containers provided with lid and brought to the laboratory, except those for dissolved oxygen, which were fixed in the field. Analysis of 10 parameters viz, pH, conductivity, total solids, dissolved oxygen, alkalinity, acidity, salinity, BOD, nitrate nitrogen and ammonia nitrogen was done following standard procedures (Theroux *et al,* 1943). The relative density of immatures in these tanks was also recorded by dipper sampling and expressed as immatures per three dips. Multiple linear regression analysis was done to fine out the correlation between density and the different physico-chemical parameters.

RESULTS AND DISCUSSION

Survey of various habitats revealed that septic tanks were the major breeding source for *Ar. subalbatus* in the study area. A few cesspits also showed the presence of immatures of *Ar. subalbatus.* Further investigation revealed that the cesspits where *Ar. subalbatus* breeding was noticed invariably received the effluent from the septic tank in addition to the sullage. Larvae and pupae coming out of the septic tank along with the effluent were also noticed in some cases. In drains where immatures of *Ar. subalbatus* were present, it was again found to be a spill-over from the septic tank, since it was most common to let out the effluent from the tanks into the drain wherever it was possible. The cesspools were not of any importance, as breeding of *Ar. subalbatus* was not found in them. Similarly, tree holes, split coconut as well as rat-gnawed coconut and other containers did not prove to be of any value, though breeding on rare occasions was found in earthen pots that contained water polluted with cow-dung.

The typical breeding habitat of *Ar. subalbatus* in the study area was, thus the septic tank, though this species has been recorded elsewhere from variety of breeding sites such as bamboo traps (Fletcher, 1924); sewage disposal installations (Gater, 1928); stumps of giant bamboo (Wijesundara, 1942), artificial containers (Tsukamoto and Houo, 1985). Fecal contamination appeared to be essential as mere sullage water did not support breeding. This view is supported by observations made by Barr (1964) who found that a typical habitat in Singapore for *Ar. sublbatus* was pit containing washings from pig-sties and Omori and Tanikawa (1960) who were able to capture *Ar. subalbatus* only in the trap associated with liquified feces during their investigation on invasion of mosquitos into the privy through a ventilator pipe.

The distribution of septic tanks as expressed in terms of number per 100 houses ranged between 64 and 84 in urban area while it was 31 to 34 in rural area. The proportion of septic tanks was significantly ($X^2 = 28.95$; $p < 0.05$) higher in urban area compared to rural area.

The productive status of septic tanks and receptacles in different months for the urban and rural areas is given in Table 1. The positivity rate of septic tanks in urban area ranged between 0.66 (July) and 8.68 (February) in different months (Fig 1). In rural area positivity was recorded for the months of February (1.98%) to April (8.00%). The overall proportion of septic tanks breeding *Ar. subalbatus* was significantly ($p = 0.011$) higher in urban areas (0.0447) compared to rural areas (0.0181).

The role of receptacles in supporting *Ar. subalbatus* breeding was observed to be insignificant. Out of a total of 15,192 receptacles examined, in different months only 21 (0.14%) were found to be positive. Breeding in receptacle was observed to be sporadic and in most of the months no breeding occurred in this habitat.

Table 1

Productive status of septic tanks in urban and rural area.

Month	Urban		Rural	
	Number surveyed	Number positive	Number surveyed	Number positive
Jan '88	344	28	24	0
Feb	680	59	101	2
Mar	548	43	72	2
Apr	343	21	50	4
May	173	12	NS	-
Jun	409	3	51	0
Jul	305	2	NS	-
Aug	149	2	31	0
Sep	210	4	44	0
Oct	301	4	24	0
Nov	530	7	46	0
Dec	375	10	NS	-
Total	4367	195	443	8

NS = not surveyed.

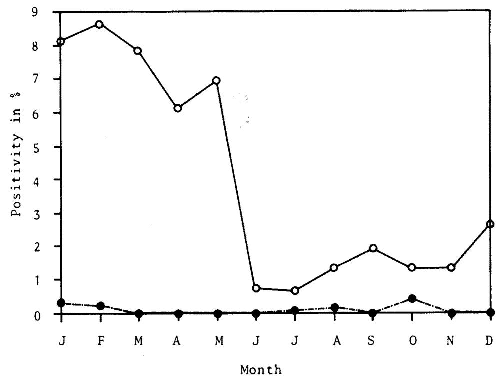

Fig 1—Positivity rate of septic tanks (○) and receptacles (●) in different months.

The values of different constituents obtained on analysis of water samples from septic tanks breeding *Ar. subalbatus,* along with the density of immatures are given in Table 2. The pH was found to be on the alkaline side with a range of 8.0-8.5. The total alkalinity was also high ranging between 310-1048 mg/l, whereas the acidity ranged between 24 and 128 mg/l. The preference of this species for alkaline waters has been observed by Alwis and Munasinghe (1971) who found it to be the dominant species in sites with a pH greater than 8.2. All the samples were devoid of dissolved oxygen and the BOD ranged between 10 and 190 mg/l. The low values obtained for BOD inspite of high pollution could be possibly due to anaerobic bacteria being the decomposers in the septic tank. Total solids ranged between 11,440 and 27, 920 mg/l, with a mean value or 18,618 mg/l. While nitrate nitrogen was low ($\bar{x} = 0.22$ mg/l) ammonia nitrogen was high ($\bar{x} = 25$ mg/l). Multiple linear regression analysis showed that ammonia nitrogen was the only factor that was significantly ($r = 0.797$; $p < 0.05$) correlated with immature density.

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Table 2

Physico-chemical characteristics of septic tanks supporting breeding of *Armigeres subalbatus*.

Septic tank No.	pH	Conductivity MHOS/cm	DO mg/l	Alkalinity mg/l	Acidity mg/l	Salinity mg/l	Total solids mg/l	BOD mg/l	NN mg/l	AN mg/l	Density*
1	8.4	5100	0	1048	110	440.0	20440	20	0.32	20	232
2	8.5	4700	0	1014	128	180.0	27920	190	0.40	10	199
3	8.1	2500	0	376	78	147.5	11440	10	0.16	10	116
4	8.0	3300	0	814	122	232.5	16800	30	0.08	20	255
5	8.0	4100	0	310	24	15.0	20000	10	0.24	20	117
6	8.1	3600	0	1006	70	237.5	16960	10	0.08	30	595
7	8.4	3400	0	427	74	147.0	15840	10	0.34	40	815
8	8.2	4300	0	1019	114	28.0	12600	30	0.08	70	653
9	8.0	2700	0	746	37	221.5	18360	20	0.18	20	304
10	8.1	3600	0	812	108	332.0	25820	10	0.31	10	142
Mean	8.2	3730	0	757.2	86.5	198.1	18618	34	0.22	25	

DO = Dissolved oxygen, BOD = Bio-chemical oxygen demand, NN = Nitrate nitrogen, AN = Ammonia nitrogen.
* = Number of immatures per three dips.

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