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RESEARCH ARTICLE

SPATIAL COLONIZATION DYNAMICS OF *MICRONECTA SCUTELLARIS* AND COEXISTING AQUATIC INSECTS IN TROPICAL PONDS AND LAKES

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ABSTRACT

Occurrence, prevalence and distribution of representative key species of aquatic heteroptera were investigated in selective fresh water bodies at Kancheepuram and Chennai districts of Tamilnadu. Traditional unrestricted sampling method was adopted. Water bodies with silt loam substratum showed higher correlation with abundance of aquatic bugs than with sandy loam, loamy sand, clay loam and clay. Taramani pond with clayey substratum was not colonized by *M. scutellaris*. Soil organic matter influences the colonization of bottom region of shore water resulting in dominance of *M. scutellaris* in permanent habitats. Permanent pond at Chetpet, Chennai having silt loam (silt 55 %, sand 25% and clay 20%) soil substratum and 10.2 % organic carbon showed abundance of aquatic bugs. The first two consecutive positions in community structure indices are shared by permanent pond ecosystems followed by temporary pond community. Species diversity index represents equitability in species abundance among species. Chengalpet permanent pond exhibits very poor species diversity index in spite of having high species abundance next to Chetpet pond. Habitat stability and abundance of niches influence colonization dynamics. In newly formed habitats, through climate change, the bugs colonize so rapidly that the fauna is in equilibrium with the prevailing environmental conditions. Colonization and community structure of aquatic insects vary among stable ponds, temporary ponds and lakes.

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INTRODUCTION

Insects are the most successful product of evolution, by any reasonable definition of biological success and they surpass all the terrestrial organisms in number. Numerical representation may not be an unadulterated blessing, still forming one of the measures of biological success. They are highly adaptive, both physiologically and morphologically to the existing environmental conditions (Venkatesan, 2005). Life faces environments which are more often niggardly than bountiful, more frequently inimical than benign. For life to endure, it must develop defenses and adaptations. Aquatic insects are remarkable for their diversity of form reflecting adaptations to a variety of niches (Polhemus, 1978; 2008). For such forms, the habitat is an ever-changing mosaic of periodicities and predictabilities. Aquatic habitats provide diverse patterns of ecological niches for the distribution and survival of aquatic bugs (Fischer *et al.,* 2000). In newly formed habitats, the bugs colonize so rapidly that the fauna is in equilibrium with the prevailing environmental conditions (Woodward and Kiesecker, 1994). Harrison (1980) has reported that aquatic bugs widely disperse and persist with or without reproducing for some time in the invaded habitat. Water bugs are well known to dwelling in specific microhabitats wherein their life activities are performed and sustained. Among various lentic freshwater ecosystems, the topography can be categorized into surface, column and bottom (Venkatesan and Cloarec, 1988). The size and nature of the habitat, presence of aquatic vegetation, physico-chemical factors and availability of prey are related to the colonization of water bugs (Ambrose, 2015). The present study aims at spatial colonization dynamics of representative key species of aquatic heteroptera from Kancheepuram and Chennai districts of Tamilnadu, India.

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MATERIALS AND METHODS

Selection of Key Species of Heteroptera

Selective heteropterans from varied microhabitats were surveyed to identify the preferable area or substratum and their presence or absence in the habitat were recorded. Following Ambrose (2015) four key species were selected *viz.*

Supra aquatic forms

Tenagogonus fluviorum (family Gerridae) are the potential representatives for the supra aquatic life.

Truly aquatic column dwellers

Anisops bouvieri (family Notonectidae) are the potential representatives for the truly aquatic column dwelling heteropterans. *Diplonychus rusticus* (family Belostomatidae) are also column dwellers that also frequent the water surface as well as the bottom of the habitat.

Truly aquatic bottom dwellers

Micronecta scutellaris (family Corixidae) represents the bottom community.

Study area and collection stations

The revenue districts of Chennai and Kancheepuram, Tamil Nadu, India in general is 3 months hot and other 9 months hotter. The annual rainfall is 110cm and of which 700mm is received during Northeast monsoon period (October-December) and 400mm in Southwest monsoon (June-September). Atmospheric temperature ranges from 25°C during monsoon to 45°C in summer months. Sampling was done by driving around the districts of Kancheepuram and Chennai, and mainly sampling water bodies that were easily accessible by road. Study on occurrence, prevalence and distribution of representative key species was carried out in Chetpet pond (13°N, 80°E), Koyambedu pond (13.3°N, 80.7°E), Thirunindravur pond (13°N, 80°E), Alamadhi lake (13°N, 80°E), Hastinapuram pond (12°N, 80°E), Chitalapakkam lake (12°N, 80°E), Madipakkam lake (12°N, 80°E), Kovilampakkam lake (12°N, 80°E), Tharamani pond (12°N, 80°E), Velacherry lake (12°N, 80°E), Kolapakkam lake (12°N, 80°E), Mudichur lake (12°N, 80°E) and Chengalpet lake as well as pond (12°N, 79°E). Selective water bodies were sampled once in each month from August 1998 – July 2000.Twenty three surveys were completed in 15 fresh water lentic habitats.

Water margin and littoral zone of the study sites were selected as collection stations. Five collection locations were established at a distance of 25 – 30m in stable lentic habitats and 10-15m in temporary habitats. On all collection days the collection was made in the same collection locations and at the same time. Substratum soil samples were analyzed for texture, pH and organic carbon content (APHA, 1989). Bulk density of soil samples was calculated.

Sampling Techniques

Traditional unrestricted sampling method was adopted and collections were made following the standardized sweep net procedure of Crisp (1962) and Pajunen (1972). Aquatic bugs were collected differently depending on their behaviour or habitat (Menke, 1979). Two different nets with 30 and 16cm in dimeter were used. *D. rusticus* were collected adopting the technique of Venkatesan (1981). *A. bouiveri* and *T. fluviorum* were collected using a net having 30 cm diameter. Since *M. scutellaris* are too small to be caught with ordinary aquatic nets, a net of denser material was preferred (Jansson, 1976). Nymph and adult *M. scutellaris* were netted with a small hand net made of dense terylene gauze and 16cm in diameter.

A fixed netting route was selected, normally through the deepest part of the pool. Before the start of netting, water was agitated vigorously to cause a standard distribution of animals, and the net was then moved along the bottom of pond/lake at constant speed. Before each net sweep, the water was again agitated and netting was carried out in the standard sampling route. For the sake of convenience, the first three nettings of a series were taken at intervals of 10 minutes. For larger lakes/swamps nine sweeps were used, for the smaller ones six sweeps. Contents of the net were transferred to polypropylene containers and *M. scutellaris* were removed with the aid of wide mouthed glass pipette. Faunal assemblage was identified. Areas, where sampling gave negative result, were confidently assumed to be outside the distributional range of these bugs.

Species Indices

Species dominance,species abundance, Shannon Wiener diversity index, species richness, species evenness and species commonality were calculated (Wallwork, 1976; Nolan and Callahan, 2006). Data were analyzed with suitable statistical tools.

RESULTS

Occurrence of *M. scutellaris* and co-existing *T. fluviorum*, *A. bouivieri* and *D. resticus* inlakes, stable ponds and temporary ponds were recorded. Chetpet permanent pond harboured more number of aquatic bugs (15.18%), followed by Chengalpet permanent pond (13.93%), Chengalpet temporary pond(12.19%), Koyambedu temporary pond(11.53%), Kovilambakkam lake (8.30%), Thirunindravur permanent pond (6.86%), Alamadhi lake (6.03%), Hasthinapuram permanent pond(4.72), Kolapakkam lake (4.42%), Velacherry lake (3.92%), Chengalpet lake (3.78%), Madipakkam lake (2.46%), Mudichur lake (1.75%) and Taramani temporary pond (1.44%). In general, abundance of Aquatic bugs were more numerous in ponds rather than lakes of the study area (Table 1).

Abundance of *A. bouiveri* was the highest (37.82%) among the aquatic bugs followed by *D. rusticus* (25.80%), *M. scutellaris* (23.09%) and *T. fluviorum* (13.30%) in the study area (Fig. 1). Analysis of colonization strategy in terms of per cent distribution among ponds and lakes of the study area revealed that *A. bouiveri* was the most predominant species with per cent distribution of 33.1 in ponds and 45.26 in lakes. *T. fluviorum* (15.32%; 9.83%) and *D. rusticus* (28.55%; 20.56%). In general *T. fluviorum* (15.23%) and *D. rusticus* (28.55%) showed higher preference to colonize ponds rather than lakes. *A. bouvieri* preferred to colonize lakes (45.26%). Marginally higher preference was shown by the bottom dwellers *M. scutellaris* to colonize lakes (24.35%) than ponds (23.03%) (Fig. 2).

Among the three different aquatic habitats studied, *M. scutellaris* were more numerous (26.27%) in the perennial pond ecosystem. Co-existing key species studied represented

73.73% but in temporary ponds, corixid population was 18.49% only. In lake ecosystem, *M. scutellaris* managed to occupy 24.35% in terms of number of individuals, leaving the rest (75.65%) to the co-existing aquatic bugs under study (Fig. 3).

Since habitat heterogeneity influences colonization dynamics, substratum soil samples were analyzed for its textural components, bulk density, hydrogen ion concentration and organic carbon content.

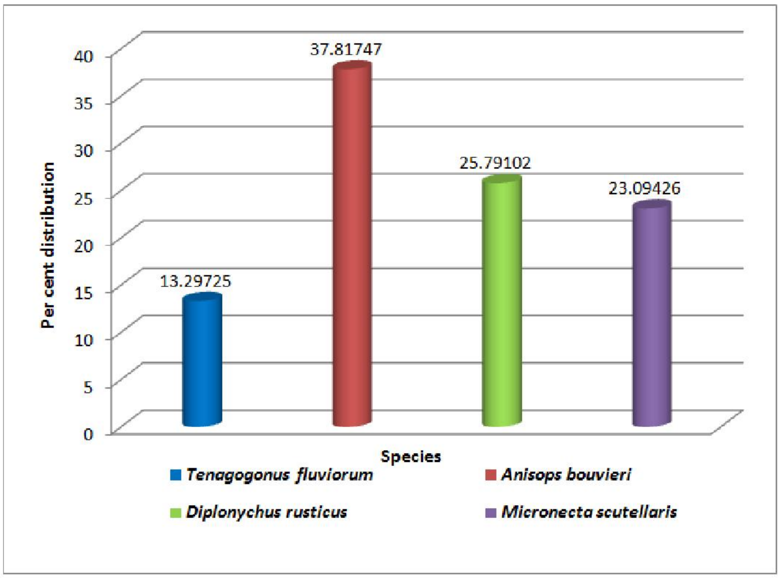


Figure 1. Abundance and per cent distribution of *M. scutellaris, T. fluviorum*, *A. bouvieri* and *D. rusticus* in lentic water bodies

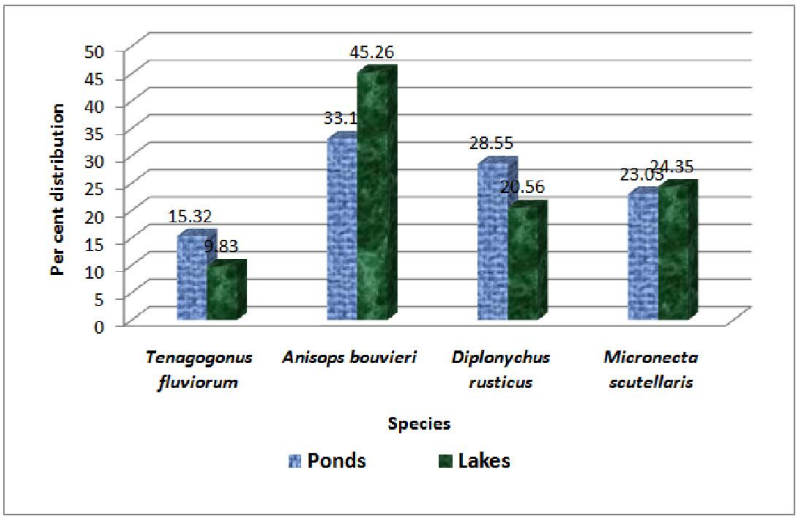


Figure 2. Distribution of *M. scutellaris, T. fluviorum*, *A. bouvieri* and *D. rusticus*in ponds and lakes at the districts of Chennai and Kancheepuram

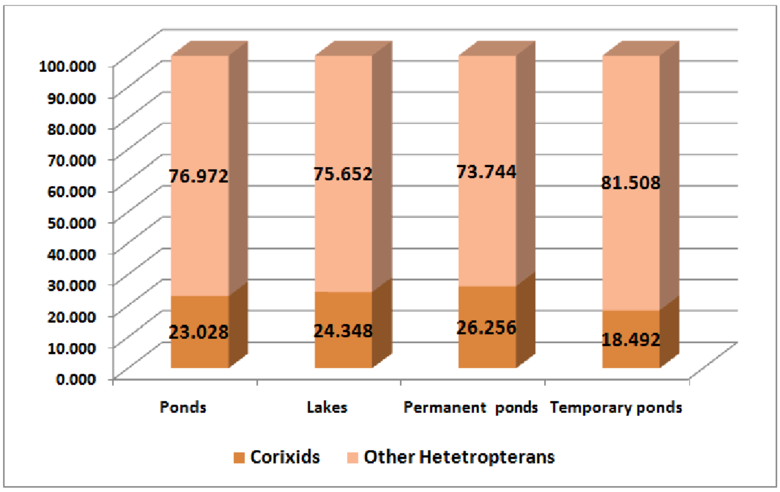


Figure 3. Co-existence of *M. scutellaris* and *T. fluviorum*, *A. bouvieri* and *D. rusticus* in ponds and lakes in the districts of Chennai and Kancheepuram

Table 1. Occurrence, prevalence and abundance of *Micronecta scutellaris* and representative key species of heteroptera in the districts of Chennai and Kancheepruam

Aquatic habitats	*Tenagogonus fluviorum*	*Anisops bouvieri*	*Diplonychus rusticus*	*Micronecta scutellaris*	Species abundance	Per cent abundance
Chetpet Pond (P)	1344±104	2585±301	2325±225	1964±268	8218 (2054.5±537.77)	15.17945
Chengalpet Pond (P)	1332±82	1966±298	2256±304	1990±189	7544 (1886±392.02)	13.9345
Koyambedu Pond (T)	1089±96	2376±210	1819±165	957±57	6241 (1560.3±662.92)	11.52773
Chengalpet Pond (T)	1106±89	2410±199	1937±192	1147±79	6600 (1650±634.80)	12.19084
Tharamanai Pond (T)	00±00	545±60	236±20	00±00	781 (195.25±258.35)	1.442583
Thirunindravur Pond (T)	165±12	1503±42	945±49	1102±84	3715 (928.75±560.76)	6.861966
Hasthinapuram Pond (P)	346±58	724±21	645±58	843±90	2558 (639.5±211.92)	4.724875
Alamathi Lake	360±41	1990±179	180±29	734±69	3264 (816±815.97)	6.028926
Chengalpet Lake	334±30	598±40	200±30	912±75	2044 (511±314.34)	3.775467
Chitlapakkam Lake	264±29	1080±103	184±34	360±32	1888 (472±411.67)	3.48732
Kolapakkam Lake	209±21	945±81	542±51	695±69	2391 (597.75±307.83)	4.41641
Kovilambakkam Lake	367±39	1908±115	975±39	1246±117	4496 (1124±638.95)	8.304549
Madipakkam Lake	205±17	622±49	505±41	00±00	1332 (333±283.07)	2.460334
Mudichur Lake	78±0.6	198±22	202±16	469±51	947 (236.75±165.18)	1.749201
Velacherry Lake	00±00	1024±97	1012±93	84±12	2120 (530±564.56)	3.915846
Habitat abundance	7199 (479.93±479.50)	20474 (1364.9±785.0)	13963 (930.87±783.47)	12503 (833.53±616.2)	54139 (3609.3±2449.5)	100.00
Per cent abundance	13.29725	37.81747	25.79102	23.09426	100.00	

P-Permanent pond T-Temporary pond, Values in parenthesis are mean ± Standard Deviation

Table 2. Characteristics of soil samples of selective freshwater bodies in the districts of Chennai and Kancheepuram

S. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Lakes								Ponds						
Characteristics	Alamathi lake	Chengalpet lake	Chitlapakkam lake	Kolapakkam lake	Kovilambakkam lake	Madipakkam lake	Mudichur lake	Velacherry lake	Chengalpet pond (P)	Chengalpet pond (T)	Chetpet pond (P)	Hasthinapuram pond (P)	Koyambedu pond (T)	Tharamani pond (T)	Thirunindravur pond (T)
Clay (%)	12.19	7.5	18	16	6.56	60	10	Nil	7.5	7.6	20	27	29	50	26
Silt (%)	27.06	66.5	31	27	41.5	20	10	50	66.5	10.45	55	25	34	20	49
Sand (%)	60.75	26	51	57	51.94	20	80	50	26	81.95	25	24	37	30	25
Texture	Sandy loam	Silt loam	Sandy loam	Sandy loam	Silt loam	Clay	Sandy loam	Silt loam	Silt loam	Loamy sand	Silt loam	Clay loam	Clay loam	Clay	Loam
Bulk density	1.52	1.52	1.47	1.47	1.57	1.21	1.59	NA	1.52	1.52	1.38	1.3	1.35	1.25	1.34
pH	7.6	7.6	7.1	7.2	7.0	7.6	7.6	6.2	7.0	7.0	7.8	6.9	6.9	7.2	7.0
Organic carbon (%)	2.3	5.8	3.0	4.2	3.6	3.4	2.3	Trace	7.8	5.9	10.2	3.1	5.8	1.0	2.2

Table 3. Species abundance, diversity, richness and evenness in selective freshwater bodies in the districts of Chennai and Kancheepruam

Category	LAKE								POND						
	Alamathi	Chengalpet	Chitlapakkam	Kolapakkam	Kovilambakkam	Madipakkam	Mudichur	Velacherry	Chengalpet (p)	Chengalpet (T)	Chetpet (P)	Hastinapuram (P)	Koyambedu (T)	Tharamani (T)	Thirunindravur (T)
Species abundance	3264	2044	1888	2391	4496	1332	947	2120	7544	6600	8218	2558	6241	781	3715
Species diversity Index (H)	1.0402	1.24311	1.13751	1.27551	1.25538	1.01132	1.21042	0.83241	0.1385	1.3311	1.359222	1.34104	1.31916	0.1385	1.21313
Species richness	4	4	4	4	4	3	4	3	4	4	4	4	4	2	4
Species evenness	1.7277	2.0648	1.8894	2.1186	2.0851	2.1196	2.0105	1.7447	0.2300	2.2109	2.2576	2.2274	2.1911	0.4601	2.0150

Table 4. Species commonality index (SCI) in selective freshwater bodies in the districts of Chennai and Kancheepruam

Combined habitats	Total no. of species	No. common species	Species Commonality Index (SCI)
Permanent ponds	4	4	100.00
Temporary ponds	4	2	50.00
Lakes and Permanent ponds	4	3	75.00
Lakes and Temporary ponds	4	2	50.00
Permanent ponds and Temporary ponds	4	2	50.00
Lakes , Permanent ponds and Temporary ponds	4	2	50.00

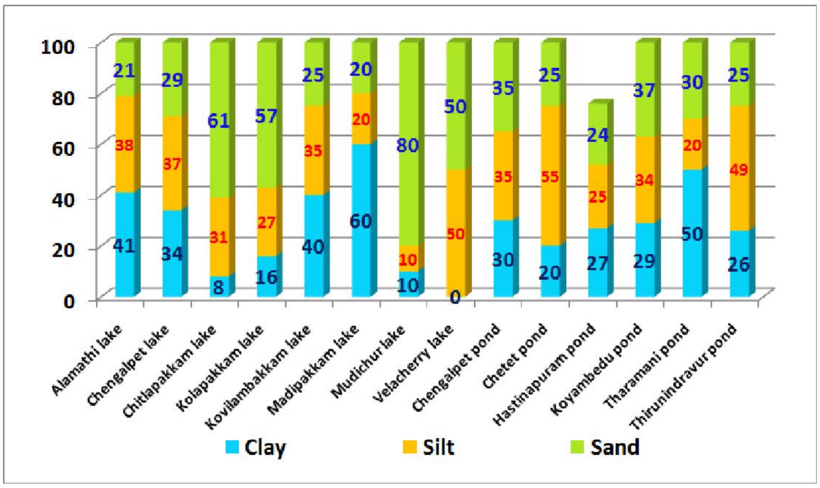
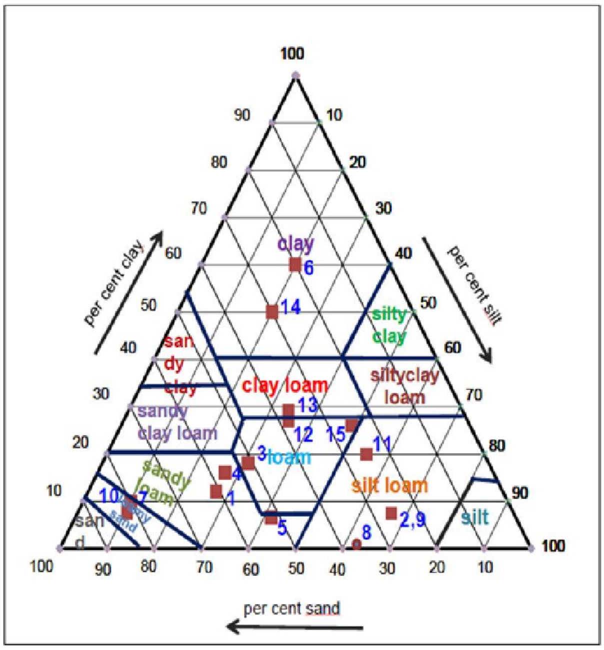


Figure 4. Characteristics of soil samples of study sites in the districts of Chennai and Kancheepuram



S. No.	Habitats		Texture	Bulk density
1	Lake	Alamadhi	Sandy loam	1.52
2		Chengalpet	Silt loam	1.52
3		Chitlapakkam	Sandy loam	1.47
4		Kolapakkam	Sandy loam	1.47
5		Kovilambakkam	Silt loam	1.57
6		Madipakkam	Clay	1.21
7		Mudichur	Sandy loam	1.59
8		Velacherry	Silt loam	NA
9	Ponds	Chengalpet (P)	Silt loam	1.52
10		Chengalpet (T)	Loamy sand	1.52
11		Chetpet (P)	Silt loam	1.38
12		Hasthinapuram (P)	Clay loam	1.3
13		Koyambedu (T)	Clay loam	1.35
14		Tharamani (T)	Clay	1.25
15		Thirunindravur (T)	loam	1.34

Figure 5. Textural Triangle of the soil substratum of aquatic habitats in the districts of Chennai and Kancheepuram

Fitment of composition of soil substratum to Saxton Textural Triangle has revealed that substratum of Chengalpet temporary pond was loamy sand with bulk density of 1.52. Alamathi, Chitlapakkam, Kolapakkam and Mudichur lakes were sandy loam with their respective bulk densities of 1.52, 1.47, 1.47 and 1.59. Chengalpet, Kovilambakkam and Velacherry lakes, Chengalpet andChetpet permanent ponds were silt loam with respective bulk densities of 1.52, 1.57, NA, 1.52 and 1.38. substratum was a loam soil with a bulk density of 1.34 in Thirunindravur temporary pond. Clay loam was the texture of the substratum soil of Hasthinapuram and Koyambedu ponds with their respective bulk densities of 1.3 and 1.35. Clayey substratum was revealed by Madipakkam lake and Taramani pond with bulk densities of 1.21 and 1.25 respectively (Table 2; Fig. 4 and 5).

Organic contents of the samples varied between trace and 10.2%. Highest organic content was recorded in Chetpet pond (10.2%) followed by Chengalpet permanent pond (7.8%), Chengalpet temporary pond (5.9%), Chengalpet lake and Koyambedu temporary pond (5.8%) and Kolapakkam lake (4.2%). Hydrogen ion concentration of substratum samples was found to be neutral in Kovilambakkam lake, both ponds of Chengalpet and Thirunindravur pond. Slightly acidic p^H was observed in Hasthinapuram and Koyambedu ponds (6.9) followed by Velacherry lake (6.2). All other aquatic habitats were alkaline (Table 2). *M. scutellaris* were totally absent in Madipakkam lake and Taramani pond, whose soil substratum was clay. Abundance of corixids were prominent in water bodies (Chetpet pond, Chengalpet permanent pond, Chengalpet lake and Kovilambakkam lake) with silt loam as soil substratum. Velacherry lake had silt loam substratum containing trace amount of organic carbon and its p^H was acidic. *M. scutellaris* were scarce. Non occurrence of corixids is characteristic of Madipakkam lake and Tharmani pond in which organic contents were found to be 3.4% and 1.0% respectively. Species abundance (Table 3) was more in the permanent pond at Chetpet (8218 in numbers) and least in the temporary pond at Taramani (781 in numbers) during the study period in Chennai district.

In general, abundance of selective aquatic bugs were Chetpet permanent pond (8218) > Chengalpetpemonent pond (7544) > Chengalpet temporary pond (6600) > Koyambedu temporary pond (6241) > Kovilambakkam lake (4496) >Thirunindravur temporary pond (3715) > Alamadhi lake (3264) > Hasthinapuram lake (2120) > Chengalpet lake (2044) > Chitlapakkam lake (1888) > Madipakkam lake (1332) > Mudichur lake (947) >Taramani temporary pond (781). Shannon Wiener species diversity index (Table 3), a determinant of relative abundance of individual species within groups of different species, recorded the highest index (H) in Chetpet pond (1.359) followed by Hasthinapuram (1.341), Koyambedu (1.319), Chengalpet temporary pond (1.331), Kolappakkam (1.276), Kovilambakkam (1.256), Chengalpet lake (.243), Thirunidravur (1.213), Mudichur lake (1.210), Chitlapakkam (1.138), Alamathi (1.040), Madipakkam (1.011), Velacherry (0.832) and Chengalpet permanant pond and Taramani temporary pond (0.139).

Species richness (Table 3) is the number of species in a particular habitat. Except Taramani temporary pond, Madipakam and Velacherry lakes showed occurrence and prevalence of all 4 selective species. Madipakkam and Velacherry lakes registered 3 species whereas Taramani temporary pond recorded only 2. Species evenness index (Table 3) measures evenness of species abundance and is complementary to diversity index concept. It indicates as to how individuals of various species are distributed in a community. Among 15 water bodies studied, species were more evenly distributed in Chetpet permanent pond (2.2576) followed by Hasthinapuram permanent pond (2.2274) Madipakkam lake (2.1196), Koyambedu temporary pond (2.1911), Kolappakkam lake (2.186), Kovilammppakam lake (2.0851), Chengalpet, (2.0648), Mudichur lake as well as Thirunindravur temporary pond (2.0105), Chitlapakkam lake (1.88894), and Chengalpet permanent pond (0.2300). Species commonality indices (Table 4) for permanent ponds was 100% followed by lakes and permanent ponds (75%), and lakes and temporary ponds, permanent and temporary ponds, temporary ponds and lakes, permanent and temporary ponds (50%).

DISCUSSION

Habitat plays a vital role in deciding activities of organisms. Substratum is the stage upon which the drama of aquatic insect ecology is acted out. It is the medium upon which aquatic insects move, rest, find shelter and seek food. Ecology and distribution of aquatic insects are highly governed by the type of habitat inhabited by them. Habit distinguishes between adaptations of aquatic insects maintaining position and moving about in aquatic environments.The truly aquatic column dweller, *A. bouvieri*, is the commonest species (37.82%) followed by another column dweller, *D. rusticus* (25.79%). The above findings conform to earlier investigators (Venkatesan, 2005). Notonectids fly efficiently and are excellent invaders into various types of water bodies. They are often the first successive inhabitants of aquatic habitats (Cook and Streams, 1984). Being colonizer of limnetic water column with or without vegetation, notonectidae are non-specialized predators taking almost any prey type that they can catch (Gilbert and Burns, 1999). *M. scutellaris* (23.09%) have higher dispersal potential which allows them to exploit various available habitats. The major factors limiting the occurrence of primarily detritivorous Micronectae are food, sufficient oxygen saturation, pollution and mortality (Jansson, 1977). The supra-aquatic *T. fluviorum,* an opportunistic predator was the least abundant species (13.30%). According to Menke (1979) and Batzer (1996) predatory activities of aquatic insects have a strong influence in shaping aquatic communities. Migratory capacity of corixids is an important factor causing fluctuation in their colonization dynamics (Velasco and Millan, 1998). Soil as a substratum cannot be quantified directly through linear measurement but categorical variables must be used to document the components of the soil. Texture and chemistry of substratum play a decisive role in occurrence, prevalence, distribution and species dominance. Organic content of substratum influences dominance of *M. scutellaris*. According to Shieh and Yang (1999), habitat heterogeneity and stability enhance colonization dynamics.

Water bodies with silt loam substratum showed higher correlation with abundance of aquatic bugs than with sandy loam, loamy sand, clay loam and clay. Taramani pond with clayey substratum was not found to be colonized by *M. scutellaris*. Madipakkam lake, whose soil substratum had more organic content showed absence of *M.scutellaris*. This may be due to the presence of clayey substratum, as in Taramani pond. Velachery lake, inspite of having silt loam substratum, showed least abundance of *M. scutellaris* and it may due to near absence of organic content. In habitats with sandy loam substratum, *M. scutellaris* exhibited least correlation (0.098) with texture of the soil and organic content. It may be understood that substratum influences occurrence, prevalence, distribution and colonization of *M. scutellaris*. According to Jansson (1977), shallow bays with wide reed beds and muddy shores as well as bays with sanded bottom are not apparently suitable habitats of *M. griseola, M. minutissima* and *M. poweri.*

Ecologically *M. scutellaris* cause intra and inter-specific interactions at various levels in freshwater bodies. Diversity of trophic structure has a greater impact on distribution and abundance of aquatic insect population. This causes varied dwelling areas of bugs such as the upper and lower water surfaces, water column, aquatic vegetation, prevalence of sandy, silty and clayey nature of the soil substratum (Cummins, 1978). Such a relation between population density and substratum reflects the insects response to supply of food and living space in terms of habitat units actually utilized.

M. scutellaris colonize freshwater bodies with all types of soil substratum except clayey substratum in the districts of Chennai and Kancheepuram, whose soil substratum is characterized by average contents of clay and sand but rich in organic matter. Shallow water region of aquatic habitats with loam silt substratum strongly influence distribution and abundance of individuals. Similar such observations were made by Sinden and Killingbeck (1996). Being bottom living animals of shallower region of ponds, *M. scutellaris* exploits unoccupied niches in all freshwater bodies studied. Members of the family Corixidae prefer the bottom of the shallow waters (Sarala, 1993). Shores with a substratum of hard clay, sand, gravel or rock are reported to be generally suitable for Micronectae but not soft muddy shores with dense reed beds (Jansson 1977).

Composition and chemistry of substratum play decisive role in the occurrence, prevalence, distribution and species dominance. Soil organic matter influences the colonization of bottom region of shore water resulting in dominance of the species, *M. scutellaris* in permanent habitats. Permanent pond at Chetpet, Chennai having silt loam (silt 55 %, sand 25% and clay 20%) soil substratum and 10.2 % organic carbon showed more abundance of aquatic bugs.

Abundance of aquatic bugs were more numerous in ponds than lakes. Colonization of water bugs in temporary ponds showed greater diversity than in a larger one. According to Barton and Smith (1984), smaller habitats harbour more insect diversity than the larger ones. Spatial colonization of aquatic insects is related to the stability and size of the substrate, and the substrate type influences the total number of individuals in the respective communities (Shieh and Yang, 1999). Littoral zones of small water bodies are spatially heterogeneous habitats with diverse biotic communities (Heino, 2000). Two small ponds would together support more species than a single large pond and the ecological succession in new ponds are due to rapid colonization by plants and macro invertebrates. Cyclic nature of a temporary pond as an ecosystem is distinctive enough to support species either not found in any other habitat type or that attain the largest population size in these ponds (Williams *et al.,* 1995; Lahr *et al.,* 1999).

Ecological monitoring of selective freshwater bodies resulted in quantification of community structure in terms of species abundance, species diversity, species richness, species evenness and species commonality index. Aquatic community in permanent pond at Chetpet leads the rank in all indices and it may represent more stabilized community. It is pertinent to state that the first two consecutive positions in community structure indices are shared by permanent pond ecosystems followed by temporary pond community. Species diversity index represents equitability in species abundance among species. Chengalpet permanent pond exhibits very poor species diversity index in spite of having high species abundance next to Chetpet pond.

Conclusion

Habitat stability and abundance of niches influence colonization and population dynamics. Occurrence and prevalence of aquatic bugs in selective water bodies of Tamil Nadu, India, may vouch that they are generally more adaptable to environmental changes. Water bugs are well known for dwelling in specific micro-habitats wherein their life activities are performed and sustained. In newly formed habitats, through climate change, the bugs colonize so rapidly that the fauna is in equilibrium with the prevailing environmental conditions.

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