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Entomofaunal diversity in Kondakarla freshwater lake ecosystem at Visakhapatnam, Andhra Pradesh, India

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Abstract
An investigation was carried out to study of the aquatic entomofauna distribution Kondakarla lake from July 2012 to June 2014. A total 1227 individuals under 27 families and 51 taxa in seven orders were recorded. The aquatic insects were sampled systematically and randomly in station-wise habitats, using the standard protocols. Among the collected insects Order Hemiptera was dominant with 10 families which contributed to 37.04% of the total texa followed by Coleoptera, Ephemeroptera and Odonata each contributed to14.82%, Diptera and Trichoptera 07.41% and Megaloptera 03.70%. The percentage of taxa in an order Hemiptera dominant with 33.33% followed by families Coleoptera 25.49%, Odonata 23.53%, Ephemeroptera 07.84, Diptera and Trichoptera 03.92% and Megaloptera 01.96%. The month wise entomofauna population density calculated by using PAST diversity index from the number of population was represented at Kondakarla lake.

Keywords: Entomofauna, aquatic insects, PAST, diversity index

1. Introduction
Kondakarla Lake is the second largest natural fresh water lake in Andhra Pradesh located at a distance of 42 km from Visakhapatnam and 7 km from Anakapalle. It is located north-east of Kondakarla village, lies between latitudes 17°35'30" and 17°36'02" N, and longitudes 82°59' 27″ and 83°1`0″ E. The Lake receives water from Sarada River and excess water runs off into Bay of Bengal through man mad canals etc. The lake was spread over an area 30 sq.km and completely filled with water during rainy season. The depth of the lake earlier was about 25 ft as per records and now it is not more than 15 ft. The shape of the lake can best be described as irregular resembling a many pronged rhizome. The catchment area of lake has 20 km and it is also mostly fed by hill stream and supply channel from river Sarada [1].

India is one of the mega diverse countries with a notable aquatic habitats of about 3,166,414 Km2 with significant variations in rainfall, altitude topography and latitude. About 7, 51,000 known species of insects, consists three-fourths of all species of animals on the Earth. Most of the insects are terrestrial and their diversity also includes many species that are aquatic in habit [2]. Insects are the most successful species invaded virtually all aquatic habitats and often high diversity [3]. The Aquatic insects are significant in processing organic matter and transporting energy along stream channels etc. [4, 5] Some of these insects may be beneficial to human beings and some of them are quite harmful to us [6]. The larval stages of insects constitute the principal nutritive fauna of fish [7, 8]. In aquatic environment substratum is one of the vital factors that govern the population dynamics of the aquatic insects.

Studies on invertebrate fauna of lentic ecosystems were correlated to species habitat relationship with regard to the environmental variables [9]. Over 95% of the total individual in freshwater 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. Due to limited knowledge of the taxonomy and distribution of aquatic insects in the country, most of the studies have been confined to supra-specific taxonomic levels. The study is aimed at compiling the first inventory of the aquatic insect diversity and so far no study was reported aquatic entomofauna of Kondakarla Ava, Andhra Pradesh.

Fig 1: Kondakarla freshwater lake Map

2. Materials and Methods

2.2 Study Area

Four stations were selected for the present study to collection of aquatic insect diversity of during the period June 2012 to May 2014. They were (Station 1- Kakarapalli (E), Station II- Kondakarla Bird sanctuary (W), Station III - Vadrapalli (N), Station IV - Avasomavaram (S).

2.2 Methodology

Aquatic insects were collected monthly from different four stations of the freshwater lake by the nylon pond net method [10]. The insects were sorted, counted and identified by using standard keys [11-18]. For identification, only two or three specimens were used and the rests were returned to the sites after counting. Aquatic insects and water samples in three replicates were collected monthly from different stretches of the stream during 2012-14 by three different methods such as "all out search" method, "a nylon pond net" method [19] according to the habitat characteristics. Three such drags constituted a sample. Relative abundance of insects in family level and taxa level were calculated [20, 21].

2.3 Data Analysis

By using statistical tools, data were analysed prior to this normality tests were done by PAST (PAlaeontological STatistics) [22]. The Shannon- Weiner index and Simpson dominance index were determined for all station to analyse the species diversity and component of dominance respectively. Buzas and Gibson's evenness (eH/S) index was used to calculate relative abundance of each insect order in all stations.

3. Results and Discussion

The results of the present study revealed that the occurrence of fifty one aquatic taxa belong to seven orders, 27 families were recorded. The recorded seven orders i.e. Coleoptera, Diptera, Ephemeroptera, Hemiptera, Megaloptera, Odonata and Trichoptera. 27 families were Elmidae, Hydrophilidae, Dytiscidae and Limnichidae of order Coleoptera. Chironomidae and Sciomyzidae of order Diptera. Caenidae, Baetidade, Ephemerellidae, Heptageniidae of order Ephemeroptera. Nepidae, Pleidae, Belostomatidae, Naucoridae, Gerridae, Notonectidae, Veliidae, Helotrephidae, Mesoveliidae and Microveliidae of the order Hemiptera. Corylladidae of order Megaloptera. Coenagrionidae, Libellulidae, Gomphidae and Corduliidae of order Odonata. Polycentropodidae and Leptoceridae of order Trichoptera. For analysed of the taxa, 1227 aquatic insects were collected at four stations during the study period Table I.

In the present study the order Hemiptera was found most diverse and relatively abundant in the freshwater lake. The similar study was observed that aquatic insect community was represented to 31 species belonging to 18 families of 5 orders. Record of 17 species and 8 families of the order Hemiptera showed that it is the largest order in terms of aquatic insect diversity followed by order Coleoptera having 7 species and 5 families [23]. Atotal of 47 genera belong to 7 orders and28 families were identified of diversity of aquatic insects in Karamana River, Southern Western Ghats, India [24]. Medona *et al*. [25] noted a total of 7243 individuals of entamofauna representing 43 genera categorized under 32 families and 9 orders were collected from the upstream and downstream of the Sothuparai Reservoir [25]. Bijita and Smita [26] represented to 21 species of aquatic insects belonging to 14 families and 7 orders are Hemiptera, Coleoptera, Trichoptera, Ephemeroptera, Odonata, Collembola and Diptera. Rashmi Sharma [27] observed the diversity of more than 18 families belonging to Dytiscidae Helonidae, Hydraenidae, Hydrophilidae, Psephenidae, Corixidae, Gerriidae, Nepidae, Notonectidae, and Validae besides larval forms and aquatic and terrestrial insect. Abhijina *et al*. [28] studied Vellani lake represented by 60species classified under 37 families and 8 orders, Coleoptera was diverse in number of 22 genera.

In the present investigation the number and percentage composition of families and taxa under different orders are shown in Table 2. Order Hemiptera was dominant with 10 families which contributed to 37.04% of the total texa followed by Coleoptera, Ephemeroptera and Odonata each contributed to 4 (14.82%), Diptera and Trichoptera 02 (07.41%) and Megaloptera 01 (03.70) Table 2, Fig 2. The percentage of taxa in an order Hemiptera dominant with 17 (33.33%) followed by families Coleoptera 13 (25.49%), Odonata 12 (23.53%), Ephemeroptera 04 (07.84), Diptera and Trichoptera 02 (03.92%) and Megaloptera 01 (01.96%) Table 2, Fig 3.

The number and percentage composition of taxa under various families were Hydrophilidae dominated and contributed 11.75% in total population followed by Dytiscidae contributed to 09.80%, Libellulidae 07.84%, Gerridae, Notonectidae, Coenagrionidae and Gomphidae contributed to 05.88%. Nepidae, Pleidae, Belostomatidae and Corduliidae contributed to 03.92% and Elmidae, Limnichidae, Chironomidae, Sciomyzidae, Caenidae, Baetidae, Ephemerellidae, Heptageniidae, Naucoridae, Veliidae, Helotrephidae, Mesoveliidae, Microveliidae, Corylladidae, Polycentropodidae and Leptoceridae contributed to 01.96% Table 3, Fig 4.

The composition of families and taxa were represented from 1154 individuals and recorded the percentage composition is 45.0, 29.5 and 18.3% [29]. Hemiptera (46%) was the dominant followed by the order Coleoptera (22%). The similar study shows diversity of aquatic insects in Karamana River, Southern Western Ghats, India [24]. Medona *et al* [25] noted the highest numbers of taxa were in the order Ephemeroptera, while the Hemipterans had the highest number. Hemiptera showed the highest numerical abundance (36.73%) of the total insect fauna. It was represented by 8 family's *viz*., Hydrometridae, Belastomidae, Gerridae, Ranatridae, Notonectidae, Ne- pidae, Naucoridae and Corixidae. Mafuyai *et al*. [30] studies on aquatic Hemiptera of Pocharam Lake in Andhra Pradesh. Aquatic insect population in Lakha Banjara Lake population of individuals and percentage (87%). The orders followed by Hemiptera in their number and percentage

were Coleoptera (7%), Odonata (4%) and Diptera (2%) [31]. By using statistical tools, data were analysed prior to this normality tests were done by PAST Table 4. The Shannon-Weiner index were determined the highest indices shown in Hemiptera (1.972) and lowest in Trichoptera (0.653) Fig 5. Simpson Index were shown that the highest indices in Trichoptera (0.536) and lowest in Hemiptera Fig 6. This result is opposite to Shannon diversity index. According to Menhinick Index the diversity of entomofauna highest in Hemiptera (0.508) and lowest in Trichoptera (0.163) Fig7, these diversity indices results were similar to Shannon Index. Buzas and Gibson's Index shows that the highest in Diptera (0.991) and lowest in Odonata (0.693) Fig 8. Berger-Parker Dominance Index reveled that highest in Trichoptera (0.640) and lowest in Hemiptera (0.320) Fig 9. Margalef Richness Index expressed as highest in Hemiptera (1.510) and lowest in Trichoptera (0.2000) this diversity indices results were similar to Shannon Index Fig 10.

The study results coincide to other investigators [32], the maximum diversity (Shannon index H) of 1.5 and the Simpson index was 0.75 and minimum dominance (D) of 0.24 for the entire sampling period. A minimum diversity indices is 0.86 and highest dominance 0.56. The Evenness of distribution of aquatic insects in the stations of river ranged from 0.47 to 0.83 [24]. Shannon- Wiener diversity index (H′) values were found to be less than 1 in all the seasons indicating polluted nature of stream water [33]. In Pre-monsoon the stream water was relatively good with more diverse taxa encountering highest Shannon H′ (0.772), where as in winter the system was assembled by more dominant groups encountering highest Berger-Parker index of Dominance (0.903). Balachandran *et al* [34] reported to diversity and distribution of aquatic insects in Aghanashini River of Central Western Ghats of India. Some other studies on aquatic insects reported in India [35-38].

Table 1: Family and taxa wise distribution under various orders in Kondakarla lake during the study period 2012 -2014

Order	Family	Taxa
Coleoptera	Elmidae	*Stenelmis*
	Hydrophilidae	*Allocotocerus*
		Amphiops
		Berosus sp.
		Enochrus
		Helochares
		Sperchopsini
	Dytiscidae	*Cybister*
		Berosus indicus
		Agabus sp.
		Hydroporus
		Eretes
	Limnichidae	*Limnichus*
Diptera	Chironomidae	*Chironomus*
	Sciomyzidae	*Sepedon*
Ephemeroptera	Caenidae	*Caenis*
	Baetidae	*Baetis*
	Ephemerellidae	*Ephemerella*
	Heptageniidae	*Epeorus*
Hemiptera	Nepidae	*Laccotrephes*
		Ranatra
	Pleidae	*Paraplea*
		Neoplea
	Belostomatidae	*Belostoma*
		Spherodema
	Naucoridae	*Nepa cineria*
	Gerridae	*Gerris*
		Rhagadotarsus
		Halobates
	Notonectidae	*Notonecta glauca*
		Micronecta haliploides
		Micronecta Sp.
	Veliidae	*Microvelia*
	Helotrephidae	*Nanotrephes*
	Mesoveliidae	*Mesovelia*
	Microveliidae	*Microvelia*
Megaloptera	Corylladidae	*Corydalus*
Odonata	Coenagrionidae	*Cercion*
		Ceriagrion
		Ischnura
	Libellulidae	*Crocothemis*
		Hydrobasileus
		Nannophya
		Urothemis
	Gomphidae	*Heliogomphus*

		Melligomphus
		Paragomphus
	Corduliidae	*Epitheca*
		Somatochlora
Trichoptera	Polycentropodidae	*Polycentropus*
	Leptoceridae	*Leptocerus*

Table 2: Number and percent composition under various orders

Order	No. of families	% of families in an order	No. of Taxa	% of Taxa in an order
Coleoptera	04	14.82	13	25.49
Diptera	02	07.41	02	03.92
Ephemeroptera	04	14.82	04	07.84
Hemiptera	10	37.04	17	33.33
Megaloptera	01	03.70	01	01.96
Odonata	04	14.82	12	23.53
Trichoptera	02	07.41	02	03.92

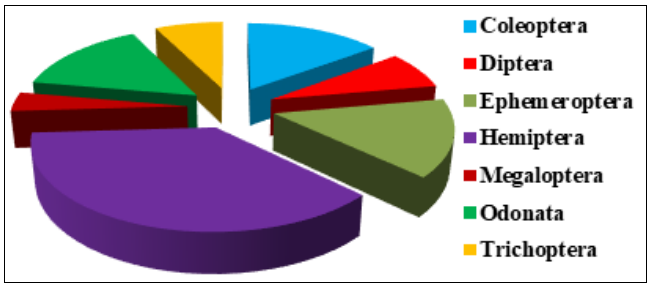

Fig 2: No. of families

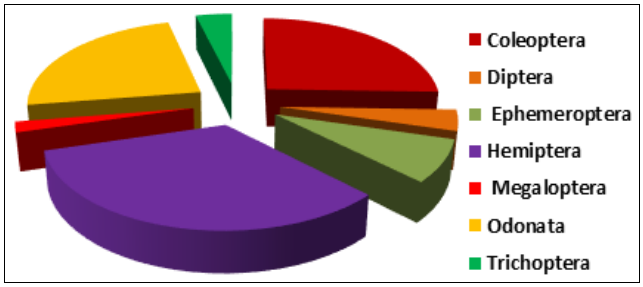

Fig 3: % of Taxa in an order

Table 3: The number and percentage composition of taxa under various families

Families	No. of taxa	% of Taxa in families	Families	No. of taxa	% of Taxa in families
Elmidae	01	01.96	Gerridae	03	05.88
Hydrophilidae	06	11.75	Notonectidae	03	05.88
Dytiscidae	05	09.80	Veliidae	01	01.96
Limnichidae	01	01.96	Helotrephidae	01	01.96
Chironomidae	01	01.96	Mesoveliidae	01	01.96
Sciomyzidae	01	01.96	Microveliidae	01	01.96
Caenidae	01	01.96	Corylladidae	01	01.96
Baetidae	01	01.96	Coenagrionidae	03	05.88
Ephemerellidae	01	01.96	Libellulidae	04	07.84
Heptageniidae	01	01.96	Gomphidae	03	05.88
Nepidae	02	03.92	Corduliidae	02	03.92
Pleidae	02	03.92	Polycentropodidae	01	01.96
Belostomatidae	02	03.92	Leptoceridae	01	01.96
Naucoridae	01	01.96			

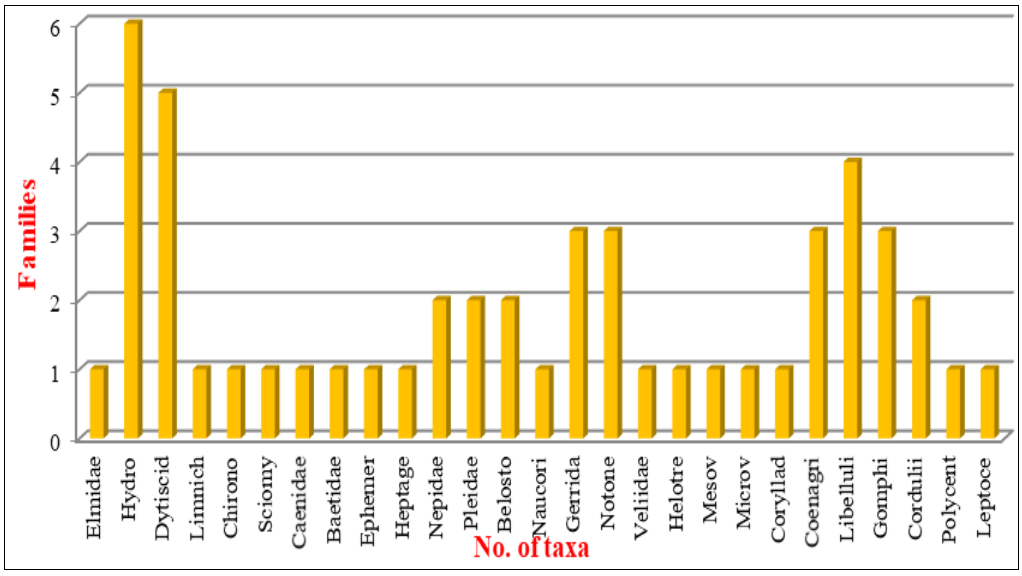

Fig 4: Percentage contribution of Taxa in families

Table 4: Diversity indices of Entomofauna in Kondakarla freshwater lake during the study period (Alpha Biodiversity [α])

Orders	Shannon Index	Simpson Index	Menhinick Index	Buzas and Gibson's Index	Berger-Parker Dominance Index	Margalef Richness Index
Coleoptera	1.036	0.402	0.233	0.704	0.480	0.527
Diptera	0.684	0.501	0.258	0.991	0.567	0.244
Ephemeroptera	1.240	0.322	0.335	0.864	0.476	0.605
Hemiptera	1.972	0.176	0.508	0.719	0.320	1.510
Megaloptera	-	-	-	-	-	-
Odonata	0.731	0.493	0.277	0.693	0.547	0.420
Trichoptera	0.653	0.536	0.163	0.961	0.640	0.200

Fig 5: Shannon Index

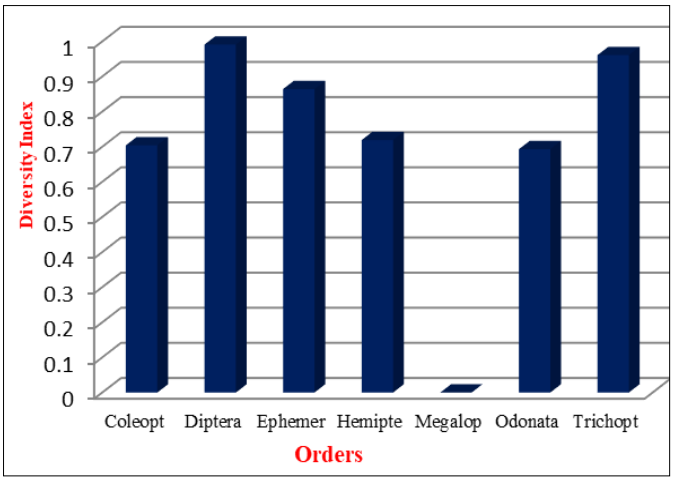

Fig 8: Buzas and Gibson's Index

Fig 6: Simpson Index

Fig 9: Berger-Parker Dominance Index

Fig 7: Menhinick Index

Fig 10: Margalef Richness Index

4. Conclusion

It is concluded thatthe results of the present study revealed that the occurrence of fifty one aquatic taxa belong to seven orders, 27 families were recorded. Order Hemiptera was dominant with 10 families of the total texa followed by

Coleoptera, Ephemeroptera and Odonata each contributed to 4, Diptera and Trichoptera 02 and Megaloptera 01. Shannon Index, Simpson Index, Menhinick Index, Buzas and Gibson's Index, Berger-Parker Dominance Index and Margalef Richness Index shows to good diversity indices in this freshwater lake.

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6. References

1. Chandrasekhar SVA, Siddiqi SZ. Kondakarla Lake, Andhra Pradesh - A Taxoecological Profile Rec. Zool. Surv. India. 2005; 104(Part 3-4):63-76.
2. Westfall MJ Jr, Tennessen KJ. An Introduction to the Aquatic Insects of North America, 3rd Ed. R. W. Merritt, K. W. Cummins (eds.). Kendell Hunt Publishing Company: Dubuque, Iowa. Odonata, 1996, 164-211.
3. Anne EH, Gary AL, Dominic TC, Robert MN. Aquatic Insect Ecology. In: Ecology and Classification of North American Freshwater Invertebrates, 3rd Ed. Edited by J H. Thorp and A. P. Covich. (Academic Press), California, USA, 2010, 659-694.
4. Hynes HBN. The Ecology of Running Waters. Liverpool University Press, Liverpool, 1970.
5. Malmqvist B. Aquatic invertebrates in riverine landscapes. Freshwater Biology. 2002; 47:679-694.
6. Ahmed Ziauddin AK. Studies on the Ecology of aquatic Insects With special reference to fish Pond, Ph.D. thesis North eastern Hill University, Meghalaya, India, 1983.
7. Tachet H, Richoux P, Bournaud M, Usseglio-Polatera P. Invertébrésd’eaudouce: systématique, biologie, écologie. CNRS Edn, Paris, 2003, 587.
8. Minshall GW. Responses of stream benthic macroinvertebrates to fire. Forest Ecology and Management. 2003; 178:155-161.
9. Compin A, Cereghino R. Sensitivity of aquatic insect species richness to disturbance in the Adour – Garonne stream system (France). Ecological Indicators. 2003; 2:345-360.
10. Subramanian KA, Sivarama krishnan KG. Aquatic Insects for Biomonitoring Freshwater Ecosystems-A Methodology Manual. Asoka Trust for Research in Ecology and Environment (ATREE), Bangalore, India, 2007.
11. Bahl A, Basu RC. State Fauna Series 10: Fauna of Manipur. ZSI. Kolkata, 2004, 625.
12. Epler JH. Identification Manual for the Aquatic and Semiaquatic Heteroptera of Florida (Belostomatidae, Corixidae, Gelastocoridae, Gerridae, Hebridae, Hydrometridae, Mesoveliidae, Naucoridae, Nepidae, Notonectidae, Ochteridae, Pleidae, Saldidae, Veliidae).Florida Department of Environmental Protection, Tallahassee, 2006, 186.
13. Webb JM, Suter PJ. Identification of larvae of Australian Baetidae (Ephemeroptera). La Trobe University, http://Wiki.Trin.Org.Au/Pub/Mayflies/Taxonomicw orkshops 2001.
14. Nieser N. Guide to aquatic heteroptera of Singapore and Peninsular Malaysia III. Pleidae and Notonectidae. The Raffles Bulletin of Zoology. 2004; 52:79-96.
15. Thirumalai G. Aquatic and semi-aquatic Heteroptera of India, Indian Association of Aquatic Biologists, Hyderabad. 1999; 7:74.
16. Thirumalai G. A check list of Gerromorpha (Hemiptera) from India. Records of Zoological Survey of India. 2002; 100:55-97.
17. Jessup BK, Markowitz A, Stribling JB, Friedman E, Labelle K, Dziepak N. Family level key to the stream invertebrates of maryland and surrounding areas. Third Edition. (Maryland Department of Natural Resources. Section. 2003; 10:98.
18. Gupta YC, Chaturvedi DK. A New Species of Water Skater, *Ptilomera* Amyot and Serville, 1843 from India (Hemiptera: Heteroptera, Gerridae). Asian J Exp. Sci. 2008; 22:165-170.
19. Merritt RW, Cummins KW, Berg MB (eds). An Introduction to the Aquatic Insects of North America (4th ed.) Kendall/Hunt Publ. Co., Dubuque, 2008; IA: 1158.
20. Bahl A, Basu RC. State Fauna Series 10: Fauna of Manipur. ZSI. Kolkata, 2004, 625.
21. Epler JH. Identification Manual for the Aquatic and Semiaquatic Heteroptera of Florida (Belostomatidae Corixidae, Gelastocoridae, Gerridae, Hebridae, Hydrometridae, Mesoveliidae, Naucoridae, Nepidae, Notonectidae, Ochteridae, Pleidae, Saldidae, Veliidae). Florida Department of Environmental Protection, Tallahassee, FL, 2006, 186.
22. PAST. Hammer Ø, Harper DAT. PAlaeontological STatistics. Blackwell, 2006.
23. Dharitri Choudhury, Susmita Gupta. Aquatic insect community of Deepor beel (Ramsar site), Assam, India. Journal of Entomology and Zoology Studies. 2015; 3(1):182-192.
24. Bismi LS, Madhusoodanan Pillai P. Diversity of Aquatic Insects in Karamana River, Southern Western Ghats, India. International Journal of Science and Research. 2013; 6:14.
25. Medona Mary R, Nirmala T, Delphine Rose MR. Diversity and distribution of aquatic insects In Sothuparai Reservoir, at Periyakulam, Theni District, Tamilnadu, India. Int J Cur Res Rev. 2015; 7:9.
26. Bijita Barman, Susmita Gupta. Tropical Ecology. 2016; 57(2):243-253.
27. Rashmi Sharma. Faunal Diversity of Insects of Fresh Water Lake of Ajmer Rajasthan. IOSR-JPBS. 2015; 106(IV):39-43.
28. Abhijina UG, Ratheesh R, Biju Kumar A. Distribution and diversity of aqutic insects of Vallayani lake in Kerala. J En. Bio. 2013; 34:605-611.
29. Popoola KOK, Otalekor A. Analysis of Aquatic Insects’ Communities of Awba Reservoir and its Physico-Chemical Properties. Research Journal of Environmental and Earth Sciences. 2011; 3(4):422-428.
30. Mafuyai HB, Wade JW, Agoom AK, Audu BS. Aquatic insect composition at a *Simulium* breeding site on the River Assop, Plateau State, Nigeria. J Aquat. Sci. 2004; 19(1):9-15.

31. Anjana Choudhary, Janakahi. Diversity and distesribution of aquatic insect population in Lakha Banjara Lake, Sagar (M. P.), India. J Int Aca Res Mult. 2015; 3:367-374.
32. Mason CF. Biology of freshwater pollution. Longman Scientific and Technical, 1981, 250.
33. Turkmen G, Kazanci N. Applications of various biodiversity indices to benthic Macroinvertebrate assemblages in streams of a national park in Turkey. Rev Hydrobiol. 2010; 3:11-125.
34. Balachandran C, Dinakaran S, Chandran MDS, Ramachandra TV. Diversity and Distribution of Aquatic Insects in Aghanashini River of Central Western Ghats, India. National Conference on Conservation and Management of Wetland Ecosystems. School of Environmental Sciences, Mahatma Gandhi University, Kottayam, Kerala, 2012, 1-10.
35. Barman B, Gupta S. Aquatic insects as bioindicator of water quality- A study on Bakuamari stream, Chakrashila Wildlife Sanctuary, Assam, North East India Journal of Entomology and Zoology Studies. 2015; 3(3):178-186.
36. Bhandarkar SV, Bhandarkar WR. A study on species diversity of benthic macro invertebrates in freshwater lotic ecosystems in Gadchiroli district Maharashtra. Int. J of Life Sciences. 2013; 1(1):22-31.
37. Bhattacharya DK. 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.
38. Abhijna UG, Ratheesh R, Bijukumar A. Distribution and diversity of aquatic insects of Vellayanilake in Kerala. Journal of Environmental Biology. 2013; 34:605-611.