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A Survey on Mosquitoe Diversity in Parangipettai Coast, Southeast Coast of Tamilnadu, India

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ABSTRACT

A preliminary survey of mosquito diversity in the different habitats of the Parangipettai coast, southeast coast of India was made during March, 2007 to February, 2008, for a qualitative and quantitative assessment of mosquito distribution. Different habitats were selected as sampling stations; such as mangrove, estuarine and salt marsh ecosystem. Bimonthly collections were made with the Shannon trap and human bait, including diurnal, crepuscular and nocturnal period of mosquito activity. A total of 337 individuals of mosquito species belonging to 3 genera, 5 families and 7 orders were collected from all the three habitats. In summer season totally 107 individuals, in rainy season 148 individuals and in winter season 82 individuals were recorded. Different statistical tools were used to know the Shannon-Weaver diversity index (2.37-2.356), Simpson's index (0.9039-0.9016), Margalef richness (2.269-2.001) and Pielou's evenness (0.9725-0.9589) of mosquitoes. The possible causes of these differences are discussed.

Key words: Diversity, mosquito, mangrove, estuarine, ecosystem

INTRODUCTION

Mosquitoes are well known groups of insects belonging to the family Culicidae of the order Diptera. They are known to be the vectors of many dreadful human diseases like malaria, filariasis, encephalitis, dengue fever etc. Mosquitoes distributed worldwide and practically no part of the globe that can serve for human existence is free from mosquitoes. The mosquitoes in general, are quite abundant in coastal belts. But there is no devoted study on mosquitoes of a particular coastal area of India covering mangroves, estuary and salt marsh. In coastal areas such as salt marshes and mangrove swamps, many species of adult mosquitoes are often found but collections of mosquito larvae and pupae from habitats that are occasionally flooded by tides and rains yield far fewer species (O'Meara, 1976).

Mangroves constitute an important ecosystem in the coastal regions and act as barriers to sea intrusion and coastal erosion (Swaminathan *et al.,* 1994). Although, less than 5% of 2, 500 described mosquito species regularly breed in brackish waters, they represent a rather diverse group of species. The diversity among insects has always been of keen interest, not only to entomologists dealing with structure and function, but also to those who are engaged in different environmental programs. Relating to the biodiversity of insect richness, Prendergast *et al.* (1993) compared the coincidence of diversity hotspots of some different groups of insects (*viz.,* butterflies and dragonflies) and examined the extent to which species-rich areas for different taxa coincide and whether species-rich areas contain substantial numbers of rare species. The importance of biodiversity for ecosystem processes has been the focus in studies on functional diversity, looking at the extant of functional differences among the species in a community (e.g., Collins and Benning, 1996; Petchey and Gaston, 2002). India has been considered as one of the mega-diversity countries possessing a rich measure of all living organisms when biodiversity is viewed as a whole. According to Mittermeier *et al.* (1999) and Myers *et al.* (2000) biological-rich areas are found in a high range across the altitudinal variation associated with diverse habitats.

Mosquitoes exploit almost all types of lentic aquatic habitats for breeding. The immature stages of mosquitoes thrive in the aquatic bodies along with conspecifics and heterospecifics forming the larval mosquito community. The resources in terms of food, predators and competitors present in the habitat determine the population status of larval mosquitoes, both qualitatively and quantitatively (Sunahara *et al.,* 2002; Carlson *et al.,* 2004). Evaluation of mosquito habitats in terms of species composition and resources help to understand the bio-ecology and related control measures of pests and vector mosquitoes is more appropriable. Hence, the present investigation was made to study the mosquitoes of the Parangipettai coast, southeast coast of India.

MATERIALS AND METHODS

Sampling site: The study was carried out near Parangipettai, southeast coast of India (11° 24' N; 79° 46' E) during summer (Mar.-Jun.), rainy (July-Oct.) and winter (Nov.-Feb.) seasons for a period of one year from March, 2007 to February, 2008 (Fig. 1).

Mosquito sampling: Mosquito collection was carried out in the selected sites using standard methods (WHO, 1975) only at night time. Random collection was also made while sampling fixed localities. Information about mosquito species, habitats etc., was recorded on a data sheet. Soon after collection, the mosquitoes were immobilized with 70% ethanol, then sorted and identified with separated, firstly by genera and thereafter by species. Immature species were collected from different breeding habitats *viz*., mangrove area, salt marshes, estuarine complex using tray and plastic container. Collected mosquitoes were identified using keys by Mohrig (1969), Gutsevich *et al.* (1974) and Wood *et al.* (1979) while nomenclature followed (Reinert, 2000).

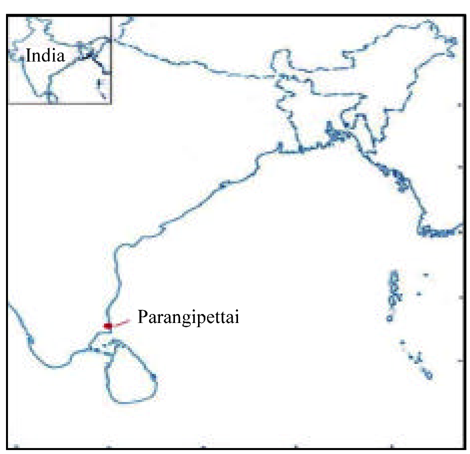

Fig. 1: Map showing the study area

Data analysis: Different statistical tools were used in the present study, to know the Shannon- Weaver diversity index, Simpson's index, Margalef richness and Pielou evenness using PAST (Ver. 1.42). The number of individuals of each species present was recorded in the study sites. The Simpson's index (D) (Simpson, 1949), Pielou's evenness index (J`) and Shannon's diversity index (H') were used (Shannon and Weaver, 1949). Beta diversity was analyzed using the Bray-Curtis similarity index using presence/absence data. Cluster analysis was done following hierarchical agglomerative clustering (Bray and Curtis, 1957). Each data point is plotted with CA first axis row scores on the horizontal axis (Hennebert and Lees, 1991). Principal component analysis was used to evaluate the biotic integrity of communities (Fig. 4).

RESULTS

Mosquito diversity was encountered at different habitats such as Mangroves, Salt marshes and estuarine complexes. A total of 337 individuals of mosquito (Diptera: Culicidae) belonging to 3 genera, 5 families and 7 orders were collected from all the three habitats. In the temporary pools, maximum number of species was encountered, in the summer season (107 species of mosquitoes), followed by rainy season (148 species of mosquitoes) and winter season (82 species of mosquitoes). Diversity indices (Shannon- Weaver index, Simpson's index), richness (Margalef index) and evenness (Pielou index) for three different seasons were calculated. Shannon-Weaver and Simpson's index were higher in Rainy season (2.37) and lower in summer season (2.356). Species richness (Margalef) was higher in winter season (2.269) and lower in rainy season (2.001). Values on evenness index showed little contrast; it was highest in rainy season (0.9725) and lowest in summer season (0.9589). The Margalef index was highest during winter season (2.269) and lowest during rainy season (2.001) (Table 1).

Highest recorded mosquito species were *Anopheles annularis*, *An. culicifacies*, *An.maculatus*, *An. stephensi*, *An. tessellatus*, *Culex mimulus*, *Cx. pipiens* and *Cx. tarsalis*. Since, the lowest mosquito species found was *Aedes aegypti*, *Ae. albopictus* and *Ae. vittatus*. The dendrogram (Fig. 2) drawn revealed clearly the separate grouping of *Culex pipiens*, *Cx. tarsalis*, *An. tessellatus* and *An. tessellatus* maximum in the study sites. *Culex pipiens*, *Cx. tarsalis* and *An. tessellatus* linked at other mosquito species. These two groups got linked at mangrove, saltmarshes and estuarine complex area (Fig. 3).

Table 1: Seasonal variation of mosquito species from different coastal ecosystems

	Estuarine			Mangrove			Salt marshes		
Species	S	R	W	S	R	W	S	R	W
Anopheles annularis	+	-	-	-	+	-	-	+	-
An. culicifacies	-	+	-	-	-	-	-	+	-
An. maculatus	-	+	-	-	+	-	-	+	-
An. Stephensi	-	-	-	-	+	-	+	-	+
An .tessellatus	-	+	+	-	+	-	-	+	+
Culex. mimulus	-	+	+	-	+	-	+	+	-
Cx. pipiens	+	+	-	+	+	-	-	+	+
Cx. tarsalis	-	-	+	-	+	+	-	-	+
Aedes aegypti	-	+	-	-	+	-	-	+	-
Ae. albopictus	-	-	+	-	+	-	-	+	-
Ae. vittatus	-	+	-	-	+	-	+	+	-

Presence (+) and Absence (-); S: Summer, R: Rainy and W: Winter

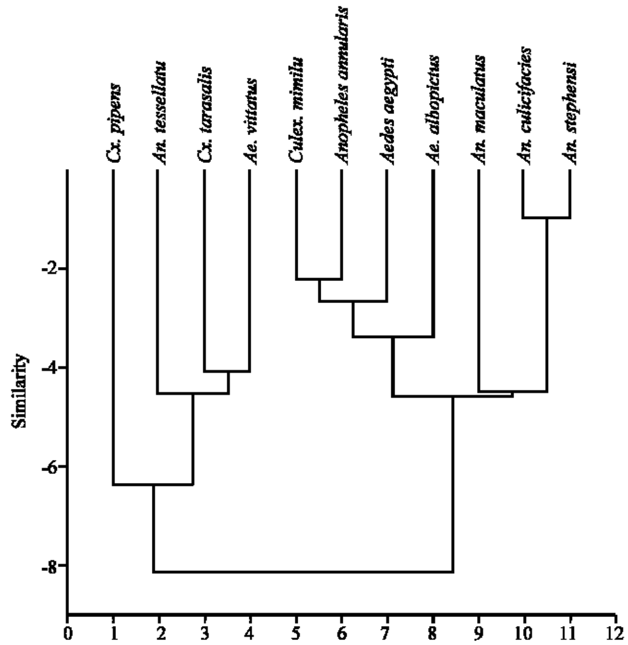

Fig. 2: A cluster analysis based on the Bray-Curtis similarity coefficient of species composition between three seasons' summer, rainy and winter

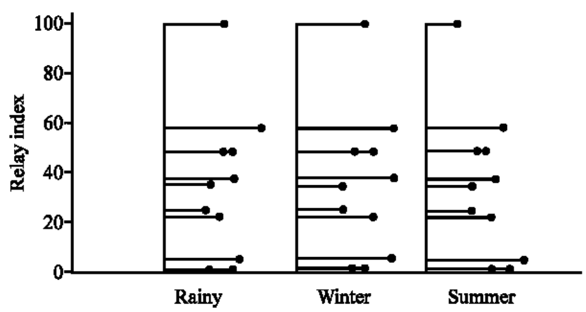

Fig. 3: Relay plot of sampling seasons by correspondence analysis

Mosquito abundance differed between study sites. The 95% confidence for the variation in Bray-Curtis analysis for a mosquito collected from Parangipettai coast, values of all the mosquito species is shown in (Fig. 4). *Culex pipiens*, *Cx. tarsalis*, *An. tessellatus* and *An. tessellates* were dominant in the study sites. Principal component analysis on estuarine complex and mangrove area showed significant relationships with species abundance (Fig. 5). Higher mosquito species taxa richness was displayed (Fig. 6) in rainy season followed by summer and winter season.

DISCUSSION

Parangipettai contains both estuarine, mangroves and saltmarshes constitute an important ecosystem. However, they are commonly associated with mosquitoes (Diptera Culicidae) and are usually regarded as negative by humans because they can cause nuisance and transmit diseases. Mosquitoes diversity showed several of the well-established diversity patterns such as a species relationship and a distribution-abundance relationship. Besides the species-area relationship, the

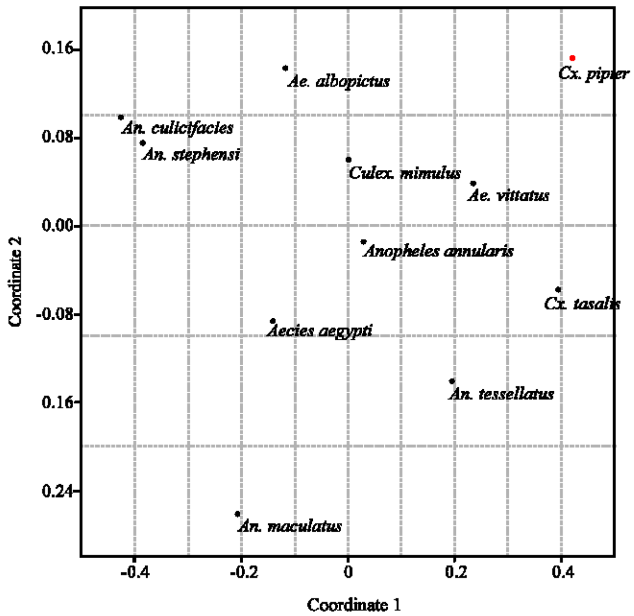

Fig. 4: Bray-Curtis analysis for a mosquito collected from Parangipettai coast

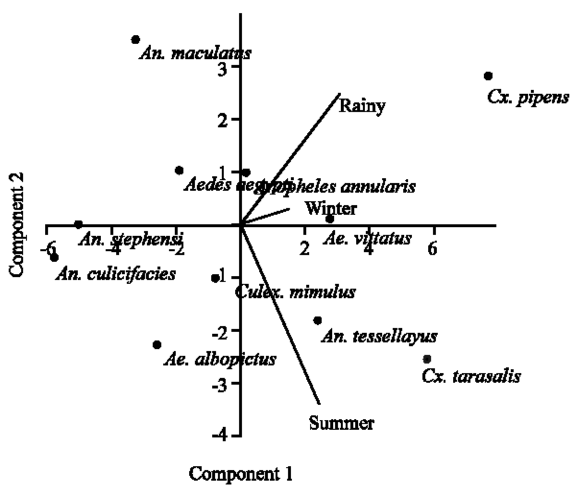

Fig. 5: Biplot showed the abundance of taxa in three seasons sampling sites by principal component analysis

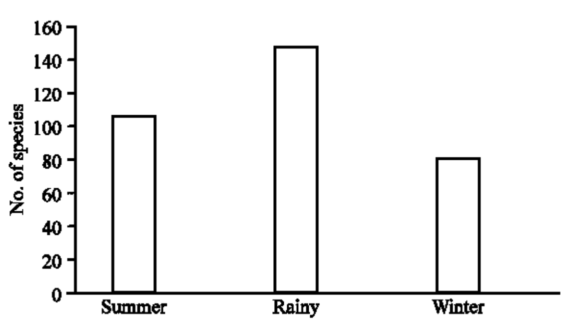

Fig. 6: Taxonomic richness of three seasons (summer, rainy and winter season)

distribution-abundance relationship has received attention in ecological studies (Hanski and Gyllenberg, 1997; Gaston *et al.,* 2000). A positive distribution-abundance relationship has been observed in other studies on dipterans (Malmqvist *et al.,* 1999; Hughes *et al.,* 2000).

In previous studies (Stewart, 1954) has been reported that American salt marsh mosquitoes visit flowers of *Avicennia* before going for a blood meal. Mosquitoes causing filariasis, malaria and encephalitis are also known to occur in mangrove forests. Mosquitoes are often incredibly numerous and the degree of abundance is exceptional (Macnae, 1968). Thangam and Kathiresan (1993) have been reported the populations are often dense and 18 species occur in Pichavaram and they reported the occurrence of filariasis, malaria and encephalitis. The incidence of filariasis was high and coincided with high populations of filarial vector, *Culex quinqufasciatus* (Slooff and Marks, 1965) have reported that in Solomon Islands, the mosquito, *Aedes* (*Geoskusea*) forceps Edwards was captured while biting a species of *Periophthalmus*. Macnae (1968) also reported that mosquitoes settle on the back of the head of the mud skipping Goby, *Boleophthalmus boddarti*. The bloodsucker, *Tabanus striatus* was also collected in Pichavaram by Senthil and Varadharajan (1995) and its occurrence is attributed to the presence of Jackal, otter and other domesticated cattle in Pichavaram mangrove. In Singapore and Malaysia, the mosquitoes and diptera insects act as vectors for pathogenic viruses that cause dreadful human diseases like Dengue and Haemorrhage fever (Murphy, 1990). Similar observations were made in mangroves from South China to Australia (Marks, 1954); India to South China, Malaya and Sumatra to Philippines and Thailand (Macnae, 1968). Thomson (1951) reported that mosquitoes had a specific association with *Avicennia* as opposed to *Rhizophora*. Mosquitoes are the notable offensive insects in mangroves and make the area totally in hospitable to humans. In South Florida the mosquitoes which breed in mangroves were reported to transmit disease like malaria and dengue fever (Tomlinson, 1986). In the present study found abundance and species richness of *Culex pipiens*, *Cx. tarsalis, An. tessellatus* and *An. tessellatus* complexes in the estuarine complex and mangrove area.

The occurrence of only two species of mosquitoes in the mangroves of Gujarat compared to the numerous species in other regions can be attributed to the degraded status of mangrove in Gujarat. The two districts Surat and Baruch are highly industrialized, consequent of which the mangrove areas are restricted to mere patches of sparse and stunted vegetation attaining not even a height of 1 m. Comparatively, the mangroves in other regions are extensive and dense with stands of 5-8 m and mostly undisturbed. Nevertheless, the occurrence of *Cx. quinquefasciatus* that breed in sullage water in the Vikhroli mangroves is indicative of the 60 threat faced by these mangroves by the drainage that is let out into the mangroves. However, in the case of rare and restricted species, there is no indication about their occurrence in most species-rich sites, but in the present findings, all the rare species of *Anophelines* and *Culex* were found in species-rich areas. Generally, all species-rich sites do not represent all mosquito species in our findings. This is may be due to the fact that the distribution of rare and uncommon species was not found within the distribution of more widespread species (Devi and Jauhari, 2005).

This study showed that diversity indexes used in environmental assessment, mainly to monitor changes in the diversity of organisms, could be applied to monitor mosquito species. Diversity indexes should be used to monitor mosquito vector species at many sites in relation to habitat type, latitude and land use and the databases generated throughout monitoring time should be used to forecast the effects of environmental change in mosquito populations. Once changes on adult mosquito species abundance are powerfully influenced by increase or removal of breeding places in the study habitats, the study of factors that regulate immature mosquito dynamics in the area is also a significant requirement. For the first time, extensive studies on diversity of mosquitoes in Parangipettai coastal ecosystems have been undertaken and it provides the first hand information on the diversity of mosquitoes in this area.

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