URBAN MALARIA AND ITS VECTORS *ANOPHELES STEPHENSI* AND *ANOPHELES CULICIFACIES* (DIPTERA : CULICIDAE) IN GURGAON, INDIA

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Abstract. The seasonal variation in the density of immature and adult malaria vectors *Anopheles stephensi* and *An. culicifacies* were recorded from January to December, 1986 in urban Gurgaon, India. The highest combined anopheline larval density (2.3 per dip) was recorded in the 31st week. The peak adult density for malaria vectors *An. stephensi* (4.14 per man hour) and *An. culicifacies* (1.02 per man hour) were reported in the month of August. The highest percentage of total infestation for anophelines and other breeding habitats were in tanks (48.72%) and ponds (6.41%) in Autumn and wells (4.79%) in the Winter season. The highest population of *An. stephensi* and *An. culicifacies* were collected from the peripheral area in comparison to central part of the study area. Maxium malaria cases along with highest larval density (1.8 per dip) were recorded from Sector 3.

INTRODUCTION

In India, malaria is still the most important mosquito vector borne disease. *Anopheles stephensi* and *An. culicifacies* are urban malaria vectors in India (Batra *et al,* 1979). The importance of Anopheline species depends on several characteristics that should be considered together. The resting density of the vector population, its susceptibility to infection, life span and probability of feeding on man are of obvious significance. An excellent review of literature on the biology of *An. culicifacies* till 1940 was published by Afridi *et al* (1940). Bhatia and Krishnan (1957) provided valuable information on *An. culicifacies.* Menon and Rajgopalan (1979) studied the seasonal changes of *An. stephensi* in Pondicherry. Rehman and Menon (1975) studied the indoor resting places in Delhi. A knowledge of breeding habitats, immature and adult density throughout the year is essential to the understanding of variation in the incidence of malaria.

It was realized that field studies were needed on the ecology and adult density of these vector species, as related to abiotic factors and malaria transmission. Thus, field studies were carried out to determine the host preference of vectors, vector density of *An. stephensi* and *An. culicifacies* and to relate this to malaria transmission in urban Gurgaon.

MATERIALS AND METHODS

The study was caried out in Gurgaon city situated 35 km from Delhi having 15 km^2 area (Fig 1). The population during the study was 111,995. For epidemiological and entomological studies the city was divided into 6 sectors. Each sector was surveyed by one insect collector for larval and adult collection of malaria vectors. *An. culicifacies* and *An. stephensi.* To study the ecology of anophelines, with particular emphasis on breeding habitats and frequency of distribution in different aquatic habitats. 3rd and 4th instar larvae and pupae were collected from pits, ponds, drains, tanks, containers, wells and Nalas (long waste water disposal channel). The larval collection was made between 0930 to 1130 hours with a ladle. Adult mosquitos were collected with aspirator tube and flash light spending 15 minutes per capture station from 0600 to 0800 hours. In each sector, 5 fixed and 5 random capturing stations were selected for larval collection. Adult collections were made from weekly intervals. Adult density was recorded as per man hour. Larval and adult mosquito population were collected using the standard method of WHO (1975).

Blood slides were collected from every fever case. Slides were stained with JSB (Jaswant Singh and Bhatachary) and examined for the presence of malaria parasites. All parasite positive cases were given radical treatment of 600 mg chloroquine base

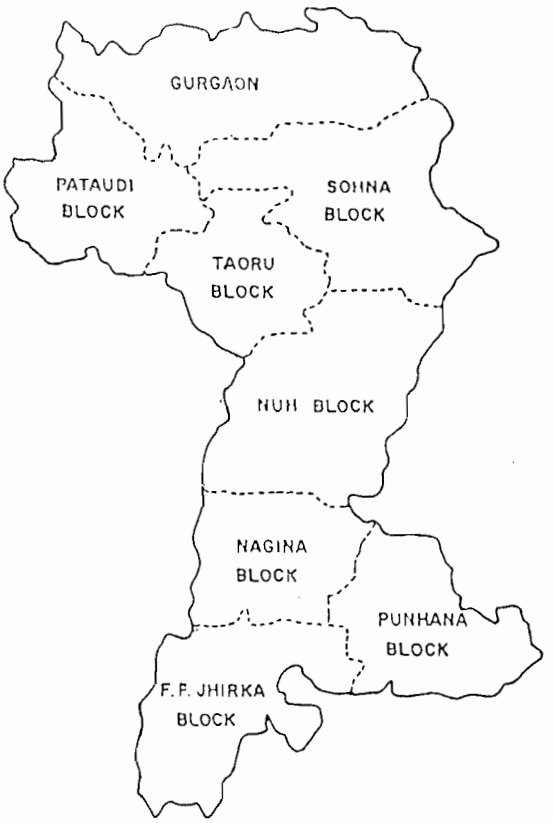

Fig 1–Map of district Gurgaon showing the study area (Gurgaon urban).

followed by 15 mg primaquine daily for 5 days for vivax malaria. For falciparum cases, one day radical treatment 600 mg chloroquine base on day zero plus 45 mg primaquine were given. Children were given proportionate doses. Malariometric surveying was carried out as described by Black (1968).

RESULTS AND DISCUSSION

The potential breeding sources increased starting after the 12th week. The highest larval density (2.30 per dip) was reported in the 31st week. The maximum breeding for larvae (15) and pupae (13) were observed in random water collections. The maximum breeding in all the weeks were collected from the random breeding sites. The monsoon season starts in this region in the month of July instead of rainfall. The regular anti-larval operations were carried out in the study area. Thus the positivity for larval and pupal population was greater in randon water collections due to chances of missing of anti-larval treatment by the workers in the random breeding places as compared to fixed breeding places. The number of sites varied in different weeks, due to holidays and leave of insect collectors. But all the sectors were surveyed on an average. Table 1 presents a summary of the various breeding sites and pits as breeding foci, which were more important in the Spring season (60.09%) than in other seasons. The highest percentages of the total infestation of anophelines in breeding habitats were in tanks (48.72%) and ponds (6.41%) in Autumn, drains (13.01%) in Winter, nalas (11.97%) in Summer and wells (4.79%) in Winter seasons. In both the central and peripheral areas, *An. culicifacies* and *An. stephensi* population were estimated (Table 2). The highest number (10) of *An. culicifacies* were reported from the peripheral area. *An. stephensi* also occurred in greatest numbers in all months in the peripheral area in comparison to the central area. Sector-wise larval density and malaria cases are given in Fig 3. Sector-based data resealed that the highest larval density (1.8 per dip) came from Sector 3. The lowest density in the wet season was reported in Sector 5. The larval density was below 1 per dip in all sectors in the dry season. The maximum malaria cases (78) were also detected from Sector 3.

Fig 4 gives the composition of different species among the total adults that emerged from a particular habitat. *An. stephensi* preferred to breed mostly in house tanks, containers, pits and construction tanks. The percentage of *An. stephensi* in the total adults that emerged from these habitats was 65%, 75%, 20% and 5.7% respectively. *An. culicifacies* was present in 2.5% samples of immature from containers. *An. subpictus* was found to breed in all types of polluted water habitats but its breeding was mainly in pits and nalas. The highest densities for adult *An. culicifacies* (1.02 per hour) and *An. stephensi* (4.14 per hour) were recorded in the month of August (Fig 2). The density of the malaria vectors *An. culicifacies* and *An. stephensi* built up gradually during the year and reached peak in the month of August. Temperature in August ranged between 27°C to 30.4°C, promoting mosquito growth. It is also seen from Fig 2 that the vector population started declining in the winter months with zero density in December and January. This is due to drying up of many breeding places and the adverse

Table 1

Seasonal relative importance of breeding habitats on Anopheline breeding.

Index	Breeding habitats (Jan 1984 - Dec 1986)							
	Pit	Pond	Drain	Cooler	Tank	Container	Nalas	Well
Spring								
a No examined	526	128	250	0	239	31	107	109
b % total	37.84	0.21	17.00	0	17.10	2.23	7.70	7.84
c No positive	25	0	0	0	13	0	3	0
d % positive	4.75	0	0	0	5.44	0	2.30	0
e % total positive	60.98	0	0	0	31.71	0	7.32	0
Summer								
a No examined	470	115	264	21	264	36	120	70
b % total	34.96	6.39	13.27	1.53	19.27	2.63	8.83	5.11
c No positive	44	0	7	0	48	2	14	2
d % positive	9.19	0	2.65	0	18.10	5.56	11.57	2.66
e % total positive	37.61	0	5.98	0	41.03	1.71	11.97	1.71
Autumn								
a No examined	483	120	230	0	236	32	113	78
b % total	37.67	9.24	17.72	0	18.18	2.47	8.71	6.01
c No positive	26	5	3	0	38	2	1	3
d % positive	5.32	4.17	1.30	0	16.10	6.25	0.88	3.84
e % total positive	33.33	6.41	3.85	0	49.72	2.56	1.28	3.80
Winter								
a No examined	641	165	333	0	340	82	153	163
b % total	34.84	8.76	17.68	0	18.06	4.35	8.44	8.66
c No positive	60	4	10	0	41	0	15	7
d % positive	8.36	2.42	5.70	0	12.05	0	8.43	4.83
e % total positive	41.09	2.73	13.01	0	28.08	0	10.20	4.79
Monsoon								
a No examined	733	218	304	17	373	66	180	103
b % total	36.53	10.00	15.17	0.34	18.62	3.23	3.43	5.14
c No positive	126	2	13	0	114	7	18	0
d % positive	17.10	0.91	4.27	0	38.56	10.60	9.52	0
e % total positive	45.00	0.71	4.64	0	40.71	2.50	6.42	0

a) Number of breeding places examined.
b) Percentage of each type of breeding place.
c) Number of positive breeding place.
d) Percentage of each type of breeding place found to be positive.
e) Percentage of each type of breeding places found positive out of total positive breeding places.

affect of low temperature on the survival of *An. culicifacies* and *An. stephensi.* Menon and Rajgopalan (1979) also reported similar observations in Pondicherry; Krishnan (1961) reported anopheline breeding in containers, pits, wells and cisterns. It is evident that in any control program, standing water containers used to be treated at weekly intervals to check the pupal population. In urban areas, anophelines have been reported to breed in man-made breeding places (Bang and Shah, 1988). Russell and Rao (1942) also reported anophelines breeding in pits, Ansari *et al* (1982) observed the breeding of anophelines from pits, drains, tanks and domestic containers in Delhi urban area.

Table 2

Seasonal occurence of malaria vectors *Anopheles culicifacies* and *Anopheles stephensi* in-peripheral and center zones from January - December, 1986.

Time spent (hours)		No. of capturing stations		Zone			
				periph		Central	
periph	central	periph	central	*An. culi*	*An. steph*	*An. culi*	*An. steph*
15	10	40	40	0	19	0	15
8	8	32	32	2	11	0	11
6	6	24	24	5	9	2	6
10	10	40	40	10	27	0	10
6	6	24	24	4	24	3	13
8	8	32	32	3	27	6	25
8	10	32	40	6	32	9	32
6	4	24	16	6	38	2	12
8	6	32	24	4	25	5	16
8	8	32	32	6	24	6	13
6	6	24	24	0	8	0	6
8	8	32	32	0	5	0	6

Seasonal changes in adult densities of *An. stephensi* and *An. culicifaices* were reflected in monthly malaria incidence. After the rainy months, the malaria incidence decreased and continued to be low in the winter months. Vector density, rainfall and temperature were also low during the same period. Choudhary *et al* (1983) also made similar observations in Nainital. This type of malaria transmission was also reported by Sharma *et al*

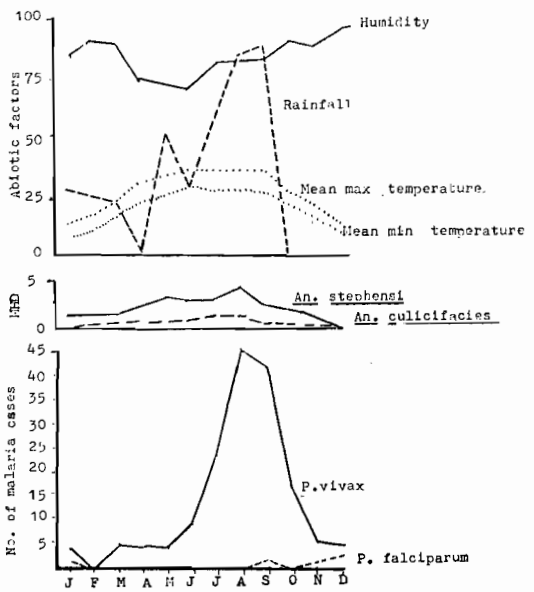

Fig 2–Seasonal resting density of malaria vectors *Anopheles culicifacies* and *Anopheles stephensi* in relation to abiotic factors.

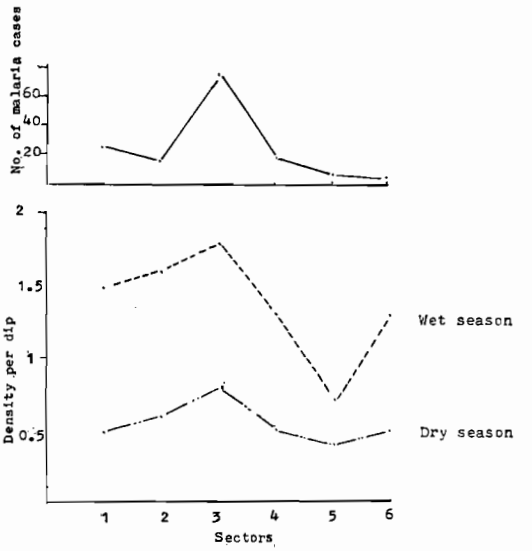

Fig 3–Sector-wise malaria incidence and larval density of urban Gurgaon.

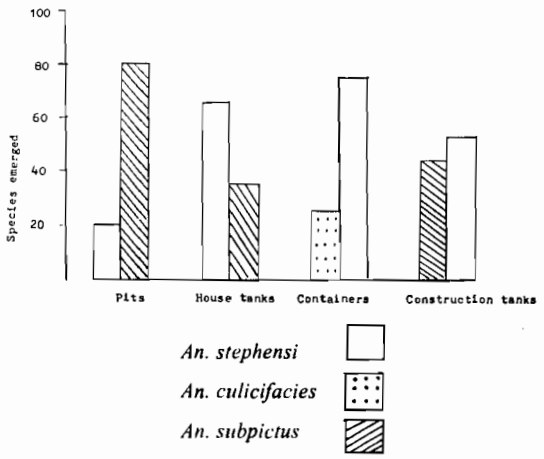

Fig 4–Percent composition of anophelines in different breeding habitats.

(1983) in Haryana State. This study is importance for planning anti-larval operations in urban areas. For successful implementation of urban malaria control programs, it is essential to identify the breeding habitats of malaria vectors. The present study revealed that anophelines prefer to breed in pits, tanks and also showed that the seasonal density of malaria vectors is cerelated with abiotic factors and malaria incidence through the year.

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