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Original Article

Diversity and Community Structure of Aquatic Insects in a Fresh Water Lentic System of Purba Medinipur District, W.B., India

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Abstract

29 species of aquatic insects have been recorded from a weed infested man made wetland near Tamluk Station. Hemiptera was numerically the most abundant group comprising 39% of the total aquatic insects followed by Coleoptera (36%) and Odonata 25%. Hemiptera and Odonata were represented by 10 species each while Coleopteran was represented by 9 species. Of these only one coleopteran species, *Canthydrus latitabilis* was found to be dominant. The water body under investigation was considered moderately polluted. On the basis of Diversity index, Evenness value and Dominance value indicated the equitability and heterogeneity of the aquatic system. While Coleoptera and Odonata exhibited a peak in July and May respectively but no distinct peak could be seen for Hemiptera. Correlation between the abiotic factors and insect species revealed that abiotic factors had some regulatory effects on aquatic insect population.

Key words: Aquatic Insects; Aquatic Ecosystem; Biodiversity.

Introduction

Among the fresh water organisms aquatic entomofauna may comprised more than 95% of all the species of macro-invertebrates (Ward, 1992) in some lentic water bodies. There are about 45000 species of insects known to inhabit diverse fresh water ecosystem (Balaram, 2005) and about 5000 species of aquatic insects are estimated to inhabit inland wetlands of India (Subramaniam and Shivaramakrishnan 2007). Aquatic insects are involved in nutrient recycling and form an integral part of natural food web in aquatic ecosystem. These constitute a dominating group of littoral, benthic and limnetic biodiversity of the freshwater ecosystem because of their high abundance, high birth rates, short generation time, large biomass, high turnover rates and rapid colonization to habitats (Roy *et al.*, 1988). These are also considered as model organism in analysing ecological characteristics of inland water bodies and thus serve as a reliable bioindicator of aquatic ecosystem. Both larvae and adult of aquatic insects prey on various kinds of aquatic organisms and also offered themselves as food for carnivores fishes. As such, these are of immense value form the point of aquaculture and public health. Some recent works on aquatic entomofauna of India are those by Bhattacharyya (2000), Pal *et al*. (2000), Khan and Ghosh (2001), Anbalagan *et al*. (2004), Saha *et al*. (2007), Das and Gupta (2010), Hazarika and Goswami (2010), Sharma and Agarwal (2012), Barman and Baruah (2013), Jenila and Nair (2013), Abhijna *et al.* (2013), Gupta and Narzary (2013), Samweel and Nazir (2014), Vasantkumar and Roopa (2014), Choudhury and Gupta (2015) and Susheela and Radha (2015). Although Pahari *et al*. (1997, 1999) and Jana *et al*. (2009) have studied some taxonomic and ecological aspects of aquatic insects in West Midnapore District. So, far no comprehensive work has been done on the quantitative ecology of the aquatic insects of Purba Medinipur District.

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Materials and Methods

The present study was conducted in a man-made perennial pond (Tamluk Station Pond, 22° 17' 52.56'' N, 87° 55'16.72'' E). The area of ponds is about 2.3 acre with an average depth of about 3.6 meter. This water body is infested with many aquatic weeds like *Nelumbo nucifera* Gaertner*, Alterhennthera sessilis* Linn., *Eclipta alba* Hassk., *Monochoria hastate* Solms., *Scirpus articulatus* (Linn.), *Cyanotis axillaries* Roem & Sch., *Aeschynomene ampera* Linn., *Hygrorryza aristata* Nees., *Hydrocotyla asiatica* Nees., *Hydrophylla difformis* L.f., *Utricularia stellaris* L.f., *Jussiaca repens* Linn., *Nymphaea nouchali* Burm. f., *Marsilea minta* Linn., *Nymphoides indica* (Linn.), *Eichhornia crassipes* (Mart.) Solms*, Commelina bengalensis* Linn., *Hydrilla vercillata* Casp.*, Vallisneria spiralis* Linn.*, Chara sp., Nitella sp., Salvinia sp., Learsia sp.*.

Insects were collected at monthly interval from Jan 2015 to December 2015 between 8.00 am to 10.00 am. The collections were made by hauling of a dip net with a mesh sizeof 245 gm Nylobolt PA, (Dukay Nilobolt Industries Pvt. Ltd., Mumbai, India). The area of the circular net was 4208 cm^2. Samples were taken from four sites at four corners. Collected insects were preserved in 70 % ethyl alcohol in specimen bottles and identified upto the species level. Water quality parameters *viz.* pH, temperature, conductivity, dissolved oxygen and carbon-di-oxide were analysed following APHA (2005).Community analysis represence to abundance, relative abundance, general diversity index (Shannon-Wiener, 1963) and evenness index (Pielou, 1966), Dominance Diversity index (Mc-Naughton, 1968)were determined using the package Ecological Methodology version 6.1 (Krebs, 2002) & Multivariate Statistical Package (MVSP) version 3.13n

Result and Discussions

During this investigation 29 species of aquatic insects were recorded (Table 1), belonging to Hemiptera, Coleoptera, and Odonata. Among these Hemiptera was numerically the most abundant comprising 39% of the total insect fauna (Figure 1). This order was represented by 04 families *viz.* Belostomatidae (41%), Corixidae (27%), Nepidae (23%) and Notonectidae (9%) (Figure 2). Coleopter-aconstituted of 36% of the total insect population with 2 families *Viz.* Dytiscidae (90%) and Hydrophilidae (10%)(Figure 3). Odonatawas 25% of the insects collected was represented by 4 families *viz.* Coenagrionoidae (47%), Libellulidae (25%), Aeshnidae (21%) and Ptatycnemididae (7%)(Figure 4).Hemiptera, Odonataand Coleoptera were represented by 10, 10 and 09 species respectively. As in present study preponderance of Hemiptera in freshwater lentic system has also been reported in earlier studies by Bhattacharya (1998) from West Bengal, Hazarika and Goswami (2010), Das and Gupta (2010), Gupta and Narzary (2013), Choudhury and Gupta (2015) and Barman & Baruah (2013) in Assam and Abhijna *et al*. (2013) in Vellayani lake in Kerala. Numerical abundance of Hemiptera over Coleoptera has also been observed by Khan and Ghosh (2001) in West Bengal and Johri *et al.* (2010) in Uttar Pradesh. Family Dytiscidae was taxonomically more diverse (7 species) (Table 1) and numerically more abundant (Figure 3) than Hydrophilidae among Coleoptera.

The member of the family Dytiscidae prefer weed infested freshwater bodies as they inhabit leaf of the submerged macrophytes. The naid of Odonata prefer macrophyte infested wetland for their better survival. Hydrophilidae on the contrary is water scavenger beetles generally occur in shallower regions of the wetlands and feed mainly on detritus (Khan and Ghosh, 2001). Findings pertaining relative abundance (Table1) revealed that out of 29 species only one species *Canthydrus laetubilis* was dominant (11.9%). Tis species appears to be the good exploiters of resources in weed infested aquatic ecosystem as compared to others. Of the remaining species 11 were subdominant (RA 5% -10%) and 17 were recedent species (RA 3.2% - 10%).

The diversity index indicated a seasonal trend. It was lowest in January and increased till June. Thereafter it progressively decreased till December. According to Wilhm & Dorris (1966) diversity index between 01 to 03 indicates a moderately perturbed condition of the water body. Since the diversity index in the present study ranged between 1.131 to 1.332, the water body under investigation may be considered as moderately polluted. Smith (1997) suggested that high species diversity indicated that such community has their resources more finely distributed among individuals of many species. Iwaski (1999), however opined that environmental stability rather than heterogeneity has greater influence on it. The value of evenness index was considerably high and ranged from 0.855 to 0.955, indicating the heterogeneity of the community. In the present study dominance index was quite low and varied from month to month without any trend. Dominance index increases with the increase in the harshness of environment and decreases with the vegetational development (McNaughton and Wolf,

1970). This finding suggests that the waterbody exhibited a relatively equitable environment. While Coleoptera and Odonata exhibited a unimodal pattern of temporal variation with a peak in July and May respectively no such trend could be seen for Hemiptera (Figure 5).

Correlation between aquatic insect population are shown in Table 3. In the present study *Laccophilus anticatus* (Coleoptera) and *Diplonychus rusticus* (Hemiptera) had a significant positive correlation with pH.Jenila and Nair (2013) also observed a similar relationship of pH with *Diplonychus indicus* and *Ranatra filiformis*. Water temperature had a significant positive correlation with *Ischnura verticalis, Ranatra varipes* and *Urothemis signata*. Jenila and Nair (2013) found that change in water temperature had a profound influence on the population of aquatic insect. In the present study two odonate species *Anax imperator* and *Aeshna fabricius* and ahemipteran species *Ranatra varipes* showed significant negative correlation with D.O..Thirumalai and Raghunathan (1988) however, opined that D.O. had no impact on aquatic insect population. *Anisops bouvieri* showed a negative correlation with conductivity while *Aeshna fabricius* had a positive correlation with it. *Hydrovatus bonvoluri, Sternolophus rufipes and Brachydiplax chalybea* exhibited positive correlation with salinity where as *Hydrocoptus subvittulus, Laccophilus anticatus, Helochares anchoralis* and *Diplonychus rusticus* showed negative correlation with salinity. Thus it is seen that influence of abiotic factors varies from species to species.

Table 1: Relative Abundance and dominance status of insect species

Order- Coleoptera	Abundance	Relative abundance (RA)%	Dominance status
Family – Dytiscidae			
***Canthydrus laetabilis* (Walker, 1858)**	114	11.92	Dominant
***Canthydru sluctuosus* (Aube, 1838)**	65	6.80	Sub Dominant
***Hydrocoptus subvittulus* (Motschulsky, 1859)**	46	4.81	Sub Dominant
Laccophilu spurvulus (*Aube, 1838*)	34	3.56	Sub Dominant
***Laccophilus anticatus* (Sharp, 1890)**	13	1.36	Recedent
***Hydrovatus bonvoluri* (Sharp)**	22	2.30	Recedent
***Cybester tripunctatus* (Sharp, 1882)**	11	1.15	Recedent
Family –Hydrophilidae			
***Helochares anchoralis* (Sharp, 1890)**	21	2.20	Recedent
***Sternolophus rufipes* (Fabricius ,1792)**	13	1.36	Recedent
Order- Odonata			
Family -Coenagrionoidae			
***Ischnura verticalis* (Say, 1839)**	29	3.03	Sub Dominant
***Pseudogrion rubriceps* (Selys, 1876)**	37	3.87	Sub Dominant
***Enallagma parvum* (Selys, 1876)**	18	1.88	Recedent
***Pseudogrion microcephalum* (Rambur, 1842)**	28	2.93	Recedent
Family -Ptatycnemididae			
***Coperam arginipes* (Rambur, 1842)**	18	1.88	Recedent
Family –Aeshnidae			
***Anax imperator* (Leach, 1815)**	25	2.62	Recedent
***Aeshna fabricius* (Syst, 1775)**	25	2.62	Recedent
Family –Libellulidae			
***Brachydiplax chalybea* (Brauer, 1868)**	24	2.51	Recedent
***Urothemis signata* (Rambur, 1842)**	20	2.09	Recedent
***crocothemis servilia* (Drury, 1773)**	17	1.78	Recedent
Order - Hemiptera			
Family - Nepidae			
***Laccotrephes ruber* (Linnaeus, 1764)**	24	2.51	Recedent
***Laccotrephes maculates* (Fabricius, 1775)**	16	1.67	Recedent
***Ranatra filiformis* (Fabricius, 1790)**	32	3.35	Sub Dominant
***Ranatra varipes* (Stal, 1861)**	13	1.36	Recedent
Family - Belostomatidae			
***Diplonychus annulatam* (Fabricius, 1803)**	88	9.21	Sub Dominant
***Diplonychus rusticus* (Fabricius, 1794)**	43	4.50	Sub Dominant
***ethocerus indicus* (Lepeletier and Serville, 1825)**	22	2.30	Recedent
Family - Notonectidae			
***Anisops bouvieri* (Kirkaldy)**	35	3.66	Sub Dominant
Family-Corixidae			
***Micronectascutellaris* (Dist)**	36	3.77	Sub Dominant
***Plea liturata* (Fieber)**	67	7.01	Sub Dominant

R.A. <1 = Subrecedent, 1.1-3.1 = Recedent, 3.2-10% Subdominant, 10.1-31.6 = Dominant & >31.7% = Eudominant (Engelmann, 1973)

Table 2: SpeciesDiversity, Evenness and Dominance Index of the insect community

Months	Shannon-Weiner Diversity Index (H')	Evenness index (e)	Dominance Index (d)
Jan	1.131	0.855	35.4
Feb	1.154	0.887	34.5
Mar	1.234	0.906	29.5
Apr	1.260	0.901	27.4
May	1.303	0.957	15.7
Jun	1.332	0.953	15.2
July	1.235	0.895	27.4
Aug	1.237	0.908	23.1
Sep	1.255	0.935	17.9
Oct	1.274	0.952	17.1
Nov	1.2	0.894	24.7
Dec	1.173	0.917	25.4

Table 3: Correlation coefficient between insect species and abiotic factors

	pH	Temp (°c)	D.O(ppm)	Cond (ms)	Sal (ppt)
Hydrocoptus subvittulus	0.25	0.18	-0.27	0.16	-0.63*
Laccophilus anticatus	0.60*	0.29	-0.27	0.34	-0.75**
Hydrovatus bonvoluri	0.00	-0.03	0.12	0.03	0.60*
Holochares anchoralis	0.13	0.10	0.04	0.44	-0.60*
Sternolophus rufipes	0.08	0.09	-0.14	-0.03	0.63*
Ischnura verticalis	0.28	0.80**	-0.21	-0.34	-0.07
Anax imperator	-0.03	0.29	-0.74**	0.47	0.10
Aeshna fabricius	0.02	0.17	-0.73**	0.59*	0.06
Brachydiplax chalybea	-0.40	-0.17	0.08	0.22	0.60*
Urothemis signata	0.51	0.68*	-0.55	0.09	-0.31
Ranatra varipes	0.26	0.63*	-0.63*	0.22	-0.17
Diplonychus rusticus	0.81**	0.05	-0.05	0.23	-0.68*
Anisops bouvieri	0.33	0.55	-0.31	-0.59*	0.17

* = p≤0.05, ** p≤0.01

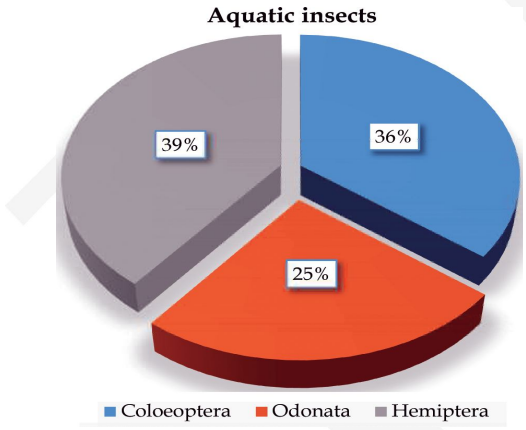

Fig. 1: Relative abundance of orders of insect fauna

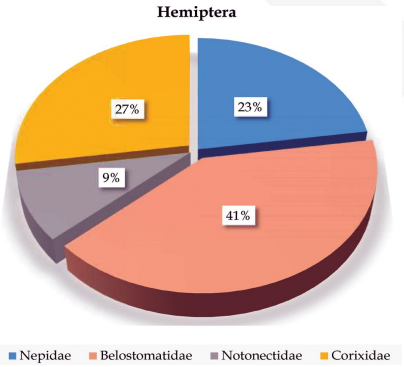

Fig. 2: Relative abundance of families of order Hemiptera

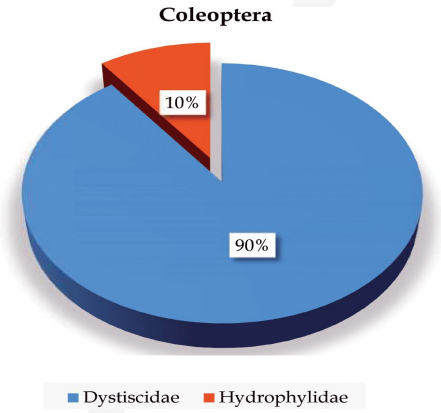

Fig. 3: Relative abundance of families of order Coleoptera

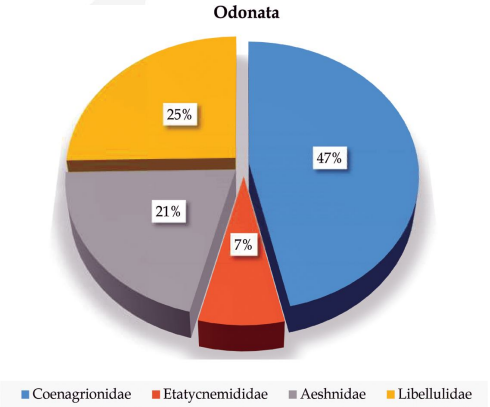

Fig. 4: Relative abundance of families of order Odonata

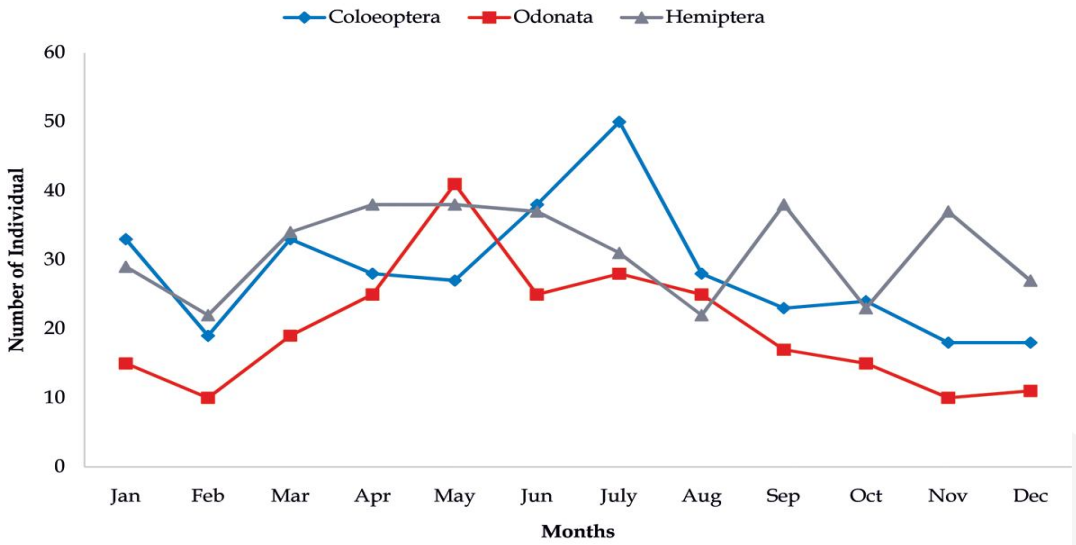

Fig. 5: Temporal variation in number ofinsects orders

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References

1. Abhijna,G. U.,Ratheesh, R., and Biju Kumar,A., Distribution and diversity of aquatic insects of Vellayani lake in Kerala,India. *Journal of Environmental Biology*, 2013; 34: 605-611.
2. Anbalagan, S., Kaleeswaran, B., and Balasubramanian, C.,Diversity and trophic categorization of aquatic insects of Courtallam hills of Western Ghats. *Entomon*., 2004; 29: 1-6.
3. APHA: Standard Method of the Examination of Water and Waste Water.21st Edn. APHA,*AWWA. and WPCFPublication*, 2005 Washington DC,USA.
4. Bal, A. and Basu, R.C.,Insecta: Hemiptera: Mesoveliidae: Hydrometridae, Veliidae and Gerridae. In:*State fauna Series 5 : Fauna of West Bengal, Z.S.I ., Calcutta*, 1994; 5(b): 535-558.
5. Bal, A. and Basu, R.C.,Insecta: Hemiptera: Mesoveliidae: Hydrometridae, Veliidae and Gerridae. In:*State fauna Series 5 : Fauna of West Bengal, Z.S.I ., Calcutta*, 1994; 5(a): 511-534.
6. Balaram, P., Insect of tropical streams. *Curr.Sci*., 89: 2005; 914.
7. Barman, A., and Baruah, K. B., Aquatic insects of KaplaBeel, a flood plain wetland of Barpeta District of Assam, India. *The Clarion International Multidisciplinary Journal*, 2013; 2(2): 27-31.
8. Bhattacharya, D. K., Insect fauna associated with large water hyacinth in freshwater wetlands of West Bengal. Biodiversity and Environment, Proceedings of the National Seminar on Environmental Biology, *Daya Publishing House, Delhi*,1998; 145-147.
9. Bhattacharya, D.K., Insect fauna associated with large water hyacinth in freshwater wetlands of West Bengal. Diversity and Environment.Proc. Nat. Seminar on Environ. Biol. (Eds.: A.K. Aditya and P. Haldar), 2000, *Daya Publishing House*, Delhi.
10. Biswas, S., Mukhopadhyay, P., and Saha, S.K., Insecta. Coleoptera :Adephaga, Family Gyrinidae and Haliplidae. In: State fauna Series 5. Fauna of West Bengal, Part 6a,1995, *Zoological Survey of India*, Calcutta
11. Biswas, S., Mukhoupadhyay, P. and Saha S.K., Insecta: Coeloptera: Adephaga, family dystiscidae. In: State faunaSeries5 :*Fauna of West Bengal, Z. S. I.*, Calcutta, 1995; 5(b): 77-120.
12. Ecological Methodology, Krebs, C. J., 2002, Version 6.1.
13. Choudhury,D., and Gupta,S., Aquatic insect community of DeeporBeel (Ramsar site), Assam, India. *Journal of Entomology and Zoology Studies*, 2015; 3(1): 182-192.
14. Das, K. & Gupta, S., Aquatic Hemiptera community of agricultural field and rain pools in Cachar District, Assam, North East India. *Assam University Journal of Science and Technology,* 2010; 5(1): 123–128.
15. Engelmann, H.D.,Untersuchungen zur Erfassung predozoogener komponenten im definierten. Okosystem.Forschungen.Staatl.*Mus. Naturkde., Gorlitz,* 1973; 23.
16. Gupta, S. and Narzary, R., Aquatic Insect community of Lake, Phulbarianua in cachar, Assam; *Journal of*

Environmental Biology, 2013; 34: 591-597.

17. Hazarika, R. and Goswami, M M., Aquatic Hemiptera of Gauhati University, Guwahati, Assam, India.*Journal of Threatened Taxa*, 2010; 2(3): 778-782.
18. Iwasaki, K., Water scorpions, *Laccotrephes japonensis*, at river margins: Their distribution and life cycle in the Yamato-gawa water system, Nara, Japan. Japanese Journal of Limnology, 1999; 60:559–568.
19. Jana, S., Bhattacharya,T., Pahari,P.R., &Dutta,T.K., Diversity and community structure of aquatic insects in a pond in Midnapore town, West Bengal, India. *Journal of Environmental Biology,* 2009; 30(2): 283-287.
20. Jenila, G.J, Nair, C.R., Biodiversity of Aquatic Insect Population in Two Permanent Ponds of Kanyakumari District. *International Journal of Fauna and Biological Studies*, 2013; 1 (2): 8-12.
21. Johri, P.K., Dayal,V., and Johri,R., Biodiversity and community structure of aquatic insects in a natural wetland (Jalesar) of district Unnao, Uttar Pradesh, *India. J. Exp. Zool. India*, 2010; 13: 363-372.
22. Kalita, G., Ecology & Distribution of macroinvertebrate enmeshed fauna in Deepar wetland of Assam, India. PhD Thesis, 2008, *Gauhati University, Guwahati*, Assam, India.
23. Khan, R.A. and Ghosh, L.K. Faunal diversity of aquatic insects in freshwater wetlands of South Eastern West Bengal.*Z.S.I. Kolkata*. 2001; 1-104.
24. Krebs, C.J., Program for Ecological Methodology. Version 6.1.2002, *Benjamin Cummings, Vancouver*, British Columbia, Canada.
25. Naughton Mc., S. J., and Wolf, L. L., General ecology. 2d ed. 1979, *Holt, Rinehart & Winston*, New York.
26. Pahari, P.R., Dutta, T.K., and Bhattacharya,T., Aquatic insects of Midnapore district-II (Coleoptera: Hydrophilidae). *Vidyasagar Univ. J. Biosciences*, 1999; 4: 17-20.
27. Pahari, P.R.,Dutta,T.K., and Bhattacharya,T., Aquatic insects of MidnaporeDistrict-I (Insecta, Coleoptera, Dytiscidae),*Vidyasagar Univ. J. Biosciences*, 1997; 3: 45-51.
28. Pal, S., Dey, S.R., Bhattacharya, D.K., Das, S.K. and Nandi, N.C.,Macrophyte preference and insect diversity of freshwater wetlands in south-eastern Bengal. Diversity and Environment, Proc. Nat. Seminar on Environ. Biol. (Eds.: A.K. Aditya and P. Haldar). 2000, *Daya Publishing House*, Delhi.
29. Pielou, E. C., The measurement of diversity in different types of biological collections. *J. Theoret. Biol.*, 1966; 13: 131-144.
30. Roy, S. P., Kumar,V.,andPathak,H. S.,Faunistic composition of aquatic insects of eastern Bihar with notes on some aspects of their ecology. *Rec. Zool. Surv. India.*, 1988; 85(1): 49-57.
31. Saha, N., Aditya, G., Bal, A. and Saha, G.K., Comparative study of functional response of common Hemiptran bugs of east Calcutta wetlands, India. *International Review of Hydrobiology*, 2007; 92: 242-257.
32. Samweel,N. and Nazir,T., Diversity of Aquatic Insects and Function of Fluvial Ecosystem of Song River of Rajaji National Park, India. *Global Journal of Science Frontier Research*: Environment & Earth Science, 2014, 14(1):07-16.
33. Sharma, R and Agrawal,N., Faunal diversity of aquatic insects in Surha Tal of District Ballia (U.P.), India. *Journal of Applied & Natural Science*, 2012; 4(1): 60 - 64.
34. Smith, R. L.,Evolution of parental care in the giant water bugs (Heteroptera: Belostomatidae), In J. Choe& B. Crespi (Eds.), The evolution of social behaviour in insects and arachnids, Cambridge: *Cambridge University Press*, 1997; 116-149.
35. Srivastava, V.D. and Sinha,C.,Insecta: Odonata, State fauna Series 3: Fauna of West Bengal, Part 4, *Zoological Survey of India*, Calcutta, 1995; 163-224.
36. Subramanian, K.A. and Sivaramakrishnan, K.G., Aquatic insects for biomonitoring fresh water ecosystems: A methodology manual, 2007, *Trust for Ecology and Environment (ATREE)*, Bangalore, India.
37. Susheela, P., and Radha,R., Studies on the nutritional constituents and the aquatic insect fauna associated with water hyacinth, Eichorniacrassipes in Singanallur Lake, Coimbatore. *International Journal of Fauna and Biological Studies*, 2015; 2(6): 05-07.
38. Thirmalai, G, Raghunathan, M.B., Population fluctuation of three families of aquatic Heteroptera in a perennial pond. *Rec zoolsurv. India* 1988; 85(3): 381-389.
39. Vasantkumar, B. and Roopa, S.V., Physico-chemical and aquatic insects diversity of pond ecosystem in Karwar, India. *Int. J. of Life Sciences*, 2014; 2(2): 148-154.
40. Ward, J. V., Aquatic Insect Ecology: Biology and Habitat. *JohnWiley and Sons Inc*. 1992; New York.
41. Wilhm, J. L., and Dorris, T. C., Species diversity of benthic macroinvertebrates in a stream receiving domestic and oil refinery effluents.Am. Midland Naturalist. 76: 427-449. 1968. Biological parameters for water quality criteria. Bioscience. 1966; 18(6): 477-481.