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Occurrence and Distribution of aquatic insect population in two lentic water bodies of Chikmagalur district, Karnataka

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Abstract
The present study summarizes the assessment of aquatic insects conducted from February to December 2019 in two permanent tanks of Chikmagalur district, Karnataka. This study enumerated 12 different species belonging to 4 orders and 08 families in Mudagodu tank. Hemiptera and Coleoptera consists of 4 species and Odonata and Diptera with 02 species each respectively. However, Duglapura tank shows 13 species belonging to 12 genera, 03 orders and 07 families. Hemiptera consists of 06 species followed by Coleoptera (05 Species) and Odonata (2 species). In the present study, Hemiptera and Coleoptera were found most diverse and relatively abundant in the both the tanks. But Odonata and Diptera were least in both the tanks. The Shannon-Weiner diversity index for aquatic insect in Duglapura tank nearer to 3.0 indicating the good quality of the water. The values of Shannon diversity index at two tanks viz., Mudagodu and Duglapura tanks are 1.298 and 2.978 respectively. The Simpson values for richness and evenness of the two tanks are 0.92 and 0.85 respectively. Duglapura tank is less polluted compared to Mudagodu tank. It is evident that the water in Mudagodu tank is deteriorated and it is unfit for domestic usage. This study also indicated the occurrence of Chironomous and mosquitoe culex of the Diptera are the index of water pollution. Thus the present study needs an urgent and strict vigilance and continuous monitoring of these perennial water bodies for conservation and sustainable management

Keywords: Aquatic insects, Two tanks, physico-chemical parameters, distribution, Chikmagalur district

Introduction

Aquatic insects makes about 4% of the total insect populace. They evolved from terrestrial forms later followed an aquatic life. Aquatic insects are the food of many fishes including other aquatic fauna. Many aquatic insects compete for food. Aquatic insects serve as numerous ecological indicator, kinds of pollution, and their extent inside water bodies. The total number of species belonging to the aquatic insect family is approximately 11,200. Of these, 8,520 species belonging to 145 families in India. Freshwater pollution is due to biodegradable materials, and chronic natural chemical inputs. These inputs have direct toxic results on both sediment and its biota, and inside the case of persistent chemical compounds, the linkage among the sediment and nearby biota exacerbates and prolongs the contamination (Lake *et al*.,2000) [13]. Habitat fragmentation and water degradation are the threats to biological diversity (Vouiri and Joensuu,1995) [22].

The biological integrity of freshwater is defined in which species composition, diversity, and functional organization is in balance and consistent with those found in nature. It is defined as an integrated and adaptable biological community with a large number of organisms (Karr and Dudley, 1981) [12]. Eutrophication due to enrichment of nitrate and phosphate ultimately leading to depletion of dissolved oxygen (Lake *et al*.,2000) [13]. Freshwater biota are affected by a variety of natural disturbances that vary in intensity, frequency, predictability, duration, and spatial extent. Such disturbances can destroy biota, disrupt ecological processes, and redistribute resources (Giller, 1996 [9]; Boulton and Lakes, 1992) [13]. Human activities are the major source influencing the earth's freshwater ecosystems (Vitousek *et al*.,1997 [21]; Sala *et al*., 2000) [18].

In many circumstances, freshwater is simultaneously open to human anthropogenic disturbances (Gorham,1996) [10]. The composition of aquatic insects varies due to several factors. The maximum critical are the physico-chemical parameters of water (Wetzel,1983) [23]. Species variety is too much in shallow, quite efficient coastal zones, while, variety is decreased in other zones because of the presence of silt/natural mud deposits and the oxygen-depleted situations resulting from biodegradation of organic matter. As a result,some specialized species emerge, regularly attaining very huge populations(Conwell and Vodopich, 1980) [5].

Aquatic habitat contains group of organisms and aquatic insects are found to be flourish in aquatic ecosystems involved in nutrient cycling. They play an important role in food chain. Aquatic invertebrates are react rapidly to the changing environment. Their abundance and variety make them for assessing the environmental circumstances of marshland (Rader et. al., 2001 [16]; Rukasana and Deepti Srivastava. 2015) [17]. Fluctuations in aquatic insect communities provide rapid information as they interact with water quality, which varies with the physical and chemical environment. Two main objectives of the current study is to a) identify the aquatic insects from two tanks b) Estimate the tank water for some physico-chemical parameters and also to study the trophic status of insects in both the tanks.

Study Area

The field work is carried out on the two permanent lentic tanks selected in Chikmagalur district of Karnataka. The tank ecosystems taken under study are Duglapura and Mudagodu (Figure 1). They are the major perennial tanks and they receives rainwater during monsoon and river water from the Bhadra channel. The water is extensively used for

cultivation of agricultural land and aquaculture purposes. They are situated at an elevation of 601 m above mean sea level and located at latitude 13°43'-13°46' N, longitude of 75°39'-75°40'E and they acquires land area of 0.7 and 0.8 square km respectively. The depth of the water bodies are 2-4 mts.

Fig 1: Views of Mudagodu and Duglapura tanks showing aquatic flora

Methodology

Collection of Insects

Insect specimens were collected during February to December 2019. Insects were collected in both the tanks by using insect net. Samples were also amassed from sediment by the usage of the kick sampling technique, Later, insects have been counted on the different sites and they were preserved in 70% alcohol for identification. The collection and counts have been made between 9 AM. and 11 AM during the day. The insect fauna were documented following Daglish (1952) [6], Borror & Delong (1957) [2], Vazirani (1964) [20] and Mc Cafferty (1981) [15]. Their occurrence are expressed in organisms per m^2.

Physico-Chemical profile of water & Statistical Analysis

Water samples were collected in triplicate using sterilized bottles and labeled them for identification. Later, water samples were taken to the laboratory for physico-chemical analysis. The water temperature was measured via usage of mercury thermometer and pH was estimated by pH meter. Electrical conductivity was recorded by using conductivity meter. Other chemical parameters have been analyzed according to standard techniques (APHA, 2005). Correlation coefficient matrix data was used to know the relations between different water variables (physico-chemical parameters) and insect richness.

Results and Discussion

Duglapura tank was not deep and water was alkaline in nature and rich in dissolved oxygen. Water temperature was vary from 25.5^{0}C to 30.50C. pH was deviated from 7.5 to 8.5. The turbidity was fluctuated from 10-20 NTU. The range of electrical conductivity was from 65 to 120 µmhos/ cm. The total dissolved solids deviated 98.5 to 128.3 mg/l. Free CO_2 was ranged from 4 to 8 mg/l. Dissolved oxygen was fluctuated from 4.84 to 8.8mg/l. Hardness deviated from 48 to 120 mg/l and total alkalinity deviate between 60 and 104 mg/l. BOD values ranged 2.2 to 4.8 mg/l. However, Mudagodu tank water was alkaline with less oxygen. The water temperature was between 26.5^{0}C and 31.50C. pH was deviated from 7.4 to 8.3. The turbidity was found to be fluctuated from 25- 42 NTU. The electrical conductivity was ranged from 98 to 160 µmhos/ cm. The total dissolved solids deviated from 102.6 to 156.3 mg/l. Free CO_2 was ranged from 4 to 12 mg/l. DO was fluctuated from 4.84 to 6.8 mg/l. Hardness of water is due to cations and anions in water and it ranged from 64 to 180 mg/l and total alkalinity fluctuated from 78 to 114 mg/l. BOD values deviated from 4.6 to 8.4 mg/l.

Species spectrum of aquatic insects are depicted in Tables 1. Nevertheless, Figure 2 to 5 shows order and family wise occurrence of aquatic insects in both the tanks. Duglapura tank harbor 13 insect species belonging to 12 genera, 03 orders and 07 families. While, Mudagodu tank has a total of 12 species comprising 04 orders,08 families and 11 genera.

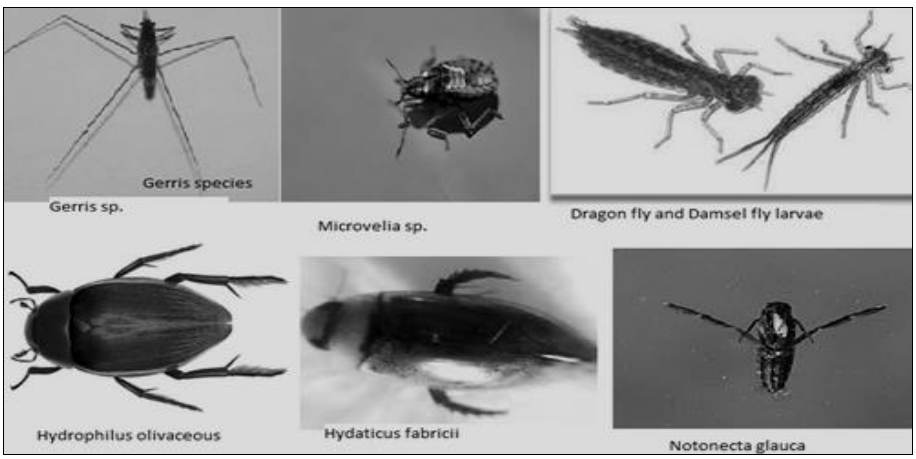

Fig 2: Aquatic insects in two tanks of Chikmagalur district

In Duglapura tank, adult and larval forms of Coleoplera and Hemiptera were recorded. But, Diptera and Odonata occurred as larvae. In sediment and water, Chironomid larvae and mosquito larvae were recorded. *Hydrophilus olivaceous* was maximum and *Gerris lacustris* was minimum in occurrences.

Orders Hemiptera, Odonata and Coleoptera are the indicators of water quality and act as bio-control agents. Similar explanation was made by Choudhary and Gupta (2015) [4] in Deepor beel, Assam and they reported 31 species, 18 families and 5 orders. Singh Kuldeep (2011) was identified 12 insects in village pond of Bikaner. Innifa Hasan *et al* (2016) have conducted an aquatic insects (25 species, 6 orders and 13 families) survey in 03 permanent ponds of Guwahati, Assam,

Whereas, physico-chemical parameters are useful for identifying the effects of pollution on water quality, trophic condition of water affect the biological community, including species pattern, distribution and diversity (Fouzia and Amir, 2013) [8]. A change in habitat can affect the type of species present in the ecosystem. Insects have the ability to migrate, they can readily move from unfavorable habitats to favorable ones and the species present in a habitat reflects the condition of the water body (Medina *et al*., 2007) [14].

The values of Shannon diversity index of Mudagodu and Duglapura tanks are 1.298 and 2.978 respectively. The Simpson index values for richness of the two tanks are 0.92 and 0.85 respectively. Table 2 and 3 shows Pearson's correlations among physico-chemical variables of water and aquatic insect density in Mudagodu and Duglapura tanks. Most of the water quality parameters showed positive relation among other water parameters but significant negative relationship among TH vs Free CO_2, DO vs TH, BOD vs TH and BOD vs Insect taxa richness.

Trophic status

Most of the Odonata and Hemiptera are the predators but Coleopterans are Grazers and Dipterans are Collectors. In this study, Mudagodu tank consists of 06 species of Predators, 04 Grazers and 02 Collectors. Nevertheless, Duglapura tank consists of 08 species of Predators and 05 species of Grazers (Figure 6).

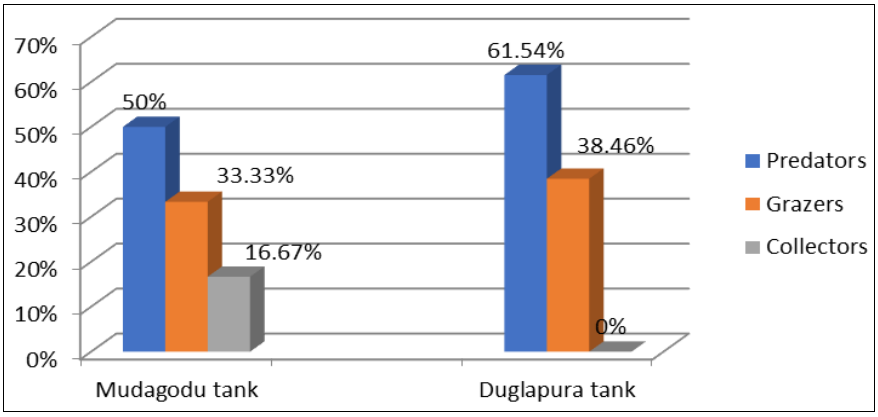

Fig 6: Trophic category (%) of Aquatic insects in Mudagodu and Duglapura tanks

Table 1: Order and family wise distribution of Aquatic insects in Mudagodu & Duglapura tanks

Mudagodu tank		
Order	**Family**	***Insect species***
Odonata	Lestidae	*Dragonfly larvae Damselfly larvae*
Hemiptera	*Nepidae*	*Laccotrephes maculates*
	Nepidae	*Ranatra elongata*
	Notonectidae	*Anisops sp.*
	Nepidae	*Nepa cineria*
Coleoptera	Dytiscidae	*Hydaticus leucozonicus*
	Dytiscidae	*H.fabricii*
	Hydrophilidae	*Hydrophilus olivaceous*
	Gyrinidae	*Dinetutes indicus*
Diptera	*Chironomidae*	*Chironomus sp*
	Culicidae	*Mosquitoe larvae*
Duglapura tank		
Coleoptera	Hydrophilidae	*Hydrophilus olivaceous*
Coleoptera	Hydrophilidae	*Tropisternus lateralis*
Coleoptera	Dytiscidae	*Dytiscus verticalis*
Coleoptera	Dytiscidae	*Hydaticus fabricii*
Coleoptera	Dytiscidae	*Laccophilus flexuosus*
Hemiptera	Notonectidae	*Notonecta undulate*
Hemiptera	Notonectidae	*Notonecta glauca*
Hemiptera	Corixidae	*Sigara pectoralis*
Hemiptera	Corixidae	*Corixa lima*
Hemiptera	Gerridae	*Gerris lacustris*
Hemiptera	Velidae	*Microvelia* species
Odonata	*Lestidae*	*Dragonfly larvae*
Odonata	*Lestidae*	*Damselfly larvae*

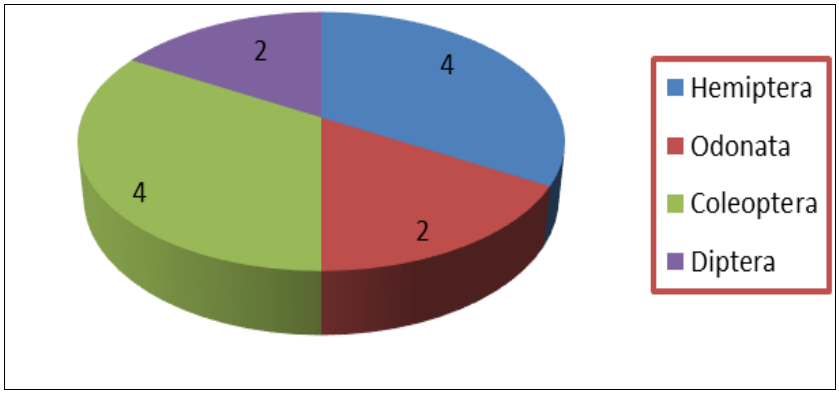

Fig 2: Order wise occurrence of aquatic insects in Mudagodu tank

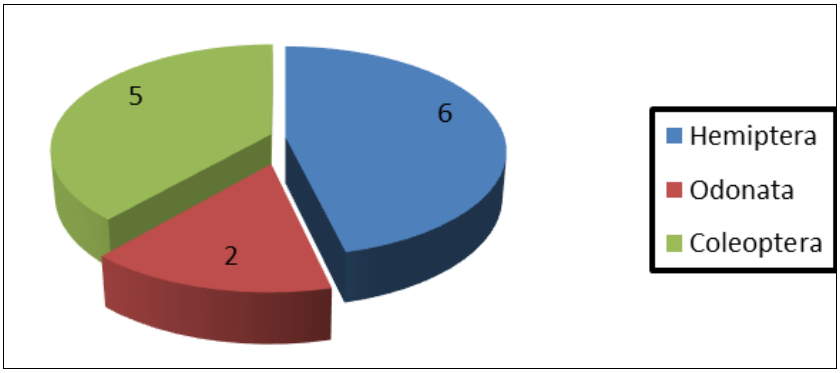

Fig 3: Order wise occurrence of aquatic insects in Duglapura tank

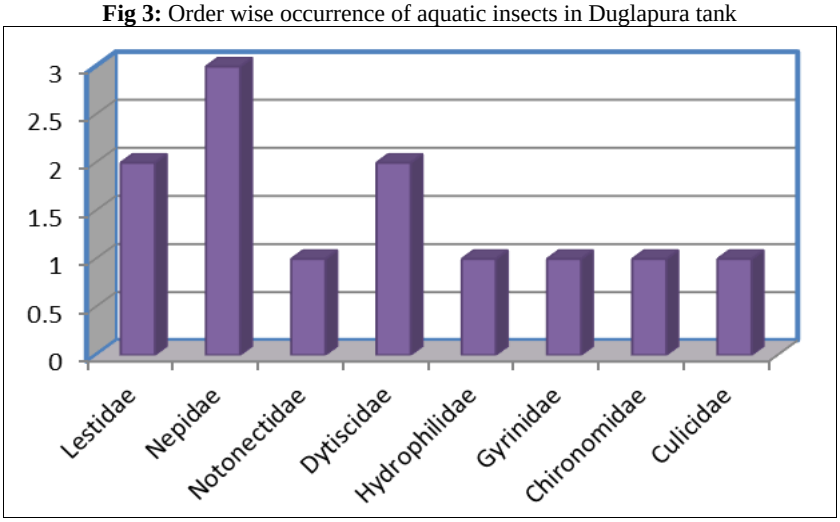

Fig 4: Number of aquatic insects in each families of Mudagodu tank

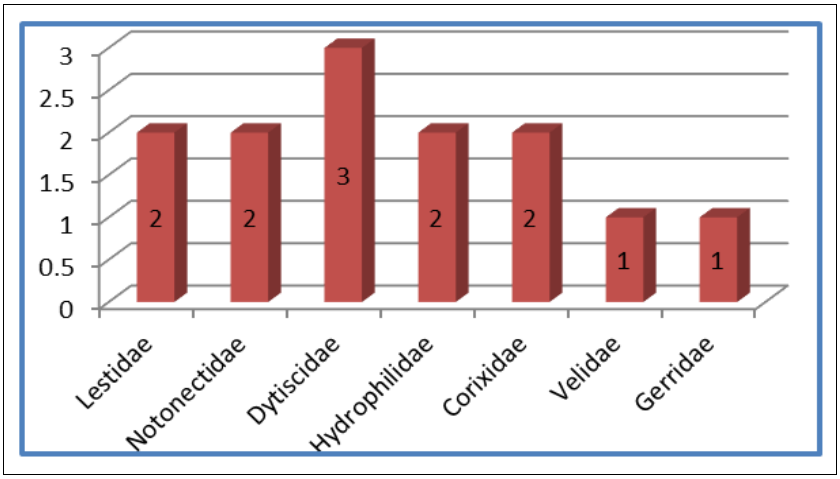

Fig 5: Number of aquatic insects in each families of Duglapura tank

Table 2: Pearson's correlations among physico-chemical variables of water and aquatic Insect Density in Mudagodu tank, Chikmagalur district.

Variables	r
Free CO_2 vs EC	0.685*
Free CO_2 vs TDS	0.702*
Free CO2 vs TH	0.670*
Total hardness vs TA	0.610*
TH vs DO	0.634*
pH vs TA	0.672*
Turbidity vs Free CO_2	0.710*
Insect density vs DO	0.780**
Insect density vs BOD	0.850**
Insect density vs Free CO_2	0.622*
Insect Density vs pH	0.625*
TDS vs Conductivity	0.930**
Total hardness vs Conductivity	0.840**
Total hardness vs TDS	0.901**
BOD vs TH	0.925**
EC vs TDS	0.912**
Turbidity vs Conductivity	0.870**
Total hardness vs BOD	0.924**

**significant at p <0.01 level; * significant at p < 0.05 level.

Table 3: Significant Pearson's correlations among physico-chemical variables of water and insect taxa richness in Duglapura tank.

Duglapura tank	
Variables	*r* value
DO vs Insect richness	0.835*
BOD vs Insect richness	-0.878*
WT vs pH	0.821*
WT vs TH	0.901*
pH vs Hardness	0.898*
pH vs BOD	0.819*
pH vs TDS	0.920*
EC vs TDS	0.990***
TDS vs Total Alkalinity	0.819*
Turbidity vs Free CO_2	0.868*
TH vs Total Alkalinity	0.855*
Hardness vs Free CO_2	-0.940**
DO vs TH	-0.872*
BOD vs TH	-0.852*

*p<.05, **p<.01, ***p<.001. WT- Water temperature; DO-Dissolved oxygen; FCO_2-FreeCarbon-dioxide; EC-Electrical conductivity; TDS-Total dissolved solids; TH-Total Hardness; BOD- Biological oxygen demand

Conclusion

Some of the physico-chemical parameters in both the tanks showed sequential and spatial variations throughout the study. Mudagodu tank receives maximum surface run off from the near by areas and this tank may included under mesotrophic state. Mudagodu tank is polluted due to domestic and agricultural activities around the tank But Duglapura tank water is used for irrigation and human consumption and it is moderately oligotrophic in nature. This concludes that the tank water is suitable for human consumption after proper treatment. The distribution of the species is influenced by survivality and distribution. The various physico-chemical parameters is dependable on tank area and suitable for aquatic insects. Therefore, insect diversity has become a source for understanding the environmental status of freshwater and the effects of changing fresh waters.

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