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Mosquito larval survey and their correlation with some chemical parameters in selected water bodies in Matara, Sri Lanka

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Abstract

Mosquito borne diseases are a major public threat especially in Tropical countries including Sri Lanka. Therefore mosquito larval survey may directly contribute to the prevention of mosquito vector borne diseases. In the present study mosquito larval survey was carried out in selected rural and urbanized habitats in Southern Sri Lanka for 9 months to study the availability of mosquito larvae with reference to the physical and chemical characters of the selected habitats. Availability of larvae, abundance of larvae and correlation between larvae abundance and physico-chemical characters were determined. Found mosquito larvae were identified to the genus taxonomic level using pictorial keys. There is a significant difference¹ between the variation of chemical characters of pH, Conductivity, nitrate and phosphate concentration. Mosquito larvae abundance 50%, 34%, 9% and 7% in Kirala Kele, Bandaththara, Nupe and Thudawa respectively. pH of the water body negatively correlated with larval abundance. All recorded mosquito genus were *Culex*, *Aedes*, *Mansonia*, and *Anopheles*. Identifying KiralaKele as a well habitat for mosquito may lead to carry out more future research on mosquito larval survey in rural, abandoned area.

Keywords: Larval Survey, Matara, Kirala kele, Conductivity, Phosphate Concentration

1. Introduction

There are 3 broad categories of mosquito breeding habitats. They are permanent water, temporary pool and artificial containers. Salt marshes are also important for providing larval habitats for diseases borne mosquitoes^[2].

There is a significant difference in physico-chemical conditions between the different habitat types such as temporary ground pools, riverbed pools. Streambed pools, flowing stream, marshes and canal turnouts. So changes of physicochemical conditions and biotic characteristics of surface water habitats may create either favorable or unfavorable for mosquito breeding, but it depends on the tolerance of different species for survival under particular conditions^[1]. Usually larval surveys are conducted, mainly for informing the distribution of the aquatic stages of the diseases transmitting mosquitoes over the space and time.

These larval surveys are greatly contributing to the initiate the larval controlling program in the selected areas. Matara is reported as continuously affected by mosquito vector borne diseases^[3]. One mosquito vector borne disease is Filariasis and it is confined to an endemic belt along the South Western Coast of Sri Lanka and also the vector mosquito of filariasis of *Culex quenequefasciatus* is abundant in the all urbanized area in Sri Lanka.

2. Materials and methods

The study was carried out from March to November 2012 at selected area of Matara town, Sri Lanka.

2.1 Site Selection

Four different areas of Bandaththara, Kirala Kele, Nupe, and Thudawa were selected as study sites based on the two categories of urbanized and rural. First two sites were selected as rural sites and last two sites were selected as urbanized sites respectively. Though rural sites were covered with vegetation and hardly with human habitats and urbanized sites were surrounded by highly congested residences. All these four sites were contained with different types of water bodies.

2.2 Sampling of water bodies

Larval mosquitoes were sampled every two weeks using 0.45L dipper [1]. Samples were collected from the four selected mosquito larval habitats. During the each collection day, 4 samples were collected, and for each sample, 10 dipping were done. Collections of mosquito larvae were done from the different places of the water body i.e. from the middle of the water body, at the edge of the water body etc. Mosquito larvae were collected from the natural containers such as coconut shells and artificial containers such as plastic cups, discarded utensils and yoghurt cups etc.

2.3 Water sample analysis

Collected water samples were analyzed and water quality parameters were measured according to the standard methods such as conductivity (Conductivity meter (Ha Nina instrument), pH (Eutech instruments, pH 510), concentration of nitrate and concentration of phosphate (Spectrophotometer 6405 UV/V is [4]. Then

presence of mosquito larvae and the number of mosquito larvae were recorded. Early stages of mosquito larvae reared up to 3rd or 4th larval instars and after the 4th instars stage their identification was done using standard key [2].

2.4 Preservation of mosquito larvae for identification

As the most mosquito larvae are small specimens their identification should be conducted with the microscope [5]. Because of the difficulties in identification of live active larvae they should be heat killed and then they were preserved in 80% ethyl alcohol. Since they are dried quickly the collected samples were brought to the laboratory and microscopic slides were prepared except the early stage of the (1stand 2nd larvae) and examined under a microscope at 60X or higher magnification [6], and identified using mosquito larval key [7].

3. Results

During the study periods, availability of mosquito larvae, correlation between chemical parameters of water bodies and larval abundance and mosquito larval taxonomy up to generic level were done.

3.1 Abundance of mosquito larvae in study sites

The abundance of mosquito larvae in four sites, Kirala Kele and Bandaththara sites had comparatively higher mosquito larval abundance than the other two sites during the study period. The highest abundance was recorded in Kirala Kele site and the mosquito larval abundance was lower in urbanized sites, Thudawa and Nupe. Among the all sites least mosquito abundance has been recorded in Thudawa (Figure 1).

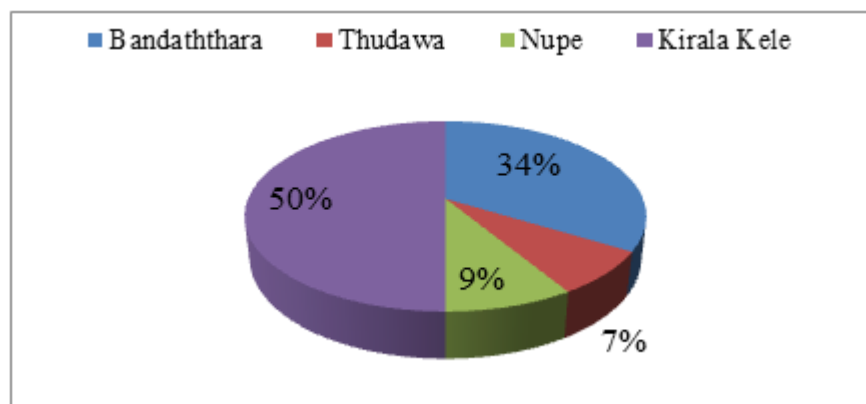


Fig 1: Abundance of mosquito larvae in four sites

Anopheles, *Aedes*, *Culex*, *Culiseta* and *Mansonia* were the main mosquito species found in the study site. Abundance of *Culex sp* and *Aedes sp* (Plate 1) were higher in four sites. *Mansonia sp.* and *Anopheles* abundance was higher only in Bandaththara and Kirala Kele site (Figure 2).

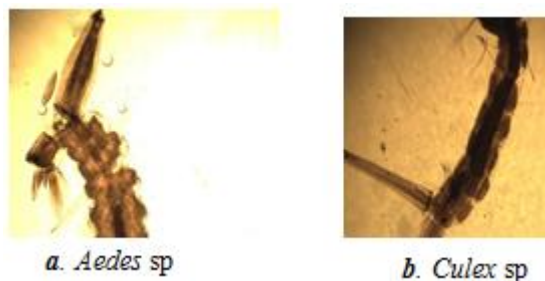


Plate 1: some of the mosquito larvae found in the study site

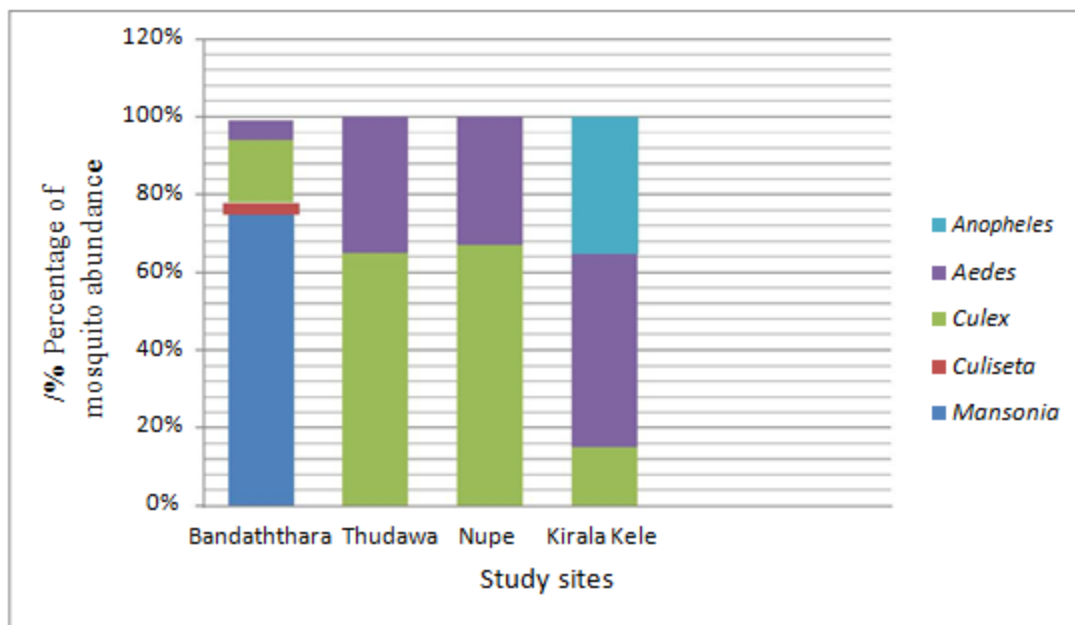


Fig 2: Abundance of mosquito larvae in study sites with relevant to their genus

3.2 Correlation between the mosquito larval abundance and chemical parameters of water

Table 1: Relationship between mosquito abundance and chemical factors of the water body

Water quality parameters	Sites			
	Bandaththara	Thudawa	Nupe	Kirala Kele
Conductivity/ $\mu\text{Scm-1}$	0.564 * (p=0.029)	0.223 (p=0.424)	0.146 (p=0.603)	0.458 (p=0.086)
pH	0.128 (p=0.649)	0.132 (0.638)	0.419 (p=0.120)	-0.639* (p=0.010)
Nitrate concentration	-0.688 (p=0.312)	0.292 (p=0.634)	0.114 (p=0.855)	-0.179 (p=0.620)
Phosphate concentration	0.144 (p=0.692)	0.908 * (p=0.012)	0.953 * (p=0.003)	-0.321 (p=0.535)

* Significantly different at 0.01 or 0.05 level

Conductivity showed a significant positive correlation with mosquito abundance ($p < 0.05$) in Bandaththara site. There was no significant correlation between larval abundance and conductivity within other sites.

pH was significantly negatively correlated with mosquito larval abundance ($p < 0.05$) within Kirala Kele site, but not such correlation reference to other sites. Although phosphate concentration showed a significant strong positive correlation with mosquito larval abundance ($p < 0.05$) nitrate concentration didn't show any significant correlation with larval abundance.

4. Discussion

Anopheles, *Culex*, *Aedes*, *Mansonia*, *Haemagogus*, *Psorophora* are mainly considered as medically important mosquito vectors^[7]. Mosquito borne disease out breaking is correlated with environmental changes. As example water logging, seepage from canals, excess water in the drainage system, reduced velocity of canal etc, favor the increasing of vectors by creating vector breeding sites^[8].

Present study mainly focused on the habitats present in rural and urbanized areas with the different character and they are varying with the ecological characters also. Quality of the larval habitats differ with the natural factors, this is interpreted by the intraspecific competition and anthropogenic activities. After the preliminary examination habitats were selected.

Nupe stream is the main drainage canal in the Nupe area. Some species of *Culex*, such as *Culex pipiens*^[9] inhabit in drainage canal^[10]. *Culex* sp. recorded at both sites of Thudawa and Nupe. *C. quinquefasciatus* is the most important vector of *W. bancrofti* in Sri Lanka and coconut pits in Matara act as the prolific breeding sites of *Culex*^[11]. Availability of *Culex* within these sites may be due to the confining of *Culex* to the all urban area of country^[12].

In Sri Lanka small discarded containers were act as the major breeding sources and productive for larval development of *Aedes* sp. Since they were rarely removed due to the improper waste disposal services^[13] and this might be the reason for available *Aedes* in Thudawa and Nupe because many discarded containers found around the Nupe sites.

When considering the other two sites of Kirala Kele and Bandaththara, *Anopheles* and *Mansonia* (Table 1) were recorded. These two sites are somewhat rural and not urbanized. Thus the different vegetation is present within these areas. *Anopheles* was found within Kirala Kele site. And this may be due to the removing of plant covering because sometimes deforestation, land

clearing for rice fields^[14] lead to the occurrence some mosquito species. Different plants also act as the habitats for different mosquito species.

The present study about the relationship between the abundance of mosquitoes with the different water quality was also assessed. Among the various water quality parameters used by various scientists^[15], following parameters namely, conductivity, pH, nitrates and phosphates are considered in my study. According to the results of my study these parameters are also important for the availability of mosquito larvae. Among the studied chemical parameters, pH, conductivity and phosphate concentration showed a considerable importance among all hydrological measurements in this survey. Considering the pearson correlation of the pH with the abundance of mosquito larvae in study sites in Matara, highly significant negative correlation ($r = -0.639$) as shown in the table 1 was recorded only in Kirala Kele site. No significant correlation was observed among the other sites with mosquito larval abundance. The number of larvae may increases when the pH value lowers. The chemical character of pH of water may useful in determining the abundance of mosquito larvae in Kirala Kele. Likewise conductivity was showed a significant positive correlation with larval abundance in Bandaththara and Nupe and Thudawa sites also showed a significant positive correlation with phosphate concentrations and mosquito larval abundance.

Phosphate concentration is important hydrological parameters to determine the mosquito larval abundance of the urbanized sites. Unlike urbanized area increase of larval abundance in rural areas can be described using pH and conductivity like hydrological characters.

5. Conclusions

Mosquito larval abundance varies with the physico-chemical characters of the habitats. The present study focused on urban and rural area. The mosquito larval abundance significantly correlated with chemical characters of habitats. In Kirala Kele site pH was negatively correlated with larval abundance. Conductivity of water body positively correlated with larval abundance in Bandaththara area. Concentration of phosphate only significantly correlated within urban area. Both Thudawa and Nupe sites had strong positive correlation between larval abundance and conductivity.

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