Diversity of Aquatic Entamofauna in Ecosystem of Amaravathi River Water Nanjaikalipalayam Village, Tiruppur District, Tamil Nadu, India

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***Abstract*:**

The present study documents the diversity of aquatic entamofauna in aquatic ecosystem of AmaravathiRiver water Nanjaikalipalayam Village, Tiruppur District, Tamil Nadu, India. The insect samples for the present study were collected once a month from the sampling station. Samples were analyzed for the above said characteristics for October 2017 to December 2018 for river Amarawathi, Nanjaikalipalayam village, Tiruppur District, Tamil Nadu. The physico-chemical parameters were analyzed using standard methods. Totally 830 aquatic insect's were counted in three sample. The species *Hesperocorixacastanea* (water boatman) present in high 67.11%, next to *Thalerosphyrus* 10.12% and species *Dineutusindicus* present in low 0.72%. In abundance, order Hemiptera (79.76%) tops the list and order Coleoptera (0.73%) finds the bottom of the list. In order Ephemeroptera (13.73%) and Odonata (5.78%) contains moderate number of diversity. A total of 662 individuals are identified in order Hemiptera, it is mass group of insect population at River Amarawathi.

Keywords*: Ecosystems, Diversity, Aquatic Insects, and Entamofauna.*

I. INTRODUCTION

The AmaravathiRiver is the longest tributary of KaveriRiver in fertile the districts of Karur and Tiruppur, Tamil Nadu state, South India. The 282 kilometre (175 mi) long Amaravati River begins at the Kerala/Tamil Nadu border at the bottom of Manjampatti Valley between the Annamalai Hills and the Palni Hills in Indira Gandhi Wildlife Sanctuary and National Park in Tiruppur district. It descends in a northerly direction through Amaravathi Reservoir and Amaravathi Dam at Amaravathinagar. It is joined by the Kallapuram River at the mouth of the Ajanda valley in Udumalaipettai. Through Dharapuram and Aravakurichi it joins with the Kaveri at Thirumukkudal, about 10 kilometres (6 mi) from Karur. Nanganji, Kudavanar, Shanmuganadhi, Uppar, Kudumiar, Thenar and so many tributaries are joint with the Amaravathi River. It has the Tributary of the Pambar and Chinnar rivers from Kerala also. This river irrigates over 60,000 acres (240 km^2) of agricultural lands in Tiruppur and Karur districts. The Amaravathi Dam has 4 Megawatts of electricity generating capacity installed. The AmaravathiRiver and its basin, especially in the vicinity of Karur, are heavily used for industrial processing water and waste disposal and as a result are severely polluted due to large amount of textile dyeing and bleaching units. But nowadays in Karur, the changes are vicinity by seeing AmaravatiRiver on its clean surface because of pollution controlled by government.

Freshwater insects have important roles in the ecology of running waters. They are vital for riparian and flood plain food webs, processing organic matter and transporting energy along stream

channels, laterally to the flood plains and even vertically down into the stream bed. Actually more than 30,000 species of aquatic insect have been identified which live in freshwater and only several hundred are living in marine environments (Abhijna, *et al*., 2012). Vast majority of insect spend their primary stage in water while adults are terrestrial, for instance orders of Ephemeroptera (Mayfly), Odonata (Dragonfly and Damselfly), Plecoptera (Stonefly), Trichoptera (Caddiesfly), Megaloptera (Alderfly), Neuroptera (Lacewings), Diptera (Flies), Lepidoptera (Moths) and Hymenoptera (Wasps). There are some species of Coleoptera (Beetle) and Hemiptera (Bug) mentioned as fully aquatic that larval, nymph and adults stage exist in water (Subramanian and Sivaramkrishnan, 2015).

Studies of invertebrate fauna of lentic ecosystems were correlated to species – habitat relationship with regard to the environmental variables (Compin and Cerghino, 2003; Azrina *et al*., 2005). Over 95% of the total individual in fresh water particularly streams comprise of these immature life stages of aquatic insects. They play an important role in food chain of stream ecosystem. Some freshwater insects have specific requirements regarding their nutrients, water quality, substrate and vegetation. The aquatic insects, that have one of more life stages adapted for living in the aquatic environment, which may takes a few weeks to several years. Three aquatic orders, Ephemeroptera, Plecoptera and Odonata have a hemimetabolous life cycle. The other aquatic orders, Trichoptera and Megaloptera are holometabolous life cycle. Heteroptera has apaurometabolous life cycle. Among these orders Ephemeroptera, Plecoptera, Trichoptera, Coleoptera and Diptera are found in abundance in many streams (Subramanian and Sivaramkrishnan, 2007a). The use of aquatic insects as bio indicators provides data to estimate the degree of environmental impact and its potential effects on other living organisms (Wahizatul, *et al*., 2011). In general, aquatic insects are largely ignored in the contemporary estimation on Indian biodiversity.

About 5,000 species of aquatic insects are estimated to inhabit inland wetlands of India, represented predominantly by mayflies (Ephemeroptera), dragonflies (Odonata) and caddiesflies (Trichoptera) (Subramanian and Sivaramakrishnan, 2007a). Aquatic insects are particularly suited for use in environmental impact assessment (EIA) and has a long tradition in water quality monitoring (Bonada *et al*., 2006), act as reliable indicators, provide a spectrum of responses to disturbances at many levels of organization, ranging from organism to population, community, and even ecosystem levels (Niemi and McDonald, 2004). Many species require undisturbed habitats, thus a high number of EPT taxa indicates undisturbed streams and lakes with high habitat diversity and high species diversity (Subramanian and Sivaramakrishnan, 2007a and b). Aquatic insects are a group of arthropods that live or spend part of their life cycle in water bodies (Popoola and Otalekor, 2011). Most importantly, aquatic insects are a good indicator of water qualities due to their various environmental disturbances tolerant levels (Arimoro and Ikomi, 2008). Rivers, and the rich variety of plants and animals which they sustain, provide hunter-gatherer societies with water for drinking and washing, and with food, drugs and medicines, dyes, fibres and wood. Farmers reap the same benefits as well as, where needed, irrigation for their crops. For pastoral societies, who graze their herds over wide areas of often parched plains and mountains, perennial vegetation along the banks of rivers provides life–sustaining food and fodder during dry seasons and droughts.

II. MATERIALS AND METHODS

Study Area

The AmaravathiRiver is the longest tributary of KaveriRiver in fertile the districts of Karur and Tiruppur, Tamil Nadu state, in the present study, the samples were collected from Nanjaikalipalayam village, Velampoondi post, Dharapuram Taluk, Tiruppur District. The Water samples were analyzing the aquatic insect's population and physic chemical properties.

Sampling Methods

The study was conducted during the post monsoon period of November to January 2018. The insect samples for the present study were collected once a month from the sampling station at 10 - 11am. Several methods were used to collect samples D-frame nets, dipping and direct search on the stones of river floor stones. Specimens were picked up using forceps and placed in glass jars with labels and preserved in Ethanol. Labels indicate the sampling site and date of collection. All collected samples were identified using morphological characteristics of standard keys

Sampling of Aquatic Insects

A length of 100m reach was considered as a unit and the aquatic entamofauna were sampled using D- frame dip net as also k ick net both of which are of 500µm mesh size. The Kick net was placed in the upper stream and downstream. One meter above stream bottom substrates was kicked to dislodge invertebrates clinging to debris and stones into the kick net. The contents were emptied into the tray and invertebrates were collected. The D frame net was employed to trap specimens clinging to vegetation, root mats etc., along the boundary. Riffles and pools were sampled separately to account for sub habitat variations (Subramanian and Sivaramakrishnan, 2007a). The collected specimens were preserved in jars containing 70% ethanol.

Identification of Aquatic Insects Samples

Collected samples should be examined under a dissection or stereo zoom microscope (10X and above) and identified using standard taxonomic literature. Samples can be assigned to a family or genus using taxonomic keys for that particular group. Following keys are useful for identification: Ephemeroptera; Odonata, Plecoptera, Hemiptera, Megaloptera, Coleoptera, Diptera and Lepidoptera (Dudgeon, 1994); Hemiptera (Thirumalai and Radhakrishnan, 1999), Trichoptera (Wiggins, 1996).

Collection of Water Samples

Water samples were collected from sampling station with 1000ml plastic containers washed with nitric acid to remove any form of contaminants. Sampling was usually carried out between the hours of 8:00 am and 12:00 noon.

Analysis of Physico-chemical Parameters

The water samples collected were then taken to the laboratory and analyzed for physico-chemical parameters like Colour, Odour, Temperature, Turbidity, Total hardness, pH, Electrical Conductivity, Total Alkalinity, Calcium, Magnesium, Iron, Nitrate, Chloride, Fluoride, Sulphate, Phosphate. The physico-chemical parameters were analyzed using standard methods (APHA, 2012).

III. RESULTS

Physical chemical characteristics of AmaravathiRiver

Physical parameters were analyzed in the water samples collected from Nanjaikalipalayam village in the River Amaravathi. Physical parameters like appearance, colour, odour, temperature, turbidity, total dissolved solids, and electrical conductivity were analyzed during the study periods and values are given in Table.1. All the physiological characters are present in near the permissible limit. The chemical parameters like pH, alkalinity total, total hardness, Sodium, Potassium, magnesium, iron, nitrate, chloride, fluoride, sulphate, and phosphate were analysed in Amaravathi river water samples. Totally six physical parameters and 19 chemical parameters were analyzed. Data represented in Table-1 given average values for Chemical Parameters in Amaravathi river water samples. All are present within the permissible limit expect pH.

Table 1 -Physico-Chemical Parameters in River Amaravathi, Nanjaikalipalayam, Tirruppur District

S.No	Physico-Chemical Parameters	Acceptable Limit	Permissible Limit in the Absence of Alternate Source	Result for Water Sample
1	Appearance	-	-	Clear
2	Colour(Pt. Co – scale)	5	15	Colour less
3	Odour	Agreeable	0	None
4	Turbidity (NT units)	1	5	6
5	Total dissolved solids (mg/L)	500	2000	458
6	Electrical conductivity (micro mho/cm)	-	-	654
7	pH	6.5 to 8.5	6.5 to 8.5	6.96
8	pH-Alkalinity as $CaCo_3$ (mg/L)	-	-	0
9	Total Alkalinity $CaCo_3$ (mg/L)	200	600	172
10	Total Hardness as $CaCo_3$ (mg/L)	200	600	144
11	Calcium as Ca (mg/L)	75	200	42
12	Magnesium as Mg (mg/L)	30	100	34
13	Sodium as Na (mg/L)	-	-	42
14	Potassium as K (mg/L)	-	-	10
15	Iron as Fe (mg/L)	0.3	0.3	0.61
16	Manganese as Mn (mg/L)	0.1	0.3	0.00
17	Free Ammonia as NH_3 (mg/L)	0.5	0.5	0.09
18	Nitrite as NO_2 (mg/L)	-	-	0.10
19	Nitrate as NO_3 (mg/L)	45	45	14
20	Chloride as CI (mg/L)	250	1000	84
21	Fluoride as F (mg/L)	1	1.5	0.4
22	Sulphate as SO_4 (mg/L)	200	400	29
23	Phosphate as PO_4 (mg/L)	-	-	0.15
24	Tidy's test 4hrs as O_2 (mg/L)	-	-	0.44
25	Free residual chlorine (mg/L)	0.2	1.0	0.0

Aquatic Insects of AmaravathiRiver:

Numerical abundance of different aquatic insects has been observed in study period of Nov-2017 to Jan-2018. Table-2 gives the numerical abundance of different aquatic insects in Nanjaikalipalayam village at River Amaravathi. A total of 830 individuals of entamofauna representing ten genera categorized under four orders and ten species (Plate-1) were collected from the sampling locations. In total population of aquatic insects belongs to four orders like order Coleoptera, Ephemeroptera, Odonata and Hemiptera. In abundance, order Hemiptera (79.76%) tops

the list and order Coleoptera (0.73%) finds the bottom of the list. In order Ephemeroptera (13.73%) and Odonata (5.78%) contains moderate number of diversity.

Among all the insects order Hemiptera insect *Hesperocorixacastanea* (water boatman) was found maximum number 67.11%. Second dominance was order Ephemeroptera insect *Thalerosphyrus* 10.12% and followed by order Hemiptera insect *Velia caprai* (water cricket) 4.34% and *Lethocerusindicus* (Giand water bug) 3.86%. In this study, the most predominant insects groups are order Hemiotera. In study period the December 2017 having a maximum number of insects (326) than other two months. The table-3 shows the composition of aquatic insect orders collected from River Amaravathi. Plate-1 the graphical representations of composition of aquatic insect species collected from River Amaravathi and the composition of aquatic insect orders.

Table 2 - Numerical Abundance of Aquatic Insects in River Amaravathi, Nanjaikalipalayam, Tirruppur District (November 2017 to January 2018)

S. No	Order Name	Aquatic Insects Species Name	Aquatic Insects Collection			Total Number of Aquatic Insects (A+B+C)	% In Community
			A Nov-17	B Dec-17	C Jan-18		
1.	Hemiptera	*Notonectagluca*	14	10	0	24	2.89
		Hesperocorixacastanea(water boatman)	126	237	194	557	67.11
		Velia caprai (water cricket)	11	16	9	36	4.34
		Lethocerusindicus (Giand water bug)	12	4	16	32	3.86
		Aquarius remigis	0	6	7	13	1.57
2	Ephemeroptera	*Thalerosphyrus*	22	28	34	84	10.12
		CaenisSp	6	13	11	30	3.61
3	Odonata	*Sympetrumflaveolum* (Nymph of dragon fly)	14	3	5	22	2.65
		Ischnuraheterosticta (Damselfy nymph)	13	7	6	26	3.13
4	Coleoptera	*Dineutusindicus*	4	2	0	6	0.72
		Total	**222**	**326**	**282**	**830**	**100**

Table 3 - Composition of Aquatic insects Orders collected from River Amaravathi (November 2017 to January 2018)

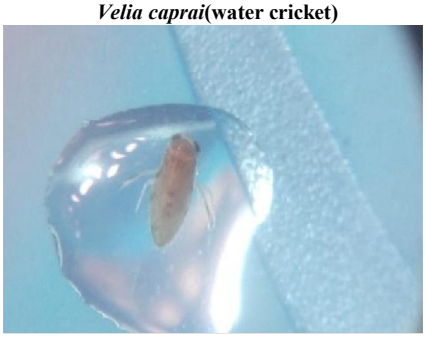
S.No	Order Name	Total Number of Insects	% In community
1.	Hemiptera	662	79.76
2.	Ephemeroptera	114	13.73
3.	Odonata	48	5.78
4.	Coleoptera	6	0.73

Lethocerusindicus(Giand water bug)

Aquarius remigis

Velia caprai(water cricket)

Dineutusindicus



Hesperocorixacastanea(water boatman)

CaenisSp

Thalerosphyrus

Ischnuraheterosticta

Notonectagluca

Sympetrumflaveolum
(Nymph of dragon fly)

Plate 1- Aquatic Insects of Amaravathi River

IV. DISCUSSION

This study provides the first formal data with regard to the aquatic insects' fauna in a part of AmarawathiRiver in Tirruppur district Tamil Nadu. In the present study, were collected various species belonging to aquatic insects. A study period three samples were collected and identified to four Orders and ten species by using microscope. This study compared to other studies of species diversity is more. Hemiptera order with 79.76% of collected sample was the most abundance frequent. Overall species abundance and richness revealed that insects of the order Hemiptera were the most dominant and that of Coleoptera was the least dominant, in this result similar to the urban freshwater lakes of Tripura (Joydeb Majumder, *et al*., 2013). A total of 662 individuals are identified in order Hemiptera, it is mass group of insect population at River Amarawathi. In order Hemiptera, species *Hesperocorixacastanea* (water boatman, 67.11%) have dominant than others.

Hemiptera: Aquatic Hemiptera have an intermediate place in the food chain, apart from being eaten, are often important predators too. The species of predatory aquatic bugs of super family Nepoidea, including families Belostomatidae and Nepidae, have been designated as threatened-vulnerable species in Red Book of Japan (IUCN, 1990) and are regarded as effective predators of fresh water snails and mosquito larvae (Ohba and Nakasuji, 2006). Certain families of bugs may be utilized in the biological control of mosquito larvae (Ohba and Nakasuji, 2006; Saha *et al*., 2007). In many cultures these insects are eaten and enjoyed. For example, Mangdana, as species of giant water bug, that is enjoyed by Thailand people in stirfiries and salads (Glausiusz, 2004). The mayfly naiads are an important source of food for fish and other aquatic wildlife. The larvae are important as food for other aquatic organisms

Ephemeroptera: In this present study overall species abundance, second place of richness have order Ephemeroptera (13.73%) and total number of insect are 114. In this order, insect *Thalerosphyrus* (10.12%) have maximum numbers. Ephemeroptera have advantages for monitoring as they are highly visible, relatively easy to sample and are represented by a few species in such habitats, which makes identification easier. Mayfly nymphs consume epiphytic algae and fine particulate organic matter (Francis *et al*., 2010). The main reasons for the low population density and low diversity of Ephemeropterans could be related to habitat degradation by pollution. The Ephemeroptera is one of the intolerant group of insects which are consider as an indicator of water quality because of its presence in both the polluted and unpolluted reaches of the aquatic body. *Thalerosphyrus* belonging to the Heptagindae family was found to be abundant in upstream and absent in downstream. However, it appears to be intolerant to pollution (Abhijna *et al*., 2012).

Odonata: In this study Odonata contributes 5.78 % of the total fauna. Insects *Sympetrumflaveolum* (Nymph of dragon fly) and *Ischnuraheterosticta* (Damselfy nymph) were the belonging to Odonata. The nymphs of this family remain attached to macrophytes. Crocothemis was the species of the Libelluidae, the naid of which is mud dwelling. 16 genera in Western Ghats have been collected by Subramanian and Sivaramakrishnan, (2005). Odonata population can be indicative of the richness of other invertebrates and macrophytes (Bried and Ervin, 2005).

Coleoptera: Order Coleoptera in this study have very least abundant, it has about only 0.73%. *Dineutusindicus*is an only species found in study location. Order Coleoptera, or beetles, is represented by some 3, 50,000 known species, but recent estimates suggest that there are hundreds of thousands or even millions of species which are not described. There are about 18,000 species of aquatic coleopteran are present on the earth at present. Aquatic coleopterans are highly diverse and distributed to nearly 30 families. The water beetles show wide diversity of colour, form and life pattern (Vazirani, 1977). Dytiscidae families generally inhabit leaf of bottom macrophytes of the clean freshwater and are predacious in nature. Hydrophylidae family are water scanvenger beetles and generally occur in shallower regions of the wetland with abundant macrophytes particularly

emergent ones and feed mainly on detritus, algae and decaying vegetative matter (Khan and Ghosh, 2001).

Aquatic Insects Diversity and Water Quality

Aquatic insects allow us to know about the health of a stream, pond, river or a lake. Aquatic insects are good indicators of water quality because they are affected by the physical, chemical, and biological conditions of the water body. They cannot escape pollution and show the collective effects of short and long term pollution events. They are particularly sensitive to the water quality like the amount of dissolved oxygen. Aquatic ecosystems are under increasing pressure from various kinds of disturbances (Tachet *et al*., 2002).

Hemiptera: Environmental reclamation of aquatic habitats is aided by aquatic Hemipterans which often can function as bio-indicators. These bugs, since they can survive in heavily polluted areas, are often used to gauge the toxins in an environment. Aquatic hemipterans stand out as an important group of aquatic insects, which are considered important in environmental reclaimation of aquatic habitats and are often used to gauge toxins in an environment (Papacek, 2001; Wollman, 2001). The hemipterans are associated with macrophytes, their diversity is high during winter as the increasing growth of macrophytes. In the present studies, Hemiptera formed the first most abundant group of insect fauna in the selected river.

Ephemeroptera: Ephemeroptera larvae are recognized worldwide for their sensitivity to oxygen depletion, and are therefore commonly used as bio indicators in many monitoring programmes. A high sensitivity of mayfly taxa to oxygen depletion, acidification, and various contaminants including metals, ammonia and other chemicals was demonstrated in both observational and experimental studies (Bauernfeind and Moog, 2000; Hickey and Clements, 1998). Mayflies are considered as “keystone” species and their presence is believed to be an important indicator of oligotrophic to mesotrophic (low to moderately productive) condition in running waters (Bauernifeind and Moog, 2000). In the present studies Ephemeroptera shows a significant association with moderately polluted water; their abundance could be seen during winter from December to March as temperature of water was not so high, there was slight decomposition of organic matter present in water body making it moderately polluted. Ephemeroptera constituted the second abundant group of insect fauna. This group was represented by *Thalerosphyrus* sp. and Caenis sp. Their presence indicates that these larvae are able to survive in polluted water with sufficient dissolved oxygen.

Odonates: Studies have included Odonata relationship with water quality, such as Temperature, pH, TDS, DO, Total alkalinity and Total Hardness etc (Azrina *et al*., 2005), biotope quality (Clausnitzer, 2003) and general species richness (Sahlen and Ekestubbe, 2001; Briers and Biggs, 2003), and use of Odonata as indicators for wetland conservation (Bried *et al*., 2007), This is largely because many of criteria of good indicator species, such as being taxonomically well known, relatively easy to identify and having distinct habitat requirements (Krebs, 2001) are fulfilled by Odonates (Corbet, 1999). Odonata constituted the third most abundant group of insect fauna. This group was represented by Nymph of dragon fly and Nymph of dragon fly. The investigations indicates that Odonata can live in polluted as well as clean water, but the algal abundance and luxuriant growth of macrophytes are prior requirements. Odonata prefer fresh water habitat with rich oxygen so their abundance are seen in winter because there is high dissolved oxygen in freshwater ecosystem in this season. In the present studies, their abundance was seen from December to January. Odonata shows least diversity and were very sparse in distribution, indicating their preference for freshwater, non-contaminated and well oxygenated habitats.

Coleoptera: Among coleopteran, the *Dineutusindicus* (water scavenger beetles) are predominant in rivers and streams. The members of family Gyrinidae (whirling beetles) are found in fresh water ponds, lakes, open flowing streams etc. There abundance occurs in summer because

of high rate of decomposition of organic matter due to high temperature which reaches up to 28-30°C. Coleoptera formed the least abundant group of insect fauna. In the present studies dominance of Coleopteran species were seen very low, which can be related to the unavailability of food and vegetation, which enhances the growth of insects during this period. The previous studies show their abundance was seen during April to June.

V. CONCLUSION

The present investigation was carried out the aquatic insect's population in the aquatic ecosystem of AmarawathiRiver. The insect samples for the present study were collected once a month from the sampling station. Several methods were used to collect samples D-frame nets, dipping and direct search on the stones of river floor stones. In study period the December 2017 having maximum number of insects (326) than other two months. Results of the present investigation were discussed aquatic insects diversity and water quality with reference to recent advancement studies. In order Hemiptera, species *Hesperocorixacastanea* (water boatman, 67.11%) have dominant than others.

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