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Population density of chironomus larvae (Diptera, Chironomidae) in selected Tuticorin salt pans, Southeast coast of India

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Abstract
In the present study, chironomid larvae were sampled for one year from 2015 to 2016 at two different saltpans *viz.*, Tharuvaikulam and Veppalodai located at Tuticorin, Southeast coast of India. Variations of environmental parameters are observed *viz.* Temperature 26.3 - 33.8ºC (SD 2.293), Salinity 20 - 235 ppt. (SD 59.623), pH 7.7 - 8.3 (SD 0.155), Nitrate 0.353 - 1.273 µmol/l (SD 0.278), Nitrite 0.073 - 0.482 µmol/l (SD 0.155), Phosphate 0.037 - 0.187 µmol/l (SD 0.04), Silicate 0.306 - 1.273 µmol/l (SD 0.223) and Ammonia 0.122 - 0.832 µmol/l (SD 0.205). The chironomid population varied from 125 to 12469 no/g/ha due to the salinity changes and more populations was noticed during monsoon seasons with SD values of 2.362 and 2.452 stations1 and 2 respectively.

Keywords: Physico-chemical, chironomid larvae, Saltpan, Tuticorin

1. Introduction

Bloodworms are the larvae of chironomid midges, small flies that superficially resemble mosquitoes, belong to the order of Diptera, this family more abundant in geographical and ecological environment [1].The chironomids are one of the most important groups of organisms to be encountered in most benthic environment. This group has a cosmopolitan occurrence occupying a wide range of benthic habitat in streams, lakes, pools, estuaries and object to variety of environmental condition. In addition, this chironomids make important food source for benthic community.

These larvae are present in all aquatic ecosystems including freshwater and marine water environment like pond, lake, saltpan, seashore and semi-aquatic and land dwellers [2]. Therefore, their identification and classification have fewer limitations in comparison to the adult stage. Chironomids larvae abundant with macro-invertebrate group and often account for the majority of aquatic insects in freshwater environments [3, 4]. These insects spend the greatest part of their life cycle in larval form, occupying a wide range of habitats compared to other insects [5]. Chironomid larvae play a vital role of degradation of food materials and induced nutrient cycle in a substratum [6].These decomposed materials are used as food items by aquatic animals including invertebrates and fishes [7].

More than 10,000 species of chironomidae were distributed over the entire world aquatic environment; important role is aquatic food webs representation of a major link between producers such as phytoplankton, benthic algae and secondary consumers [8]. Chironomids life in salinity environment is restrictive for biota, including specific adaptations, and also a challenge of global change for the living organisms [9, 10]. Different species of chironomid larvae are used as lotic and lentic water quality indicators, because their distribution is closely related to the different degrees of water depth, dissolved oxygen, organic matters and temperature [11]. The distribution of species varied based on the environmental habitat and water quality [12].

The effect of salinization, which is became a major problems in aquatic environment [13, 14, 15]. The larval stage of chironomus in different inland aquatic environments and also longer period of life cycle, based on the adaptation capability and ecological ability of larvae to extreme environmental conditions of temperature, pH, salinity, depth, fellow velocity and productivity, they can be found in many different aquatic environments [16]. The present study is assisted the chironomid larvae population in the selected saltpans of Tuticorin coast with reference to physico-chemical characteristics.

2. Materials and method
2.1 Site description
The chironomid sampling was made periodically from selected saltpans viz., Tharuvaikulam and Veppalodai. Tharuvaikulam is situated 10 km north to Tuticorin city and Veppalodai is 20 km away from Tuticorin and located in extreme southern parts of Tamil Nadu. The city constitutes 70 percent of the total salt production in Tamil Nadu state and 30 percent in India. Tuticorin is the second largest salt producer next to Gujarat. The total geographical area of the Tuticorin city is 4621 sq. km. (4, 63, 601 Ha) and constituting about 3.5 percent and coastal line covered of 121 km among these, 25,000 acres covered by saltpans. Ground water contains 55 to 65 ‰ of salinity in salt production area. Veppalodai (station 1), Tharuvaikulam (station 2) these are more salt production areas when compared to other saltpans, based on this category the study were selected.

2.2 Sample collection
Water and Chironomid larvae samples were collected for one year from April 2015 to March 2016. Physico-chemical parameters such as salinity, temperature, pH were measured using Hand Refractometer (ATAGO), Digital thermometer and pH meter (Handy lab1). Water samples were collected and estimation of nutrients by using of standard methods described by [17]. Chironomid larvae were collected by using 150 µm mesh size of nylon net and preserved using 5% formaldehyde for further analysis.

2.3 Analytical methods
In order to determine whether any significant differences existed between physico-chemical parameters and larval abundance of the sites and seasons, SD was calculated for each sample in each site and season. The hypothesis was used cumulative dominance (CD) by Primer software. The same statistics were used in order to determine whether any correlation significant differences existed between ecological factors, larval abundance and distribution.

3. Results
3.1. Physico-chemical properties
The maximum temperature (33.8 ^{0}C) was noticed during the month of May 2015 and minimum (26.3 ^{0}C) was recorded during the month of December 2015 at st.2 respectively. Maximum (235 ppt) salinity was recorded during August 2015 at St.1 and minimum was reported during (20 ppt) December 2015 at St.2. Higher (8.3) pH was noticed during June 2015 at St.2 and low pH (7.7) concentration was observed during the month of November 2015 at St.2. The cumulative dominance (CD) values were represented in Fig.1-3.

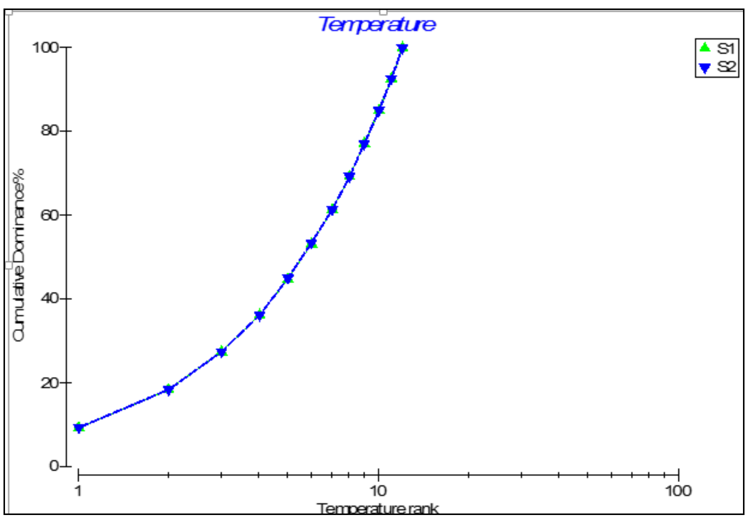

Fig1: Cumulative dominance of Temperature

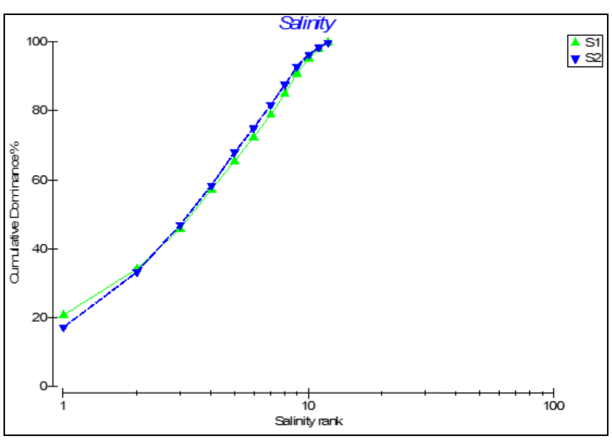

Fig 2: Cumulative dominance of Salinity

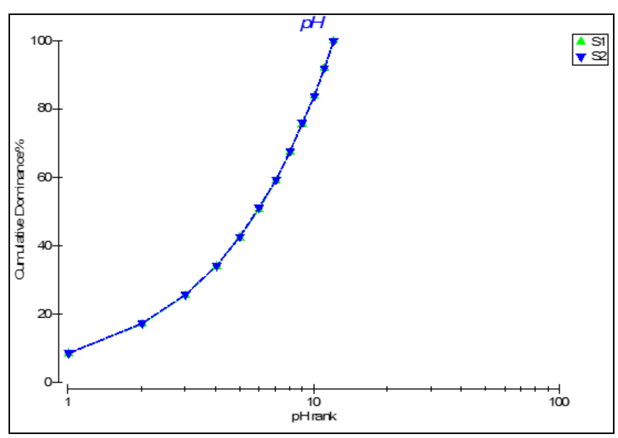

Fig 3: Cumulative dominance of pH

3.2. Inorganic nutrients

The maximum and minimum nitrate (1.273 and 0.353µmol/l) concentrations were noticed during November 2015 and May 2015 at St.1 respectively. The maximum nitrite (0.482 µmol/l) was recorded in St.2 during November 2015 and minimum concentration (0.073 µmol/l) was noticed at St. 1 during May 2015. The phosphate concentration noticed higher (0.187 µmol/l) in the month of January 2016 at St.2 and lower concentration (0.037 µmol/l) during July 2015 St.2. The cumulative dominance (CD) showed in Fig.4-6.

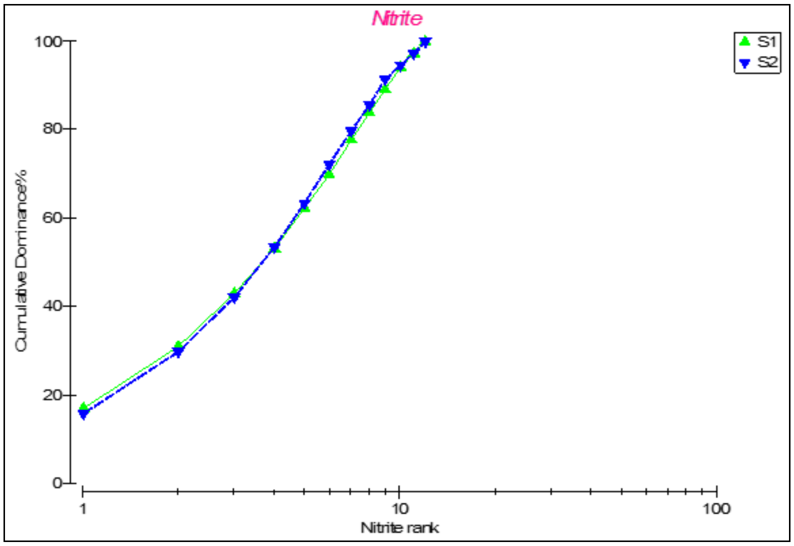

Fig4: Cumulative dominance of Nitrite

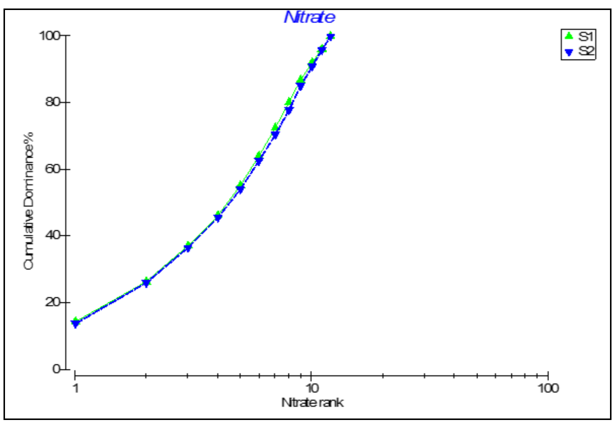

Fig 5: Cumulative dominance of Nitrate

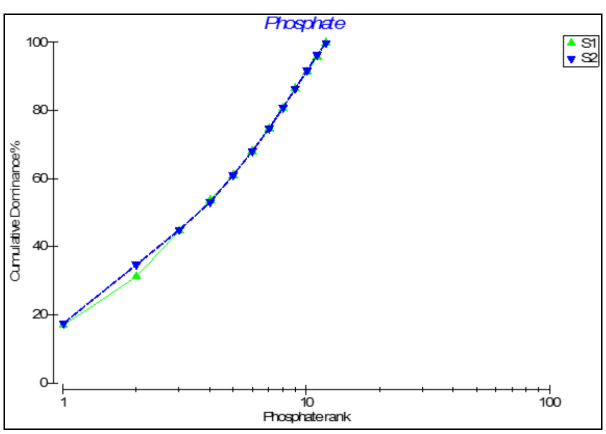

Fig 6: Cumulative dominance of Phosphate

The maximum silicate concentration (1.273 µmol/l) was found in December 2015 at St.2 and minimum (0.306 µmol/l) was noticed during August 2015 at St. 1. The maximum (0.832 µmol/l) ammonia concentration was notice during November 2015 at St.2 and minimum concentrations (0.122 µmol/l) was recorded during July 2015 at St.1 and cumulative dominance representation showed in Fig.7 and 8.

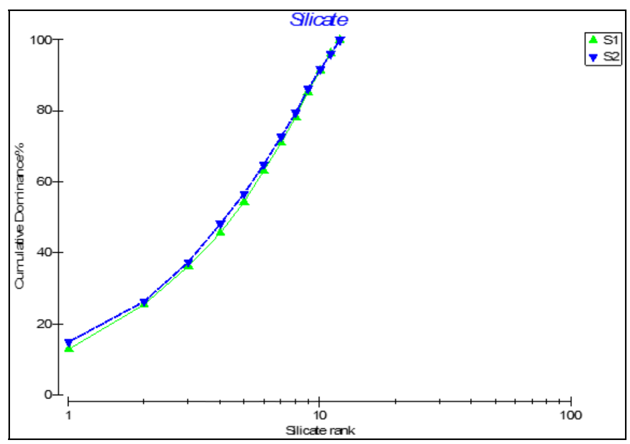

Fig 7: Cumulative dominance of Silicate

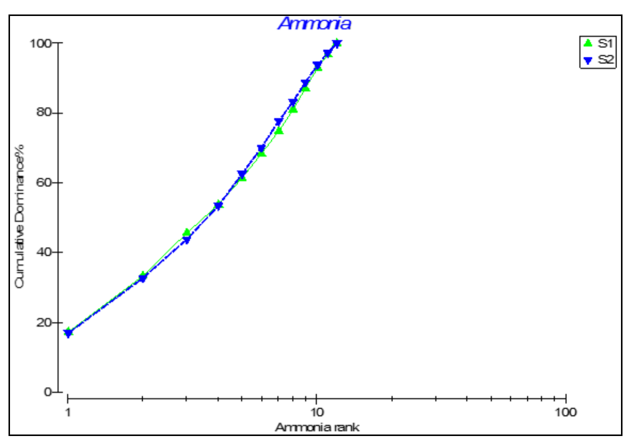

Fig 8: Cumulative dominance of Ammonia

3.3 Population

The population densities of chironomus were varied between the month based on the sudden changes of temperature and salinity, the maximum density 12469 nos. / grams / ha with 34.531%of chironomus were recorded during the month of December 2015 at St.1, while minimum (125 nos./grams/ha) chironomus density recorded during the month of April 2015 with 0.4% at St.2 and CD value shown in Fig. 9. The physico-chemical and population density were calculated by correlation significant results and given in Table.1 and 2.

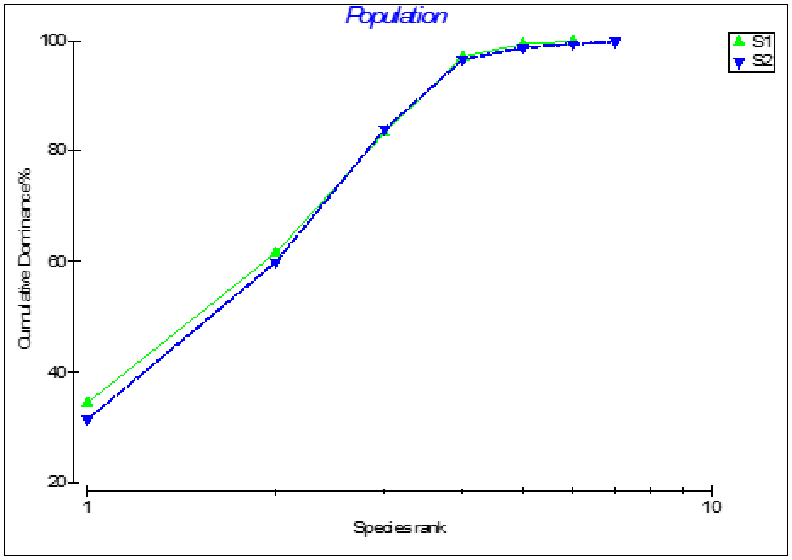

Fig 9: Caps Dominance of Population

Table.1: Correlation between the physico-chemical parameters at st.1.

Parameters	Correlations	Temperature (^{0}C)	Salinity (ppt)	pH	NO_2	NO_3	PO_4	SiO_3	NH_3
Temperature(^{0}C)	Pearson Corr.	1							
Temperature (^{0}C)	Sig.	--							
Salinity (ppt)	Pearson Corr.	0.71469	1						
Salinity (ppt)	Sig.	0.009	--						
pH	Pearson Corr.	0.36069	0.35678	1					
pH	Sig.	0.24939	0.25494	--					
Nitrite(NO_2)	Pearson Corr.	-0.49624	-0.28331	0.40706	1				
Nitrite(NO_2)	Sig.	0.10082	0.37222	0.18909	--				
Nitrate (NO_3)	Pearson Corr.	-0.82813	-0.5519	0.0691	0.80814	1			
Nitrate (NO_3)	Sig.	8.78E-04	0.06283	0.83103	0.00147	--			
Phosphate (PO_4)	Pearson Corr.	-0.85883	-0.7409	-0.08876	0.48843	0.73902	1		
Phosphate (PO_4)	Sig.	3.47E-04	0.00584	0.78384	0.10714	0.00603	--		
Silicate (SiO_3)	Pearson Corr.	-0.86229	-0.85535	-0.491	0.13083	0.53135	0.8417	1	
Silicate (SiO_3)	Sig.	3.08E-04	3.89E-04	0.10503	0.68528	0.07544	5.96E-04	--	
Ammonia (NH_3)	Pearson Corr.	-0.75965	-0.79583	0.04198	0.61102	0.78349	0.93643	0.73166	1
Ammonia (NH_3)	Sig.	0.00415	0.00196	0.89693	0.0348	0.00257	7.35E-06	0.00684	--

Table.2: Correlation between the physico-chemical parameters at st.2.

Parameters	Correlations	Temperature (^{0}C)	Salinity (ppt)	pH	NO_2	NO_3	PO_4	SiO_3	NH_3
Temperature(^{0}C)	Pearson Corr.	1							
Temperature (^{0}C)	Sig.	--							
Salinity (ppt)	Pearson Corr.	0.86338	1						
Salinity (ppt)	Sig.	2.97E-04	--						
pH	Pearson Corr.	0.1413	0.27473	1					
pH	Sig.	0.66136	0.38749	--					
Nitrite(NO_2)	Pearson Corr.	-0.409	-0.14217	0.7039	1				
Nitrite(NO_2)	Sig.	0.18677	0.65938	0.01062	--				
Nitrate (NO_3)	Pearson Corr.	-0.83783	-0.9144	0.01677	0.41047	1			
Nitrate (NO_3)	Sig.	6.68E-04	3.13E-05	0.95876	0.18504	--			
Phosphate (PO_4)	Pearson Corr.	-0.77643	-0.76667	-0.09465	0.15333	0.83759	1		
Phosphate (PO_4)	Sig.	0.00298	0.00362	0.76983	0.63424	6.73E-04	--		
Silicate (SiO_3)	Pearson Corr.	-0.87582	-0.93042	-0.15331	0.24283	0.92055	0.83614	1	
Silicate (SiO_3)	Sig.	1.88E-04	1.14E-05	0.63429	0.44698	2.18E-05	7.02E-04	--	
Ammonia (NH_3)	Pearson Corr.	-0.78092	-0.85027	0.16893	0.52168	0.91155	0.65213	0.87553	1
Ammonia (NH3)	Sig.	0.00272	4.58E-04	0.59969	0.08194	3.67E-05	0.02155	1.90E-04	--

4. Discussion

Chironomid larvae using primary live feed in aquaculture industry, these organisms are nourishment for fish larvae mainly for sturgeon fish larvae. Among other live feed these larvae contain rich iron compound, red color attract to the young larvae for pray, it contain hemoglobin. Southeast Asian countries especially Japan and China eagerly developing blood worm industry for fulfill the present demand of live feed in aquaculture industry. Related research works were done in different regions with various environmental conditions. Present study is focused effect of physico-chemical parameters on chironomid larval population in saltpan region.

Author [18] was reported that the chironomus larvae contain high nutrient value 50% protein, 10-15% Carbohydrate, 12-15% of lipids, based on this enriched died are useful for fish diet, *Chironomus plumosus* can live in running and still waters, the larvae can survive long time depending upon the water quality and temperature, it feed microalgae and detritus matters, it can grow 1 to 25 mm.

The *Chironomus salinarius* was distributed in varied salinity range 14 to 27 gl^{-1} in the Orbetello lagoon [19]. The density of chironomid larvae varied based on the different salinity range between 16 and 36 gl^{-1} [20]. In Norway [21], in North America [22], in Korea [23] described the chironomus density based on the salinity. Reported described [24] that the chironomus can survive between 0 and 27 gl^{-1} of salinity and increasing salinity will affect the development of chironmous larvae [25].

Author [26] reported the development of chironomids larvae depending on the salinity range 0 to 50 gl^{-1} and few can survived above 35 gl^{-1} of salinity, the optimal survival rate at 0 – 5 gl^{-1} salinity and 20 – 30 gl^{-1}, intermediates survived range 10-15gl^{-1}. The growth and survival rate reported according to the salinity, the present study is similar to earlier study [26]. Similar study [27] of chironomids larvae density based on the nutrient cyclic in aquatic ecosystem and its important subside for predators feed. [28, 29] were reported that the chironomids are used as indicators of various ecosystems.

Ecology of chironomus larvae in Ayad River at Udaipur city, due to the physico-chemical factors especially Temperature 17 ^{0}C, pH 6.9 and chloride 221mg/l [30]. The present study is similar to [30], the development of chironomids with reference to water quality in particular environment [31, 32, 33]. *Chironomid polytene* larvae promising tools for predict the genotoxic effect of environmental condition and its very sensitive for various physical and chemical conditions [34, 35].

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6. References

1. Ashe PA.Catalogue of chironomid genera and subgenera of the world, including synonyms. Entomologica Scandinavica Supplementary. 1983; 20:1-68.
2. Lloret J, Marín A, Marín-Guirao L. Is coastal lagoon eutrophication likely to be aggravated by global climate change? Estuarine. Coastal and Shelf Science. 2008; 78:403-412.
3. Epler JH. Identification manual for the larval Chironomidae (Diptera) of North and South Carolina. Version 1.0.Crawfordville, 2001, 53.
4. Freimuth P, Bass D. Physicochemical Conditions and Larval Chironomidae (Diptera) of an Urban Pond. Proceedings of the Oklahoma Academy of Science. 1994; 74:11-16.
5. Oliver DR. 1971 Life history of the Chironomidae. Annual Review of Entomology. 1971; 16:211-230.
6. Petersen RC. Leaf processing in a wood land stream. Freshwater Biology. 1974; 4:343-368.
7. Smith KGV. An introduction to the immature stages of British flies (Diptera, larvae, with noteson eggs, puparia and pupa). London. Royal Entomological Society of London 1984, 43-45.
8. Tokeshi M. Production ecology. In: Armitage, P. D., Cranston, PS. & Pinder, LCV. (Eds). The Chironomidae: biology and ecology of non-biting midges. Chapman & Hall, London. 1995; 571:269-296
9. Hagerman S, Dowlatabadi H, Satterfield T, Mc Daniels T. Expert views on biodiversity conservation in an era of climate change. Global Environmental, Change. 2010; 20:192-207.
10. Niang I, Dansokho M, Faye S, Gueye K, Ndiaye P. Impacts of climate change on the Senegalese coastal zones: examples of the Cap Vert peninsula and Saloum estuary. Global and Planetary Change. 2010; 72:294-301.
11. Tokeshi M. Two commensals on a host: habitat partitioning by a ciliated protozoan and a chironomid on the burrowing mayfly. Ephemera danica, Freshwater Biology. 1988; 20:31-40.
12. Hart CW. Pollution ecology of freshwater invertebrates. Community structure of larval Chironomidae (Diptera) in a backwater area of the River Danube. Freshwater Biology. 1974; 27:151-167.
13. Williams WD. Salinization: unplumbed salt in a parched landscape. Water Science and Technology. 2001; 43:85-91.
14. Ranjan P, Kazama S, Sawamoto M. Effects of climate change on coastal fresh groundwater resources. Global Environmental Change. 2006; 16:388–399.
15. Kaushal SS, Groffman PM, Likens GE, Belt KT, Stack WP, Kelly VR, *et al.* Increased salinization of fresh water in the northeastern United States. Proceedings of the National Academy of Sciences of the United States of America. 2005; 102:13517-13520.
16. Armitage P, Cranston PS, Pinder LCV. The Chironomidae. The biology and ecology of non-biting midges. Chapman and Hall, London, 1995, 572.
17. Strickland JDH, Parsons TR. A practical handbook of seawater analysis. Bull. Fish. Res. Bd. Can. 1972; 167:1-311.
18. Jirasek J, Mares J. Nutrition and feeding of early development stages of cyprinids I. Bulletin VURH Vodnay. 2001; 37:33-38.
19. Marchini A, Munari C, Mistri M. Functions and ecological status of eight Italian lagoons examined using biological traits analysis (BTA). Marine Pollution Bulletin. 2008; 56:1076-1085.
20. Ali A, Majori GA. short-term investigation of chironomid midge (Diptera: Chironomidae) problem in saltwater lakes of Orbetello, Grosseto, Italy. Mosquito News. 1984; 44:17-21.
21. Koskinen R. Seasonal and diel emergence of Chironomus salinarius Kieff. (Dipt: Chironomidae) near Bergen,

Western Norway. Annales Zoologi Fennici. 1968; 5:65-70.

22. Biever KD. Effect of diet and competition in laboratory rearing of chironomid midges. Annals of the Entomological Society of America. 1971; 64:1166-1169.
23. Ree HI, Yum JH. Redescription of Chironomus salinarius (Diptera: Chironomidae), nuisance midges that emerged in brackish water of Jinhae-man (Bay), Kyongsangnamdo, Korea. Korean Journal of Parasitology. 2006; 44:63-66.
24. Kawai K, Morihiro S, Imabayashi H. Transectional distribution patterns of chironomid larvae in estuaries. Medical Entomology and Zoology. 2000; 51:215-220.
25. Pery ARR, Ducrot V, Mons R, Garric J. Modelling toxicity and mode of action of chemicals to analyse growth and emergence tests with the midge *Chironomus riparius*. Aquatic Toxicology. 2003; 65:281-292.
26. Cartier V, Claret C, Garnier R, Franquet E. How the salinity effects life cycle of brackish water species, Chironomus salinarius KIEFER (Diptera: Chironomidae). Journal of Experimental Marine Biology and Ecology. 2011; 405:93-98.
27. Silva FL, Ruiz SS, Bocchini GL, Moreira DC. Functional feeding habits of chironomidae larvae (Inseecta, Dipteral) in a lotic system from Midwestern region of Sao Paulo State, Brazil. Pan-American Journal of Aquatic Sciences. 2008; 20:135-141.
28. Odum EP. Psychodidae-Chironomidae. Akademiai Kiado, Budapest, Ecologia. 1988; 2:113-355.
29. Ekrem T. Chironomid types at Museum Naational d' Histoire Naturelle, Paris. Chironomus Newsletter on chironomidae Research. 2000; 13:15-19.
30. Deepak Rawal. Ecological analysis of *Chironomus* larvae (Diptera: Chironomidae) collected from Ayad River in Udaipur city. International Journal of Fauna and Biological Studies. 2014; 1(5):20-21.
31. Shaw MKK. Chironomid farming-a means of recycling farm manure and potentially reducing water pollution in Hong kong, Aquaculture. 1980; 21:155-163.
32. Habib MAB, Ali MM. Dey N. Culture of chironomid larvae in artificial medium. Bangladesh Journal of Fisheries. 1992; 20:63-70.
33. Tidweell JH, Schulmeisteer CM, Coyle S. Growth, survival, and biochemical composition of freshwater prawns *Macrobrachium rosenbergii* fed natural food organisms under controlled conditions. Journal of the World Aquaculture Society. 1997; 28(2):123-132.
34. Michailova P, Petrova N, Sella G, Ramella L, Bovero S. Structural functional rearrangements in chromosome G in *Chironomus riparius* Meigen (Diptera, Chironomidae) collected from a heavy metal polluted area near Turin, Italy. Environmental Pollution. 1998; 103:27-35.
35. Diez L, Cortes E, Merimo J, Santa Cruz M. Galactose-induced puffing changes in *Chironomus thummi* Balbiani rings and their dependence on protein synthesis. Chromosoma. 1990; 99:61-70.
36. Michailova P, Szarek Gwiazda E, Kovnacki A. Effect of Contaminants on the Genome of soxe species of genus *Chironomus* (Chironomidae, Diptera) living in Sediments of Dunajec River and Czorsztyn Reservoir. Water, Air and Soil Pollution. 2009; 202:245-258.