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STUDIES ON DISTRIBUTION AND DIVERSITY OF CHIRONOMID LARVAE (INSECTA: DIPTERA), WITH RESPECT TO WATER QUALITY IN SALIM ALI LAKE, AURANGABAD, INDIA

P. R. BHOSALE, R. J. CHAVAN* AND A. M. GAIKWAD
Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad - 431 004, Maharashtra, INDIA
E-mail: bhosalepr22m@gmail.com

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***Corresponding author**

ABSTRACT
The distribution and diversity of chironomid larvae were investigated with respect to some physico-chemical parameters in Salim Ali Lake at Aurangabad (19°53′55′′N, 75°20′28′′E) to study the influence of physico-chemical parameters on Chironomidae larvae. Samples were collected from five sites of lake in each month over a period of one year, from Oct. 2009 to Sept. 2010. Total of 9 taxa belonging to two sub-families, Chironominae and Tanypodinae were observed. Chironominae was dominant for both richness and evenness, the frequent and abundant genus was *Chironomus*. The mean density of chironomid larvae during period of study was 1771 larvae/m^2. According to Shannon- Wiener diversity index Salim Ali lake has average diversity 0.57. Furthermore, according to Pearson correlation index density of chironomid larvae does not significantly correlates with studied ecological parameters of lake water.

INTRODUCTION

The chironomid family (Insecta: Diptera: Chironomidae) commonly referred to as non-biting midges, are frequently the most abundant and diverse group of insect found in freshwater ecosystems. These insects spend the greatest part of their life cycle in larval form, occupying a wide range of habitats compared to other insects. Chironomidae larvae are quite important in production of benthic biomass and they can be found in many different environments because of their ability to adapt to extremes of some physicochemical composition of water. Chironomidae constitute the most abundant group of benthic freshwater macroinvertibrates in terms of both species and abundances (Armitage *et al.*, 1995).

Chironomids have long been used by limnologists and aquatic ecologists as biotic indicators to classify lakes in terms of trophic status and hypolimnetic oxygen concentration. These are now increasingly being used by paleolimnologists to reconstruct past lake conditions and to access the impact of environmental change and pollution on the structure and function of aquatic communities. (Brooks and Birks, 2004; Rossaro *et al.*, 2006; Maskey, 2007; Nazarova *et al.*, 2008; Eggermont *et al.*, 2008; etc.)

Species composition of chironomid assemblages differs qualitatively and quantitatively among microhabitats and larvae are highly selective in their choice of site (Maasri *et al.*, 2008). The chironomid study has special ecological importance (Schmid, 1992) because of wide distribution of the group, high abundance and non-seasonal life cycle. Distribution of chironomid species can be used as water quality indicators, in lake classification (Nyman, 2007) and determining environmental conditions of lakes (Tellioglu *et al.*, 2008 and Warusawithana and Yatigammana, 2007).

From India, Sublette and Sublette (1973) recorded 21 genera of Chironomidae. Coffman *et al*. (1988) reported 55 chironomid genera (35 new to India) from south India. Numbers of investigators have added into generic composition of the chironomid fauna of India which is upto 73 in number (Coffman *et al.*, 1988). The present study was undertaken to know the diversity, density and distribution of the chironomid larvae with special respect to some ecological factors in Salim Ali lake at Aurangabad city.

MATERIALS AND METHODS

Study area

Lake under investigation, popularly known as Salim Ali Talab is located near Delhi Gate, opposite to Himayat Bagh in Aurangabad. It is located at 19p 53′ 55" N; 75p 20′ 28" E (www.wikimapia.org) in the northern part of the city. It has been renamed after the great ornithologist and naturalist Dr. Salim Ali. The lake bottom is muddy and consists of organic matter.

Five different sites were selected considering lake morphometry. The samples of water and chironomid larvae were taken on monthly basis for one year (Oct. 2009- Sep. 2010). Analysis of water parameters was carried out with Deluxe Water and Soil analysis kit and as per methods suggested by APHA (1997), Trivedy *et al*. (1995) and Kodarkar (1992). Chironomidae larvae were preserved in 70% alcohol and evaluated for m^{-2}. Slides were prepared for identification as per method given by Epler (2001). Larvae were identified at the lowest possible taxonomic level with the help of standard taxonomic keys of Epler (2001), Papp and Darvas (2000), Oliver and Roussel (1983). Shannon- Wiener diversity index (SWI) was applied to obtain statistical data about the diversity of larvae for each month and was calculated as $H = -\Sigma(Pi.\ln Pi)$. Pearson correlation index was used to determine relation between the numbers of chironomid larvae and the physicochemical parameters of water.

RESULTS AND DISCUSSION

During the study period, observed mean density was 1771 individuals/m^2 for 10 different larval Chironomidae species. Average larval density during the year ranged between 1040 and 2680 individuals/m^2. High density of larvae may be due to presence of organic matter and mud in large amount at the bottom of lake, which serves protected place and food for survival of larvae.

Minimum larval density was observed during the months November (1040) while maximum density observed during August (2680). Ozkan and Camur- Elipek (2006), reported the highest average number of larvae in summer whereas decrease during winter. In current study, average density of larvae was less in winter but maximum in monsoon followed by summer. Fluctuation in abundance of Chironomidae larvae due to season also reported by Tellioglu *et al.* (2008).

Two subfamilies; Chironominae and Tanypodinae were found. Chironominae was the more abundant subfamily (comprises of 8 species), which includes *Apedilum* sp., *Chironomus* sp. A, *Chironomus stigmaterus, Chironomus riparius, Chironomus* sp. B. (Similar to *Chironomus* sp. 'Florida'), *Kiefferulus* sp. and *Leuterborniella* sp. Tanipodinae comprises only one species *Bethbilbeckia* sp. The highly dominant species was *Chironomus riparius* with 52.36% abundance. *Chironomus stigmaterus* comprises of 19.56% relative contribution, which was followed by the species *Chironomus major* (15.73%). Considerable differences for the species and number of Chironomid larvae were observed during each month of year. It is reported that the larvae belonging to the genus *Chironomus* are often collected in aquatic ecosystems, which are subjected to high organic nutrient enrichment (Freimuth and Bass, 1994). In the current study, the larvae of *Chironomus* were also observed frequently.

Diversity of larvae in lake showed difference during each month but not in the sequence describe for density. According to Shannon index, species diversity was determined high in January (0.62), followed by December and June (0.61) and lowest diversity was observed in November (0.45).

Physico-chemical parameters of the lake varying in each month, indicates for water temperature between 19 and 27°C

Table 1: Population density (no. of individuals/m^2) of Chironomidae larvae in Salim Ali Lake (Oct. 2009- Sep. 2010)

Taxa / Months Chironominae	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average	%
Apedilum sp.	81	_	86	151	134	101	156	132	117	_	188	109	105	5.90
Chironomus sp. A	10	_	15	17	_	_	_	15	15	_	_	22	8	0.44
Chironomus riparius	560	590	1047	1209	1115	598	1047	1016	995	749	1398	805	927	52.36
Chironomus sigmaterus	213	251	387	465	413	219	389	376	368	286	489	301	346	19.56
Chironomus sp. B	_	_	81	145	98	_	84	81	80	98	156	65	74	4.18
Chronomus major	186	178	304	364	323	178	324	273	274	297	407	236	279	15.73
Kiefferulus sp.	_	_	15	17	24	_	_	15	17	_	14	5	9	0.50
Lauterborniella sp.	_	21	22	15	_	34	_	32	35	_	28	12	17	0.94
Tanypodinae														
Bethbilbeckia sp.	_	_	43	17	23	_	_	_	_	_	_	_	7	0.39
Total	1050	1040	2000	2400	2130	1130	2000	1940	1900	1430	2680	1556	1771	
SWI	0.52	0.45	0.61	0.62	0.59	0.55	0.56	0.60	0.61	0.51	0.59	0.60		
Total No. of taxa	5	4	9	9	7	5	5	8	8	4	7	8		

Table 2: Monthly variation in physico-chemical parameters of Salim Ali Lake (Oct.2009- Sep.2010)

Months /Parameters	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
WT (p C)	24	24	19	22	21	25	26	27	26	27	26	26
pH	8.05	7.56	7.02	7.3	7.5	8	8.5	8.85	8.67	7.58	7.67	8.04
Conductivity (µS/cm)	850	940	860	800	660	630	510	620	810	770	620	780
TDS (ppm)	490	300	460	280	420	570	680	790	650	520	420	560
Turbidity (NTU)	68	62	57	72	74	86	94	96	87	70	93	98
Salinity (ppm)	600	500	600	400	600	700	800	900	800	800	600	800
DO (mg/L)	8.08	7.27	7.82	8.89	8.12	7.27	5.25	3.64	7.27	7.68	8.68	8.08
Free CO_2 (mg/L)	36	28.8	37.6	48.4	149.6	132	50.2	80.8	40	17.6	50.2	18.8
TA (mg/L)	280	320	300	370	450	350	370	420	230	250	240	300
Phosphates (mg/L)	1.81	1.54	1.78	2.04	2.09	2.49	2.04	1.93	2.34	1.87	1.95	1.71
Nitrates (mg/L)	2.61	2.6	2.53	2.98	2.95	3.08	2.88	2.94	3.1	3.08	3	2.78
Hardness (mg/L)	200	196	280	298	232	398	374	370	216	192	202	202
Calcium (mg/L)	45.18	54.53	61.33	63.33	51.3	68.94	66.53	41.68	43.29	39.28	43.29	44.09
Magnesium (mg/L)	21.42	22.82	29.86	34.11	25.34	18.03	22.42	8.28	26.31	22.9	22.9	22.42
Chlorides (mg/L)	109.16	113.6	186.02	120.7	191.7	232.88	103.66	167.56	186.02	236.32	222.12	152.18

during sampling period. Same observations show that pH values varying between 7.02 and 8.85, Nalawade *et al.* (2008) also recorded the alkaline nature of water during winter season of the year 2006. Conductivity value ranged between 510 and 940μS/cm, total dissolved solids (TDS) between 280 and 790ppm, its average value higher than previous study (Nalawade *et al.,* 2008). Turbidity of lake varies between 57 and 98NTU, salinity between 400 and 900ppm, dissolved oxygen (DO) ranged between 3.64 and 8.89mg/L, free carbon dioxide (free CO_2) between 17.6 and 89.6mg/L, total alkalinity (TA) between 230 and 420mg/L, phosphates ranged from 1.54 to 2.49mg/L, nitrates ranged between 2.53 and 3.1mg/L, hardness between 192 and 398mg/L, calcium between 39.28 and 68.94mg/L, magnesium between 22.9 and 34.11mg/L and chlorides value ranged from 103.66 to 236.32mg/L (Table 2). DO and nitrates value observed in present investigation was higher than noted by Nalawade *et al.* (2008) may be due to growth of algae and sewage addition in the lake.

According to Pearson correlation, negative correlation of larval density was observed with temperature (r=-0.17), pH (r=-0.11), conductivity (r=-0.42), TDS (r=-0.06), and salinity (r=-0.12) while that of positive with turbidity (r=0.28), DO (r=0.09), free CO_2 (r=0.11), alkalinity (r=0.13), phosphates (r=0.17), nitrates (r=0.32), hardness (r=0.09) and chlorides (r=0.14), these results for correlation are not significant for both 1% and 5% level, may be due to presence of abundant organic matter for survival and mud to protect them from environmental factors which could affect the density of larvae. Also mud provides surviving place for larvae which may useful for predator avoidance as described by Hershey (1987).The study on correlation shows that, there is no significant correlation between larval density and physicochemical parameters of water. Ozkan and Camur-Elipek (2006) observed positive correlation of number of larvae with temperature and pH. Warusawithana and Yatigammana (2007) observed positive correlation between larval density and phosphate and nitrate concentration while negative correlation with temperature and pH.

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