SPECIES COMPOSITION OF MOSQUITOESAND THE RISK OF DENGUE FEVER IN THE BATTICALOADISTRICT

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ABSTRACT

Mosquito-borne diseases are a major public health problem in Sri Lanka causing high morbidity and mortality. The parasitic diseases such as Malaria and Filariasis are mainly vectored by *Anopheles culicifacies* Giles and *Culex quinquefasciatus* Say respectively. The transmission of viral disease such as Japanese encephalitis is mediated by *Culex tritaenorhynchus* Giles and Dengue and Chikungunya are transmitted by *Aedes aegypti* Linnaeus and *Aedes albopictus* Skuse. A dramatic increase in the reported cases of Dengue and Dengue Haemorrhagic Fever (DHF) in Sri Lanka has been observed in recent years. Nearly 23,656 suspected cases with over 237 deathswerereported duringthe 32 week periodof theyear2009. (Source: EpidemiologyUnit, SriLanka).

In this background, the present study was carried out from June 2008 to end of February 2009 in Urban, Suburban and Paddy field areas in the Batticaloa districts to record the mosquito species and to relate the risk of mosquito borne viral and protozoan diseases. Outdoor Cattle Baited Hut (CBH) and Cattle Baited Net (CBN) collection of adult mosquitoes were made and collected adult mosquitoes were analyzed for their species composition. Out break of Dengue was correlated with the spatial distribution of *Aedes aegypti* and *Aedes albopictus* in both indoor and outdoor ovitrap collections in the Batticaloa Urban areas and the Chenkalady Suburban areas.

During the study period, five species of *Anopheles* sp, four *Culex* sp, one species of *Mansonia* sp and *Armigerous* sp and two *Aedes* sp were identified. In addition, larvivorous predator mosquitoes such as *Lutzia* sp (subgenus of *Culex*) and *Toxorhynchites* sp were also collected. Among these identified mosquitoes, *An.subpictus* was the predominant species contributing the maximum of 33% in September in Urban areas while 32% and 16% in Suburban and Paddy field areas respectively.

Aedes aegypti was the predominant species in the outdoor collection in Batticaloa Urban area and in the indoor collection in Chenkalady Suburban area. Statistical analysis indicated that the highest values for *Aedes aegypti*, with mean value of 157.6± 19(SE), from outdoor collection in Batticaloa Urban areas and from indoor collection in Chenkalady Suburban areas with mean value of 191.55±22.70 (SE).

The study also revealed a correlation between the Dengue fever records and the presence of *Aedes aegypti* in the Batticaloa Urban area. The vector management practices should be designed based on the spatio-temporal relationships with vector species with active participation of the public and health education.

Key words: Chikungunya, Dengue, Malaria, Mosquito, Predator, Vector

INTRODUCTION

Mosquito borne infections include Malaria, Filarial and viral diseases (Dengue, Chikungunya, Yellow fever and Encephalitis). Dengue is the most important vector borne viral disease in tropical countries with 100 million reported cases in each year (Mc Bride *et al*., 2000). Dengue Fever (DF) and Dengue Haemorrhagic Fever (DHF) are serious diseases in Sri Lanka and reported 23,656 cases caused 237 deaths in 2009 (Epidemiology Unit, Ministry of Health, Sri Lanka). Chikungunya a disease caused by alpha virus and transmitted by *Aedes* mosquitoes heard the people of Jaffna until early November 2006 (Surendran *et al*., 2007). *Ae.aegypti* and *Ae.albopictus* are the mosquito species as the vectors for DF and DHF (Knudsen, 2008). *An.culicifacies* and *An.subpictus* play an important role in the transmission of Malaria in Sri Lanka (Kannathasan *et al.*, 2008). After

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Tsunami 26th December 2004 in Sri Lanka, Public Health Agencies warned the increase in vector borne diseases such as Malaria and Dengue due to the displaced people and the emergency camps (Briet *et al.,* 2005).

Although several studies related to prevalence of vectors and their susceptibility to insecticides were carried out in Northern and other regions of Sri Lanka (Thevarasa and Rajendram, 1995; Surendran *et al.,* 2007; Surendran *et al.,* 2008) only a few studies have been reported from Eastern region of Sri Lanka (Sujarajini *et al.,* 2001). For nearly a decade there has been no reports related to species composition of mosquitoes and their geographical distribution in the Eastern region. After the Tsunami, Chikungunya and Dengue out breaks have been reported from many parts of the country including Eastern region. Although many people were affected by both of these diseases there is no facility to diagnose the CHIK virus and Dengue virus in the Government Hospitals located in the Eastern region of the country. Samples are being sent to the far away Medical Research Institute in the Capital to confirm for these viruses. This badly affects early diagnosis and prompt treatment.

With this background the present study was carried out to record the prevalence, spatial distribution of mosquito species in Urban, Suburban and Paddy field areas of Batticaloa district. In addition presence of *Aedes* species were also related with the risk of Dengue Fever transmission in the Batticaloa district.

MATERIALS AND METHODS

Study area

Adult mosquito survey was carried out in five locations in the Eastern region of Batticaloa namely Bar road, Sinna uppodai, Pillaiyarady, Thannamunai and Chenkalady from June 2008 to end of February 2009. Bar road and Sinna uppodai were selected as Urban areas, Pillaiyarady and Thannamunai for Paddy field areas and Chenkalady represented Suburban areas.

Collection of *Anopheles*, *Culex,* and other adult mosquitoes

Adult mosquitoes were collected using Cattle Baited Hut (CBH) and Cattle Baited Net (CBN) collections. The collections were carried out at each sample site for 3 consecutive days the early morning from 0500 – 0600 hours using mouth aspirator. The collected blood-fed female mosquitoes were transferred immediately from the aspirator to the plastic cups covered with mosquito nets and brought to the Zoology Laboratory, Eastern University, Sri Lanka and were identified using standard keys (Amerasinghe, 1990 and 1995).

Larval collections

Mosquito larvae were collected from the water logged areas besides the paddy fields and canals from Thannamunai and Pillaiyarady. Larvae were brought to the laboratory for species identification. They were grouped into species, cultured separately and allowed to eclose to adult within the net cages.

Collection of *Aedes* mosquitoes

Aedes mosquito collections were using conventional ovitraps. Thirty houses were randomly selected from Batticaloa and Chenkalady areas. Collections were made from April 2008 to December 2008. Four ovitrap were placed in each houses, two indoor and two outdoor. The ovitraps in outdoor were kept in the shadows of small trees, beneath the shrubs and wet hidden places 15 meters away for each ovitrap. The labeled ovitraps were kept indoorat one per room beneath the refrigerator or cupboards which are dark places. Collection of eggs and larvae were carried out fortnightly. Eggs and larvae collected from each ovitraps were counted and reared separately until it reach adult stage. Larvae were fed by grounded powder of fish meal. Emerged adults were identified using standard key (Reuben, 1973).

Dengue data

Suspected and confirmed dengue data were obtained from the Regional Director of Health Service and Medical officer Health Office, Batticaloa.

Data analysis

All the statistical analysis was performed using the Minitab 14.0 version statistical software. Pearson Correlation was also performed.

RESULTS AND DISCUSSION

Species composition

An average of three consecutive day collections in each sampling site was used as the collection of mosquitoes at a time. Collections were repeated during the dry season, inter monsoon and rainy season. Eleven species of mosquitoes were trapped in the sampling sites were identified. Five of them are *Anopheles* mosquitoes; four are *Culex*, one from *Mansonia* sp

and *Armigerous* sp. TwoAnopheline mosquitoes were unidentified (Table 1).

Table 1: Species composition of mosquitoes surveyed during June 2008 to February 2009.

Mosquito species/genus	Abbreviation
Anopheles annularis	*An.a*
Anopheles barbirostris	*An.b*
Anopheles nigerrimus	*An.n*
Anopheles subpictus	*An.s*
Anopheles vagus	*An.v*
Culex gelidus	*Cu.g*
Culex fascocephala	*Cu.f*
Culex quinquefaciatus	*Cu.q*
Culex tritaeniorhynchus	*Cu.t*
Mansonia sp.	*Man*
Armigerous sp.	*Arm*
**Anopheles varuna*	
**Anopheles pallidus*	

* Unidentified mosquito species during the survey period now identified to species level

The CBH and CBN collections of adult mosquitoes were pooled between June 2008-October 2008 and November 2008-February 2009 fromfive sampling sites. Percentages of each species in a locality were indicated in Table 2.

The *Aedes* species collections were made by outdoor, indoor ovitrap methods between April 2008 and December 2008. For graphical expression sampling dates were assigned as fortnightly

in the country, is the predominant species. The spatial distribution of *An.subpictus* was observed in Urban, Suburban and Paddy field areas. Urban areas have High Dense Houses (HDH) with drainage canals, Suburban areas have Low Dense Houses (LDH) with pools and small ponds and Paddy field areas have large plots of Paddy fields and adjoining houses. The results revealed that, *An.subpictus* found high percentage in dry and inter monsoon season in both Urban and Suburban areas and low percentage in rainy season (Fig 1).

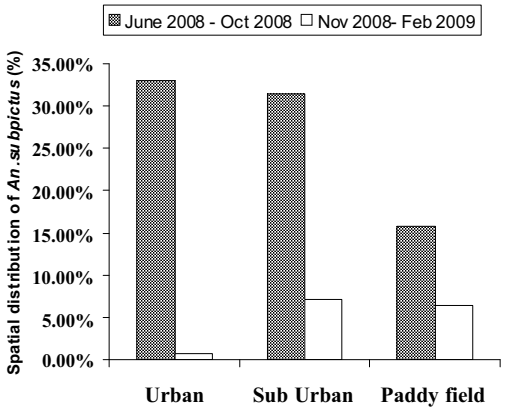

Figure 1: Spatial distribution of *An.subpictus* in different locations.

Similar seasonal distribution of high population of *Culex* sp and *Anopheles* sp was noted from March to September (Akram *et al.,* 2009) There are intra zonal variation in the mosquito distribution with season (Shiliu *et al.,* 2003). *An.subpictus* is highly reduced in rainy season (North-East monsoon). There is not much

Table 2: Species composition of mosquitoes in different location during the study period (%)

Species	Location									
	Bar road		Sinna uppodai		Pillayaradi		Thannamunai		Chenkalady	
	Jun 08 -Sep 08	Oct 08 -Feb 09	Jun 08 -Sep 08	Oct 08-Feb 09	Jun 08 -Sep 08	Oct 08-Feb 09	Jun 08 -Sep 08	Oct 08-Feb 09	Jun 08 -Sep 08	Oct 08-Feb 09
An.a	-	0.66	-	-	-	-	-	-	-	-
An.b	11.69	-	-	-	-	3.87	48.38	-	-	-
An.n	-	8.55	5.83	-	7.50	13.24	-	-	-	-
An.s	7.79	5.92	49.16	0.25	22.50	5.70	12.09	9.76	50.57	11.11
An.v	-	-	0.83	0.15	-	-	-	-	2.30	-
Arm	38.96	11.84	24.17	90.06	7.50	6.03	12.90	24.40	3.45	-
Cu.g	-	-	1.67	-	10.00	5.53	8.60	8.13	11.50	18.52
Cu.f	-	2.63	-	-	-	-	-	-	-	-
Cu.q	-	-	2.50	0.35	-	-	-	-	-	-
Cu.t	41.56	60.53	15.83	0.20	47.50	65.50	7.53	56.10	6.90	35.20
Man.	-	9.87	-	-	5.00	0.34	9.67	1.63	25.30	35.20

Spatial distribution of mosquitoes

Among the Anopheline mosquitoes species *An.subpictus*, an important secondary vector of Malaria

difference in the distribution of *An.subpictus* in Urban and Suburban during dry season and inter monsoon season. In the paddy field areas, the adult distribution

is reduced in to nearly half of the other regions. Two species of larvivorous mosquitoes were collected from the paddy fields and surrounding channels at Pillayaradi and Thannamunai. They feed on other mosquito larva instars. This might be the reason for the reduced percentage of *An.subpictus* in the paddy field areas.

Potential Dengue vector

Two species of *Aedes* mosquitoes *Ae.aegypti* and *Ae.albopictus* were identified. Among these *Ae.aegypti* is the primary potential Dengue vector and the *Ae.albopictus* is the secondary vector. In both Urban and Suburban areas the prevalence of *Ae.aegypti* in both indoor and outdoor alarms the transmission of dengue virus. The presence of *Ae.aegypti* is high in outdoor in Urban areas and indoor in Suburban areas (Fig 2). In the Suburban areas the houses are not well protected with windows than the houses in the Urban areas. There are more dark places within the houses due to reduced electricity usage within the rooms. As the *Aedes* sp prefers to lay eggs in the dark region that was available in long duration in the Suburban areas might be the causative for the increased collection in indoors.

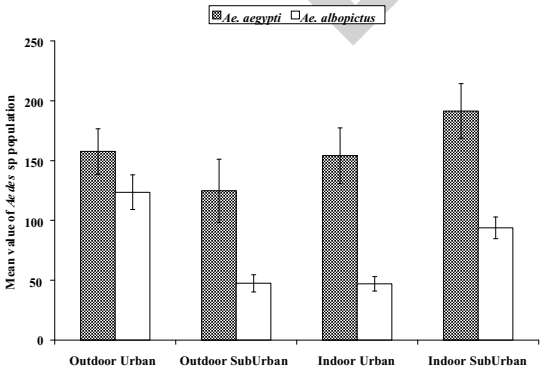

Figure 2: Comparison of *Aedes* species in indoor and outdoor collections from Urban and Suburban areas

Population of *Ae.aegypti* and recorded dengue cases shows positive weak correlation (+0.241) while *Ae. albopictus* shows negative weak correlation (-0.216) (Fig 3). Reported Dengue cases were obtained only from the Government hospital. Numbers of patients treated at private hospitals are excluded from the data and this will have bearing in the reported cases of the district.

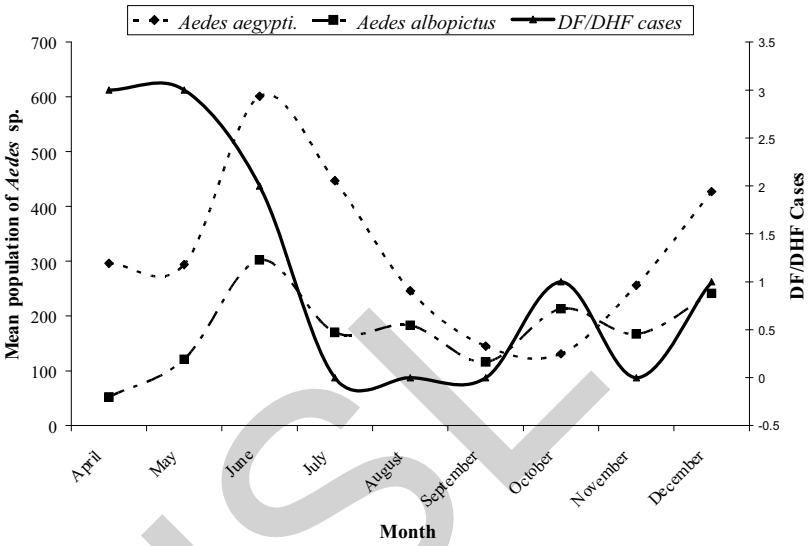

Figure 3: Relationship between Dengue vectors and Dengue cases

Prevalence of larvivorous mosquito species

Among the larvae collected from two localities presence of predacious larvae of *Lutzia* (*Culex fuscanus*) and *Toxorhynchites* sp were identified. *Lutzia* sp prefers *Aedes* sp larval instars than other *Culex* or *Anopheles (unpublished data). Lutzia* species could be colonized in the laboratory, blood fed by domestic fowl (Chicken) as a host. The observation is promising as *Lutzia* sp could be used as biological agent to control *Aedes* sp.

CONCLUSION

Vector surveillance associated with vector control is the only way to prevent Dengue and Chikungunya out breaks since no effective vaccine is available (Rawlins *et al*., 1998). Even though the incidence of Malaria has been low over the years in the district, considering the cycle nature of the disease and to avoid any future outbreaks continuous vector survey and implementation of vector control measures are essential.

The present study on species composition and spatial distribution of potential Malaria vector and Dengue vector provide valuable information for formulating an

effective vector control measure in the Eastern region. *An.subpictus*, a potential vector of Malaria is prevalent all sampled areas throughout the study period that includes dry and inter monsoon seasons.

The present of potential dengue vector *Aedes* sp in the human residential could be associated with the high transmission of diseases in the district. The differences in the indoor and outdoor collections at Urban and Suburban areas clearly express a need for devising an appropriate vector control strategy with public participation and health education. The presence of larvivorous mosquitoes is an added advantage for incorporating biological control measure into the vector control programmes. As these mosquito species are well adapted to the environment and able to colonize in the laboratory, possibility of reducing vector populations by releasing these predatory mosquitoes into the environment needs to be studied.

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