Assessment of Mosquito Vector Diversity across Habitats in the Ponnani Municipal area, Kerala, India.

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**ABSTRACT**

The spatial and temporal changes in climatic attributes will affect the biology and ecology of vectors and consequently the risk of disease transmission. Therefore periodic analysis of the changes in climatic conditions with respect to the changes in frequency, diversity and distribution of vectors on a regional basis is a prerequisite for ensuring public health and sanitation. In this perspective, the present study has been attempted to assess the diversity, distribution and abundance of mosquito vectors from Ponnani municipal area of Malappuram district with respect to two seasons. The study gains significance as this area is noted to have repeated outbreaks of filariasis in recent years. Sampling of both larvae and adult mosquitoes were carried out from heterogeneous habitats of Ponnani municipal area to determine the species composition, relative abundance and habitat characteristics. Mosquito larvae collected from temporary and permanent breeding sites such as canals, ponds, drains, rice fields etc. were reared to adults in the laboratory for species level identification. Similarly adult mosquitoes, collected from heterogeneous locations during morning and evening times were also subjected to species level identification following standard manuals. Diversity studies on the adult mosquitoes showed higher species diversity during post monsoon season (6 species belonging to 2 genera) than pre monsoon season (4 species belonging to 2 genera). However a reversal in species diversity has been noticed with mosquito larvae, with higher species diversity during Premonsoon season (9 species belonging to 4 genera) than Post monsoon season (7 species belonging to 4 genera). Dissection and subsequent microscopic observation on adult female Culexquinquefasciatus noted the absence of filarial parasites in both the seasons.

Mosquitoes are well known group of insects, which transmit many dreadful diseases causing serious health problems to human beings. The females biting habit during their search for blood meal shortly before oviposition increases their propensity to transmit various diseases associated with high morbidity and mortality. Such diseases vectored by mosquitoes include: malaria, filariasis and yellow fever, which affect hundreds of millions of people every year, causing immense suffering and hindering development.

Mosquitoes exhibit spatial and temporal distribution on the basis of species, climatic conditions and environment[14]. They breed in natural or manmade temporary, semi-permanent as well as permanent water bodies with a variety of oviposition sites such as ground water sites (pools, rivers and lakes) and container sites including bottles, cups, and tree holes [9]. Larval distribution is greatly influenced by several factors such as elevation, water movement, water condition (polluted, fresh etc.), water temperature, vegetation, types of water source and many others[9]. Oviposition, development of larva, adult emergence and many other processes take place in mosquito larval habitats, which thus play an important role in determining adult distribution and abundance [8]. Many studies pertaining to the species diversity of mosquitoes have been carried out in different parts of India and other countries[5, 7, 12].

1. Introduction

The range of natural systems and their inter relations have a serious effect on the array of changes within the climate. They include: increased evaporation of fresh and ocean water leading to increased atmospheric moisture; change in the amount and pattern of precipitation; variable temperature changes in specific climatic areas; change in overall distribution of normal weather events; increased intensity and frequency of extreme weather events; change in wind intensity; and warming of oceans resulting in rising sea level.

The changes in regional climates cause effective changes in ecosystems especially in the biotic components. Changes in temperature and precipitation patterns lead to shifts in the timing of seasons and thus reproductive timing of plants and animals as well as length of growing season. Shifts in water availability and temperatures affect species distribution and abundance due to loss/expansion of suitable habitat. Some species may become extinct if they cannot adapt at a similar rate to the changes occurring, resulting in a loss of biodiversity.
In light of above, the present study has been attempted to assess the diversity, distribution and abundance of mosquito vectors from Ponnani municipal area of Malappuram district with respect to two seasons in the year 2012. Special attention was given to the filarial vector, *Culexquinquefasciatus* as the study area is noted to have repeated outbreaks of filariasis in recent years. The ultimate objective of the study was to provide information to help Ponnani Municipal Council in instituting the appropriate control measures for populations at risk of mosquito-borne diseases.

2. MATERIALS AND METHODS

2.1. Study area

Ponnani is a Municipality in Ponnani Taluk, Malappuram District in the state of Kerala, India lies between 10.770 N latitude and 75.90E longitude. It is a sea shore town along the south banks of Barathappuzha and is bounded by the Arabian Sea on the west. The study was conducted to determine the species composition, relative abundance and habitat characteristics of mosquitoes from Ponnani municipal area with respect to two seasons. Both larvae and adult mosquitoes were collected from heterogeneous habitats of Ponnani municipal area namely puthuponnani (Site1), mukkadi (Site2), near civil station (Site3), Ponnani harbour (Site4), Ponnani town (Site5) and chanthappadi (Site6).

2.2. Sampling of adult mosquitoes

Collections of adult mosquitoes were carried out using oral aspirators and test tubes. Adult mosquitoes that were resting indoor, outdoor, biting man were collected during morning and evening hours.

2.3. Sampling of mosquito larvae

Sampling of mosquito larvae and pupae were carried out from fresh as well as polluted water bodies in the selected locations with the help of a dipper. The larval habitats included canal, pond, sewerages and water on grass land.

2.4. Laboratory processing

Larvae and pupae along with the water from each site were transferred to plastic jars. All the jars containing immature stages were covered with net of small mesh size to avoid escape of adult mosquitoes. A small hole was made in the net for collection of adult mosquitoes from the jars. No artificial food was given because the water from sampling sites was rich in nutrients. Emerging adult mosquitoes were collected with the help of a manual aspirator and killed with cotton swab of ethyl acetate.

Identification of mosquitoes collected in the premonsoon and post monsoon seasons was done using Taxonomic keys provided in "The fauna of British India, including Ceylon and Burma" by Christophers (1933) and Barraud (1934) [2, 3].

Dissection of the filarial vector adult female *Culex quinquefasciatus* was done in the laboratory by following standard procedures. The dissection was carried out under compound binocular microscope to find out the occurrence of the filarial parasite *Wuchereria bancrofti*.

2.5. Data analysis

Seasonal analysis was performed on adult mosquitoes both collected in the field and obtained in the laboratory by rearing the immature stages. Seasonal variation was analysed in terms of relative abundance and distribution using the following formulae (modified as the term density, "D" is changed to relative abundance) [10, 11].

\[
\text{Relative abundance} = \frac{I}{L} \times 100
\]

Where 'I' is number of specimens of each mosquito species and 'L' is the total number of specimens.

The mosquito species were classified in following relative abundance classes: Satellite species, relative abundance <1%; sub-dominant species, relative abundance <5% and dominant species, relative abundance >5% [13].

Distribution (C) = \( \frac{n}{N} \times 100 \)

Where 'n' is number of sites where species was found, and 'N' is total number of sites.

The following classes were used to represent distribution status of different species: C1 (sporadic) 0-20%; C2 (infrequent) 20.1-40%; C3 (moderate) 40.1-60%; C4 (frequent), 60.1-80%; and C5 (constant) 80.1-100% [4].

Percentage densities of different genera in all the sampling sites during both these seasons were also analysed.

3. RESULTS

3.1. Premonsoon collection

Taxonomic identification on adult mosquitoes revealed a total of 4 species belonging to 2 genera (*Culex, Anopheles*) whereas mosquitoes reared from larvae comprised of 9 species belonging to 4 genera (*Culex, Anopheles, Mansonia, Armigeres*). The result showed a higher species diversity in the larval collection than the post monsoonal larval collection. Relative abundance and distribution status of the total mosquito species collected in the Premonsoon season were calculated (Table 1). Of the 9 species identified, there were 6 dominant (>5%) species 2 sub-dominant species (<5%). *Culexquinquefasciatus, Culex sitiens* and *Culex vishnui* were the most predominant species in terms of relative abundance and distribution.

Data on percentage densities of the four genera (*Culex, Anopheles, Mansonia, Armigeres*) in all the sampling sites (Figure I) revealed that Culex were the predominant group (64.28%) followed by Anopheles (32.56%). Occurrence of both Armigeres (1.78%) and Mansonia (1.33%) Genera were rare during the period of study.

3.2. Postmonsoon collection

Post monsoonal adult collection data showed a higher number with respect to species diversity and frequency. (6 species belonging to 2 genera, *Culex and Anopheles*). There were 7 species belonging to 4 genera in the larval collection of mosquitoes. Relative abundance and distribution status of the total mosquito species collected in the post monsoon season were calculated (Table 2).

Percentage density of the four genera Culex, Anopheles, Armigeres and Aedes in all the sampling sites during Post monsoon season were 69.83%, 19.42%, 9.09% and 1.65% respectively (Figure II).

In an overall assessment it was noticed that the diversity and frequency of mosquitoes was higher with the post monsoonal collection. The results also gave implications on the possible diseases that these mosquitoes can spread more effectively in the post monsoon season.
3.3. Habitat preference description

In both the collections, Anopheles species proffered mainly canal and pond habitats. The dominant species like Culexquinquefaciatus, Culex sitiens and Culex vishnui were found in almost all the habitats. Sewerage inhabited highest number of individuals as well as species, while in rest of the habitats the number of individuals was independent of the number of species. The filarial vector Culexquinquefaciatus was sampled from all habitats except water on grass land, since it shows preference for large water bodies whether clean or organically rich or polluted water like wells, pools, drainage etc.

The dissection and subsequent microscopic observation of the filarial vector adult female Culexquinquefaciatus were carried out separately in the two seasons. No filarial parasites were present in all the mosquitoes collected in any of the seasons.

Table 1. Relative abundance and distribution status of mosquito species in the Premonsoon season

<table>
<thead>
<tr>
<th>Species</th>
<th>Rel. abun.</th>
<th>Distribution</th>
<th>Rel. abun. status</th>
<th>Distribution status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culexquinquefaciatus</td>
<td>17.39</td>
<td>50</td>
<td>Dominant</td>
<td>Moderate</td>
</tr>
<tr>
<td>Culexvishnui</td>
<td>17.39</td>
<td>66.66</td>
<td>Dominant</td>
<td>Frequent</td>
</tr>
<tr>
<td>Culexsitiens</td>
<td>26.52</td>
<td>83.33</td>
<td>Dominant</td>
<td>Constant</td>
</tr>
<tr>
<td>Culexfuscocephala</td>
<td>3.04</td>
<td>16.16</td>
<td>Subdominant</td>
<td>Infrequent</td>
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<tr>
<td>Anophelesstephensi</td>
<td>9.13</td>
<td>33.33</td>
<td>Dominant</td>
<td>Moderate</td>
</tr>
<tr>
<td>Anophelestheobaldi</td>
<td>9.31</td>
<td>16.66</td>
<td>Dominant</td>
<td>Infrequent</td>
</tr>
<tr>
<td>Anophelesplendidus</td>
<td>14.35</td>
<td>33.33</td>
<td>Dominant</td>
<td>Moderate</td>
</tr>
<tr>
<td>Mansoniaannulifera</td>
<td>1.3</td>
<td>16.66</td>
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<td>Infrequent</td>
</tr>
<tr>
<td>Armigeres aureolineatus</td>
<td>1.74</td>
<td>33.33</td>
<td>Subdominant</td>
<td>Moderate</td>
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</table>

Table 2. Relative abundance and distribution status of mosquito species in the Premonsoon season

<table>
<thead>
<tr>
<th>Species</th>
<th>Rel. abun.</th>
<th>Distribution</th>
<th>Rel. abun. status</th>
<th>Distribution status</th>
</tr>
</thead>
<tbody>
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<td>Constant</td>
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<tr>
<td>Culexvishnui</td>
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<td>Satellite species</td>
<td>Infrequent</td>
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<td>Culexsitiens</td>
<td>12.39</td>
<td>33.33</td>
<td>Dominant</td>
<td>Constant</td>
</tr>
<tr>
<td>Culex whitmoriei</td>
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<td>16.66</td>
<td>Satellite species</td>
<td>Infrequent</td>
</tr>
<tr>
<td>Culexfuscocephala</td>
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<td>16.66</td>
<td>Satellite species</td>
<td>Infrequent</td>
</tr>
<tr>
<td>Anophelesstephensi</td>
<td>12.4</td>
<td>33.33</td>
<td>Dominant</td>
<td>Moderate</td>
</tr>
<tr>
<td>Anophelesplendidus</td>
<td>10.33</td>
<td>33.33</td>
<td>Dominant</td>
<td>Moderate</td>
</tr>
<tr>
<td>Anophelesvagus</td>
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<tr>
<td>Aedes aegypti</td>
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<td>Infrequent</td>
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<tr>
<td>Armigeressubalbatus</td>
<td>9.09</td>
<td>33.33</td>
<td>Dominant</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Figure I. Percentage density of different genera in all the sampling sites during Premonsoon season.

Figure II. Percentage density of different genera in all the sampling sites during Post monsoon season.
4. DISCUSSION

Mosquitoes are well known group of insects, which transmit many dreadful diseases causing serious health problems to human beings. Climate change and variability are highly likely to influence the biology and ecology of mosquito vectors and consequently the risk of disease transmission. Mosquitoes exhibit spatial and temporal distribution on the basis of species, climatic conditions and environment [14].

Ponnani municipal area is known to be endemic towards many mosquito borne diseases especially filariasis. Repeated outbreaks of the disease was reported in recent years signifies the ultimate necessity of diversity studies in the area. There is no published information regarding species composition of mosquitoes in Ponnani municipal area of malappuram district, Kerala. With the aim of contributing to this knowledge, occurrence of species and habitats used by mosquitoes were investigated. The mosquito communities sampled included several important vectors of infectious diseases such as dengue, chikungunya, yellow fever, filariasis, and malaria. We showed that both the diversity of mosquito communities and the relative abundance of disease vectors varied by habitat, with the lowest diversity and highest abundance of certain vectors occurring in selected environments, whereas other vectors were most abundant in different habitats depending on their biology.

In both the collections Culexquinquefaciatus, Culex sitiens and Culex vishnui were the most predominant species in terms of relative abundance and distribution. Four of the six Culex species observed in present study, were also inaccordance with those recorded by Hamidian [6]. The filarial vector Culex quinquefaciatuswas found to be the dominant and constant species in both the seasons in accordance with some earlier studies regarding mosquito fauna in different localities [1, 12]. It was sampled from all habitats except water on grass land, since it shows preference for large water bodies whether clean or organically rich or polluted water like wells, pools, drainage etc. The filarial vector also subjected to dissection to find out the occurrence of the parasite. No filarial parasites were present in all the mosquitoes collected in any of these seasons.

The finding of this study provides adequate information towards the mosquito fauna of the area during the seasons. Better evaluation of the status of mosquito borne diseases especially filariasis in the area is necessary to understand possible health management measures that are likely to be undertaken by the ponnani municipal council.

5. Reference