Vector Databank in the Indian Armed Forces

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Abstract

Background: Medical intelligence of disease vectors deals with understanding vector distribution and control.

Methods: An entomological baseline survey using standard vector sampling techniques was done as a pilot study to map the vectors of defence importance in two cantonments of Pune with a view to establish a vector databank and impart training to armed forces personnel in vector surveillance.

Result: The project trained 142 armed forces personnel in surveillance techniques in three years. Seventeen species of mosquitoes comprising of eight vector species were collected. Three other vectors viz. *Rhipicephalus sanguineus*, *Xenopsylla cheopis* and *Leptotrombidium deliense* are reported.

Conclusion: The study emphasizes the need for vector mapping /surveillance in each area for preventing morbidity and mortality amongst troops. It also focuses on indigenous fabrication of vector sampling tools and training of personnel for capacity building which in turn will enable such surveys to be undertaken in other units and deployment areas.

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Key Words : *Leptotrombidium*; Mosquitoes, *Rhipicephalus*; Surveillance; *Xenopsylla*

Introduction

The resurgence of vector borne diseases along with the widespread development of vector resistance to insecticides has focused attention on the need to establish vector mapping and surveillance for preventing morbidity/ mortality due to these diseases.

An entomological baseline survey was done to map the vectors of defence importance in and around Pune and Kirkee cantonments as a pilot study with a view to establish a vector databank, impart training in vector surveillance and develop necessary infrastructure for undertaking mapping in other areas.

Material and Methods

Pune spread over 138 sq km area, is situated at an altitude of 598 meters and has a population of 42 lakhs. The maximum and minimum temperatures during summers are 40°C and 26°C, whereas in winters it is 29°C and 19°C respectively. The average rainfall is 70 cm (June to September). The average relative humidity ranges between 72.3 - 93%.

The study was conducted in Pune and Kirkee cantonments and Sinhagadh hill. The two cantonments are urban settlements with good drainage system and water supply, devoid of any agricultural practice. The Pune cantonment has a large drain (Bhairoba) coursing through its limits, leading to mosquitogenic conditions and an urban slum with cattle sheds. The Kirkee cantonment has a military dairy farm and rivers (Mula, Mutha) running through the cantonment.

The study was conducted for a period of three years from 2001 to 2003. All the seasons were covered during this period. The target vectors were the arthropods with known vector potential viz. the mosquitoes (*Anopheles*, *Culex*, *Aedes*), fleas, ticks and trombiculid mites.

Vector sampling was done in each sector of the two cantonments (i.e. all the five sectors) from five random and two fixed stations per sector for adults as well as for larval collection. The survey of Sinhagadh hill included base, slopes and the top. The adult mosquitoes were collected using suction tubes, magoon traps, light traps and window traps. The collection was done three times in each season from each sector. The larval collection was done using ladles and larval nets. Temporary water collections, ornamental tanks, seepages, septic tanks and other small water bodies were surveyed. The third instar larvae were reared in laboratory for identification up to species level.

The fleas were collected from rodents which were trapped using Sherman and Wonder traps. The fleas parasitizing the domestic animals (cats and dogs) were collected by manual inspection of the pets and forceps collection. The parasitic stage of trombiculid mites i.e. the larval stage was sampled by trapping rodents using Sherman traps. The ticks were collected by direct removal from body of pet dogs. The free living stages (the questing stages) were sampled using flagging and dragging method.

Results

The overall mosquito collection was highest by suction

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tube (74.72%) followed by CDC light trap (18.13%), window trap (6.6%) and 0.55 % by magoon trap. The collection of Anophelines was highest by suction tube (47.62%) followed by CDC light trap (28.57%) and remaining 23.81% from magoon and window traps. Whereas, in case of Culicines, collection was maximum by suction tube (78.26%) followed by 16.78% by CDC light trap and very low collection (4.96%) by window and magoon traps.

The mosquitoes collected from Pune cantonment were *Anopheles*, *Culex*, *Aedes* and *Armigeres*, with maximum collection of *Culex*. A total of six anopheline species, including four vector species were collected, the details of which are given in Table 1. Numerically the highest collection was of *Anopheles subpictus*. This was followed by *Anopheles stephensi* and *Anopheles culicifacies*, the urban and the rural vectors of malaria respectively. *Anopheles subpictus* has also been reported in greater numbers than any other anopheline species by other workers [1]. Amongst the vector species, *An culicifacies* has been reported in greater abundance by other workers [2,3], however, the same was not found in this study.

A total of six *Culex* species were collected from Pune cantonment, with maximum (95.34%) collection of *Cx quinquefasciatus*. The per 10 man-hour density of *Cx quinquefasciatus* was 215.7, which is moderately high. The densities of the other species of *Culex* were fairly low. The larval density of Anopheline and Culicine was 4.42 and 29.35 larvae per dip respectively.

Culex species once again contributed maximally to the total collection of mosquitoes from Kirkee cantonment (Table 2). A total of four anopheline species were collected with *An subpictus* collected in maximum numbers, followed by *An*

annularis and *An culicifacies*. The culicine collection from Kirkee reveals presence of only three species of *Culex*. The maximum collection was of *Culex quinquefasciatus* with per 10 man-hour density of 179.5, which is lower than that of Pune cantonment (215.7). The anopheline and culicine larval density was 2.07 and 12.59 respectively, which is much lower than the larval densities of Pune cantonment.

The seasonal prevalence of mosquitoes in the two cantonments reveals that the densities of *An stephensi*, *An varuna* and *An vagus* were maximum during summers (Table 3). The density of *An annularis* on the other hand was higher in rainy and winter seasons. Amongst the Culicines, *Cx quinquefasciatus* was found in higher densities in all the three seasons with abundance in rainy season, whereas the densities of the other Culicines, *Cx cornutus*, *Cx gelidus*, *Cx sitiens* and *Cx univittatus* was higher in summer season. *Aedes aegypti* was found in all the three seasons, with abundance in rainy season, whereas, *Armigeres* sp was found in higher numbers in winter months. *Mansonia* was recorded only from Kirkee cantonment where hyacinth growth in the two rivers provides ideal breeding habitat for this mosquito.

The fleas collection included dog, cat, rat fleas and three specimens of *Nosopsyllus* species (Table 4). The maximum collection was of dog flea *Ctenocephalides canis* (94.45%), followed by rat flea (*Xenopsylla cheopis*). The rodent infestation rate was 12.14, whereas, a low general flea index (0.60) and *X cheopis* index (0.50) was found in this study.

The collection of ticks yielded various stages of dog tick, *Rhipicephalus sanguineus* (Table 5). The nymphal stage was maximum (56.63%) amongst all the parasitic stages collected, which is incriminated in transmission of Indian tick typhus.

The trombiculid mites were not found in the surveys undertaken in the two cantonments. The study area was therefore extended to include Sinhagadh for training of personnel. The rodents trapped in the survey (Table 6) were *Rattus rattus rattus* (R r r), *Rattus meltada* (R m), *Rattus*

Table 1

Species diversity and abundance of *Anopheles* and *Culex* in Pune cantonment.

Species	Adult Mosquitoes	
	(%) of total collection	Per 10 man hour catch
Anopheles species		
<i>Anopheles stephensi</i>	20.6	8.0
<i>Anopheles culicifacies</i>	18.2	7.1
<i>Anopheles subpictus</i>	59.5	23.0
<i>Anopheles varuna</i>	0.7	0.3
<i>Anopheles vagus</i>	0.7	0.3
<i>Anopheles annularis</i>	0.3	0.1
Total Anopheles	(100.0)	
Culex species		
<i>Culex quinquefasciatus</i>	95.3	215.7
<i>Culex cornutus</i>	1.8	4.0
<i>Culex gelidus</i>	2.24	5.1
<i>Culex sitiens</i>	0.35	3.3
<i>Culex univittatus</i>	0.06	0.8
<i>Culex sinensis</i>	0.24	0.5
Total Culex	(100.0)	
Larval Density/Dip		
Anopheles	4.42	
Culex	29.35	

Table 2

Species diversity and abundance of *Anopheles* and *Culex* in Kirkee cantonment.

Species	Adult Mosquitoes	
	(%) of total collection	Per 10 man hour catch
Anopheles species		
<i>Anopheles culicifacies</i>	5.62	0.6
<i>Anopheles subpictus</i>	46.88	2.0
<i>Anopheles annularis</i>	31.25	1.3
<i>Anopheles vagus</i>	6.25	0.5
Total Anopheles	(100.0)	
Culex species		
<i>Culex quinquefasciatus</i>	91.57	179.5
<i>Culex cornutus</i>	3.57	7.0
<i>Culex gelidus</i>	4.86	9.5
Total Culex	(100.0)	
Larval Density/Dip		
Anopheles	2.07	
Culex	12.59	

Table 3

Seasonal abundance of mosquitoes (per 10 man hour catch) in Pune

Mosquito Species	Summer	Rainy	Winter
<i>Anopheles stephensi</i>	8.1	2.1	0.3
<i>Anopheles culicifacies</i>	1.4	8.4	0.00
<i>Anopheles subpictus</i>	9.4	22.7	0.00
<i>Anopheles varuna</i>	0.3	0.00	0.00
<i>Anopheles vagus</i>	0.3	0.00	0.00
<i>Anopheles annularis</i>	0.00	0.4	0.4
<i>Culex quinquefasciatus</i>	88.4	133.4	114.1
<i>Culex cornutus</i>	3.3	2.3	0.00
<i>Culex gelidus</i>	19.8	4.3	0.00
<i>Culex sitiens</i>	1.1	0.00	0.00
<i>Culex univittatus</i>	0.2	0.00	0.00
<i>Culex sinensis</i>	0.3	0.4	0.00
<i>Aedes aegypti</i>	0.8	3.3	0.7
<i>Aedes albopictus</i>	0.00	0.9	0.00
<i>Aedes vittatus</i>	0.00	0.4	0.00
<i>Mansonia species</i>	0.00	2.3	0.00
<i>Armigeres species</i>	20.1	31.3	128.1

Note: The months mentioned for each season are as per the environmental conditions prevailing at Pune. Summer: March – May, Rainy: June –September, Winter: November – February.

pallidior (R p), *Suncus murinus* (S m), *Mus booduga* and *Mus platythrix* (Mus spp).

Three species of *Leptotrombidium* and a single species of *Herpetacarus* were found. The maximum collection was from *Suncus murinus* followed by collection from *Rattus rattus rattus*. *Leptotrombidium deliense* was most abundant (73.96%), followed by *Leptotrombidium delimushi kulkarni* forming 24.01% of the total mite collection.

In the three year study period, a total of 30 postgraduate students (Community Medicine) and 96 paramedicals (Health Assistants- I) were trained in the use of sampling tools and surveillance techniques. In addition, 16 paramedicals (laboratory and health assistants) from a field formation, were trained specifically in Rickettsial disease surveillance.

Discussion

Mapping of vectors of defence importance will enable adoption of preventive measures and to reduce morbidity and mortality due to vector borne diseases in armed forces.

A total of 17 mosquito species were collected from the two cantonments i.e. six *Anopheles* species, six

Table 4

Inter specific flea diversity in the two study sites by direct bait collection method from domestic animals

Species	Dog	Cat	Rat	Total
<i>Ctenocephalides canis</i>	460	0	0	460
<i>Ctenocephalides felis</i>	0	10	0	10
<i>Nosopsylla spp</i>	0	0	3	3
<i>Xenopsylla cheopis</i>	0	0	14	14
Total	460	10	17	487

Table 5

Dog tick *Rhipicephalus sanguineus* stages collected from the study sites

<i>R. sanguineus</i> Stages	Number	Percentage
Larva	57	07.98
Nymph	403	56.44
Adult	254	35.58
Total	714	100.00

species of *Culex*, three species of *Aedes* and one species each of *Mansonia* and *Armigeres*. Recent mosquito survey reports are not available for the city of Pune. The earlier survey was reported from Pune by Ramachandra Rao T [1,2] in the year 1957. The presence of *An varuna* in the present study is reported for the first time.

The study also records an increase over the years in the abundance of *An stephensi*. The deforestation and initiation of construction activity may have contributed to rise in densities of *An stephensi*. In the light of the study results, it is essential that vectors *An stephensi* and *An culicifacies* be put under surveillance to prevent outbreaks of malaria in the cantonment areas. The results also indicate presence of *An annularis* from the two cantonments. The present survey has not recorded *An fluviatilis* from the two cantonments, although it is present in other parts of the city.

Non-availability of reports on *Culex* species from Pune makes the current findings incomparable. Many species of *Culex* have been reported from India [3, 4]. However, the present study reports presence of only six species of *Culex*, of which *Cx quinquefasciatus* was collected in maximum numbers. This is important

Table 6

Inter specific diversity of trombiculid mite collected from various rodents from Sinhagadh area

Mite Species	R r r	S m	Mus spp	Bandicota spp	R m	R p	Total (%)
<i>Leptotrombidium deliense</i>	819	1236	43	12	4	5	2119 (73.96)
<i>Leptotrombidium delimushi kulkarni</i>	97	560	29	2	-	-	688 (24.01)
<i>Leptotrombidium sinhgarhense</i>	23	31	-	-	-	-	54 (1.89)
<i>Herpetacarus longisetosa</i>	4	-	-	-	-	-	4 (0.14)
Total	943	1827	72	14	4	5	2865 (100)

Note: R r r: *Rattus rattus rattus*; S m: *Suncus murinus*; Mus sp: *Mus booduga* and *Mus platythrix*; R m: *Rattus melta*; R p: *Rattus pallidior*

since Pune is endemic for filariasis. The presence of *Cx gelidus* may be important as it is one of the vectors of Japanese encephalitis in India.

The important vector species of *Aedes* in India are *Ae aegypti* and *Ae albopictus* [5]. The other species reported from the country is *Ae vittatus*. All the three species were recorded from Pune cantonment. All except *Ae vittatus* were recorded from Kirkee cantonment as well. The outbreaks of dengue in the study area necessitate continuous monitoring of this vector. The larval as well as adult surveys in the dengue sensitive areas should be undertaken to provide early warning and initiation of preventive measures.

The vectors of Indian tick typhus and Kyasunar Forest Disease (KFD) are *Rhipicephalus* and *Haemaphysalis* species respectively [6, 7]. An outbreak of Indian tick typhus in 1998 at Pune had brought to focus the need to initiate surveillance for dog tick *Rhipicephalus sanguineus*.

Three trombiculid mite vector species have been reported from India viz. *L deliense*, *L dihumeralis* and *L subintermedium* [8]. The present study reports *L deliense* as the principal vector of scrub typhus in India from Pune. The other vector species have neither been reported from Pune, nor found in our surveys.

The study reports the presence of fleas, *Xenopsylla cheopis*, *Ctenocephalides canis*, *Ctenocephalides felis* and *Nosopsyllus* spp; the only vector species being *X cheopis* [9]. So far, the city has not witnessed any outbreaks of flea borne diseases, however it may pose a potential danger in the near future under favourable ecological conditions.

The findings indicate importance of vector mapping

in each geographical area to reduce morbidity and mortality amongst troops and their families from vector borne diseases and initiation of timely vector control measures. The study recommends that vector mapping should be undertaken at each station and documented to maintain a vector databank.

The commanders/medical officers should be apprised of the vectors and the diseases prevalent in their area to raise their index of suspicion for these diseases for effective prevention.

Conflicts of Interest

None identified

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