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A study on the diversity of aquatic insect communities concerning the water quality of Samaguri Beel, Assam, India

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Abstract
The freshwater ecology is significantly influenced by aquatic insects. The current study examines the taxonomy and species diversity of aquatic insects in the Samaguri beel in the Nagaon region of Assam, India.. Besides this, the present study also helps us to establish the species-habitat relationship concerning the water quality of the habitat. From January to June 2022, an assessment of the aquatic insect community of Samaguri beel was done. An estimated 44 species from 6 orders and 20 families made up the water insect ecosystem that was observed during the study period. Order Hemiptera with nine families and twenty-four species, followed by Coleoptera with five families and nine species, Odonata with two families and six species, Ephemeroptera with two species belonging to a single family, and order Hymenoptera with the fewest species (including 1 species from 1 family). Insects of various species depend on different physicochemical conditions of the water and have different tolerance to the water quality. The physicochemical properties of the water of the Beel were found to be of preferable quality, which is perfect for the growth of most of the aquatic organisms and it is one of the main reasons for the highly diverse aquatic insect community in this area.

Keywords: insects, wetland, physico-chemical parameters, aquatic ecosystem

Introduction

Although many of the insects in our surroundings are considered a pest, they are important to maintain ecological balance in the ecosystem. The majority and widest variety of creatures on earth are insects [1, 2]. A category of arthropods known as aquatic insects are those that spend the majority of their lives in or on the surface of bodies of water. However, many aquatic insects, including those in the Ephemeroptera, Plecoptera, and Trichoptera families, are terrestrial in nature. They play a significant role in proper functioning of the aquatic ecosystem [3]. Insects are an essential part of invertebrates where they are one of the major controlling groups in food webs, where many aquatic organisms such as fish, amphibians, and water birds feed on the aquatic insects. Moreover, aquatic insects also serve as food for terrestrial organisms, especially during the adult phase when they are themselves terrestrial. Occasionally insects may be considered predators feeding on varieties of zooplankton, phytoplankton, or some on small fish also. Insects are essential to the ecosystem because they aid in nutrient recycling through the decomposition of wood and leaf litter, the elimination of carrion and dung, and soil turnover. They also play an important role in the pollination of plants and in the preservation of plant community structure and composition through phytophagy [4].

According to their diversity, abundance, and distribution in relation to the physical and chemical characteristics of the habitats, aquatic insects can be used as biological indicators [5]. Datas obtained from the indicator organisms are helpful in estimating the level of environmental impact and its probable hazards for other living organisms. Moreover, their presence or absence is used to indicate clean or polluted water [5-7]. A different group of insect has a different tolerance of the water quality in which it lives i.e. different group of insect depends on different set of conditions to survive. Some insects can tolerate poor quality water with high temperatures, too high nutrient levels, and low pH such as mosquito larvae. On the other hand, some insects are sensitive to poor water quality. For example, most of the larvae of caddisflies, mayflies, and stoneflies cannot survive in polluted and poor-quality water so they are found in clean water with high oxygen levels, moderate temperature, low nutrient load, and suitable pH. Streams with these aquatic insects are assumed to have a good quality of water [6].

One of the nations with the highest levels of biodiversity is India [8]. Although the World Conservation Monitoring Centre identified the Northeastern region of India as a biodiversity hotspot [9], little is known about the water insect species that inhabits this area. The studies on the aquatic insect divesrsity conducted in North-east India in comparison to the studies in other parts of India [10-17], are comparatively fewer. Assam has over 3,500 wetlands recognized by Assam Remote Sensing Application Centre [18] and Samaguri beel is one of them. Wetlands are a part of the vast aquatic ecosystem, that plays a vital role in the biogeochemical cycle. It is also important from a socio-economic, ecological, biological, and aesthetic viewpoint. Wetlands provide habitats for flora and fauna to maintain ecological balance and biological and genetic diversity. In this regard, this study will advance our understanding of the taxonomy and species variety of Samaguri beel aquatic insects as well as our ability to create a connection between a species' habitat and the ecosystem's water quality. The term species-habitat relationship describes the relationship between the area of a habitat, or a part of a habitat concerning the number of species found within that particular area.

Materials and Methods

Study Area

On the northeastern edge of the Nagaon District, in Samaguri beel, this investigation was conducted. The

Samaguri beel is situated between latitudes 26°25' N and 92°51' E. One of the ox-bow-shaped wetlands in the Nagaon district, Samaguri beel was created over time by the abandoned Kolong river's course. About 20 kilometres separate it from Nagaon town. According to a Google Earth photograph, the beel has a 43.65 hectare area covered. Sonaribali and NH 37 are to the north of the beel, followed by Gatanga to the east, Samaguri Grant and Auniati Satra to the south, and Baziagaon to the west. Another connection between Samaguri beel and a nearby creek known as "Ghatir Ghulung" exists. Samaguri Beel is Popularly known as 'Pokhi Tirtha' (Bird Pilgrimage).

Fig 1: Map showing India, Assam, and different sites of Samaguri beel

Time and sampling methods

The current work is based on research completed during a six-month period, starting in January 2022 and ending in June 2022. During the investigation, the floating/swimming insects from the littoral zone of the examined environment were collected using circular hand-operated nets composed of finely meshed polyester mosquito curtain cloths. In this process, the vegetation was spread out and the net was dragged around it for a set amount of time. The sample was made up of three of these drags. The insects were then sorted, counted, and stored in 70% ethyl alcohol for identification after being taken from three replicate samples. With the aid of information found on the internet and in reputable books like IMMS' General Textbook of Entomology: Volume I: Structure, Physiology, and Development and Modern Entomology, Second Edition by D.B Tembhare, the larger aquatic insects were sorted by eyes, while the smaller ones were done by using a dissecting microscope. Digital cameras were used to take the pictures (Model NIKON D3200 DSLR Camera). For testing, water samples were brought to the Nowgong College (Autonomous), Zoology department's laboratory.

Physico-chemical parameters of water sample

A thermometer was used to estimate the water's temperature, and a pH metre was used to determine its pH. Standard titrimetric techniques were used to analyse the dissolved oxygen and free carbon dioxide, and laboratory tests were performed on other parameters including TDS, turbidit, iron, calcium, total hardness, magnesium, total alkalinity, chloride, total arsenic, nitrate, fluoride, and residual chlorine [19].

Results and Discussion

Analysis of Physico-chemical parameters of the water body:
The physico-chemical parameter study is very essential to get an exact idea about the water quality. Moreover we can compare the results of different physicochemical parameter values of water bodies with the abundance of aquatic organisms found there. The physicochemical parameters of the water of Samaguri beel are summarized below (in Table 1).

Table 1: Water sample analysis result during June 2022

Sl No.	Parameter Name	Test Result
1	Turbidity	2 NTU
2	Air Temperature	31℃
	Water Temperature	26℃
3	pH Value	7.15
4	Dissolved oxygen	7.9 mg/lt
5	Free carbon dioxide	5.6 mg/lt
6	TDS (Total Dissolved Solids)	57 mg/lt
7	Iron as Fe	0.35 mg/lt
8	Total Hardness as $CaCO_3$	76 mg/lt
9	Calcium as Ca	30 mg/lt
10	Magnesium as Mg	11.22 mg/lt
11	Total Alkalinity as $CaCO_3$	112 mg/lt
12	Chloride as Cl	4 mg/lt
13	Nitrate as NO_3	Not Detected
14	Total Arsenic as As	Not Detected
15	Fluoride	Not Detected
16	Residual Chlorine	Not Detected

The water quality of the Samaguri beel can be considered as good, based on the physicochemical parameters studied, and suitable for aquatic organisms to grow and reproduce.

Diversity of Aquatic insects

From the present study, we have recorded a total of 44 species of aquatic insects belonging to 6 orders (Hemiptera, Coleoptera, Diptera, Odonata, Ephemeroptera, and Hymenoptera) and 20 families (Corixidae, Pleidae, Notonectidae, Naucoridae, Mesoveliidae, Belostomatidae, Nepidae, Gerridae, Veliidae of the order Hemiptera; Chironomidae and Culicidae of order Diptera; Dytiscidae, Gyrinidae, Hydrophilidae, Chrysomelidae, Curculionidae of order Coleoptera; Libellulidae, Coenagrionidae of order Odonata; Baetidae of order Ephemeroptera; and Formicidae of order Hymenoptera). Order Hemiptera represents the highest number of species (having 9 families and 24 species) followed by Coleoptera (which contains 5 families and 9 species) and Odonata (having 2 families and 6 species) and order Hymenoptera represents the lowest number of species (1 species from 1 family) followed by Ephemeroptera (2 species belonging to 1 family) were recorded during this work. In areas, with shallow water, the abundance of Hemipteran was higher whereas in the areas with dense planktons the abundance of Coleopteran was higher. The details of the insects found are given below in tabulated form (Table 2) with their distribution.

Table 2: Distribution of species based on their family and order

Sl no	Order	Family	Species
1	Hemiptera	Corixidae	*Micronecta siva* (Kirkaldy,1897)
			Micronecta haliploides (Horvath, 1904)
			Micronecta scutellaris (Stal,1858)
			Sigara alternate (Say, 1825)
		Pleidae	*Paraplea frontalis* (Fieber,1844)
			Plea liturata (Fieber, 1844)
		Notonectidae	*Notonecta undulata (*Say, 1832*)*
			*Anisops breddini (*Kirkcaldy, 1901*)*
			*Anisops bouvieri (*Kirkaldy, 1904*)*
			*Aphelonecta sp. (*Lansbury, 1965*)*
		Naucoridae	*Pelocoris femoratus (*Palisot de Beauvois, 1820*)*
		Mesoveliidae	*Mesovelia vittigera (*Horvath, 1895*)*
			*Mesovelia mulsanti (*White, 1879*)*
		Belostomatidae	*Diplonychus rusticus* (Fabricius, 1781)
			Belostoma sp. (Latreille, 1807)
		Nepidae	*Ranatra filiformes* (Fabricius, 1790)
			Ranatra varipes (Stal, 1861)
			Nepa apiculata (Uhler, 1862)
			Laccotraphes sp. (Stal, 1865)
			Ranatra longipes longipes (Stal, 1861)
		Gerridae	*Gerris sp.* (Fabricius, 1775)
			Neogerris sp. (Matsumura, 1913)
			Limnogonis nitidus (Myar, 1865)
		Veliidae	*Microvelia sp.* (Westwood, 1834)
2.	Diptera	Chironomidae	*Chironomous sp.* (Megien, 1803)
		Culicidae	*Culex sp.* (Linnaeus, 1758)
3.	Coleoptera	Dytiscidae	*Cybister* fimbriolatus (Say, 1825)
			*Cybister chinensis (*Motschulsky, 1854)
		Gyrinidae	*Laccophilus indicus* (Gschwendtner, 1936)
			Dineutus sp. (Macleay, 1825)
		Hydrophilidae	*Hydrophilus sp.* (Geoffroy, 1762)
			Berosus sp. (Leach, 1817)
			Laccobius sp. (Erichson, 1837)
		Chrysomelidae	*Donacia sp.* (Fabricius, 1775)
		Curcuolinidae	*Neochetina sp.* (Hustache, 1926)

			Sphenophorus sp. (Schoenherr, 1838)
4.	Odonata	Libellulidae	*Plathemis Lydia* (Drury, 1773)
			Pantala flavescens (Fabricius, 1798)
			Leucorrhinia sp. (Brittinger, 1850)
			Neurothemis sp. (Brauer, 1867)
		Coenagrionidae	*Ischnura sp.*(Charpentier, 1840)
			Pseudagrion sp. (Selys, 1876)
5.	Ephemeroptera	Baetidae	*Cloeon sp.* (Leach, 1815)
			Baetis sp. (Leach, 1815)
6.	Hymenoptera	Formicidae	*Polyrhachis sokolova* (Forel, 1902)

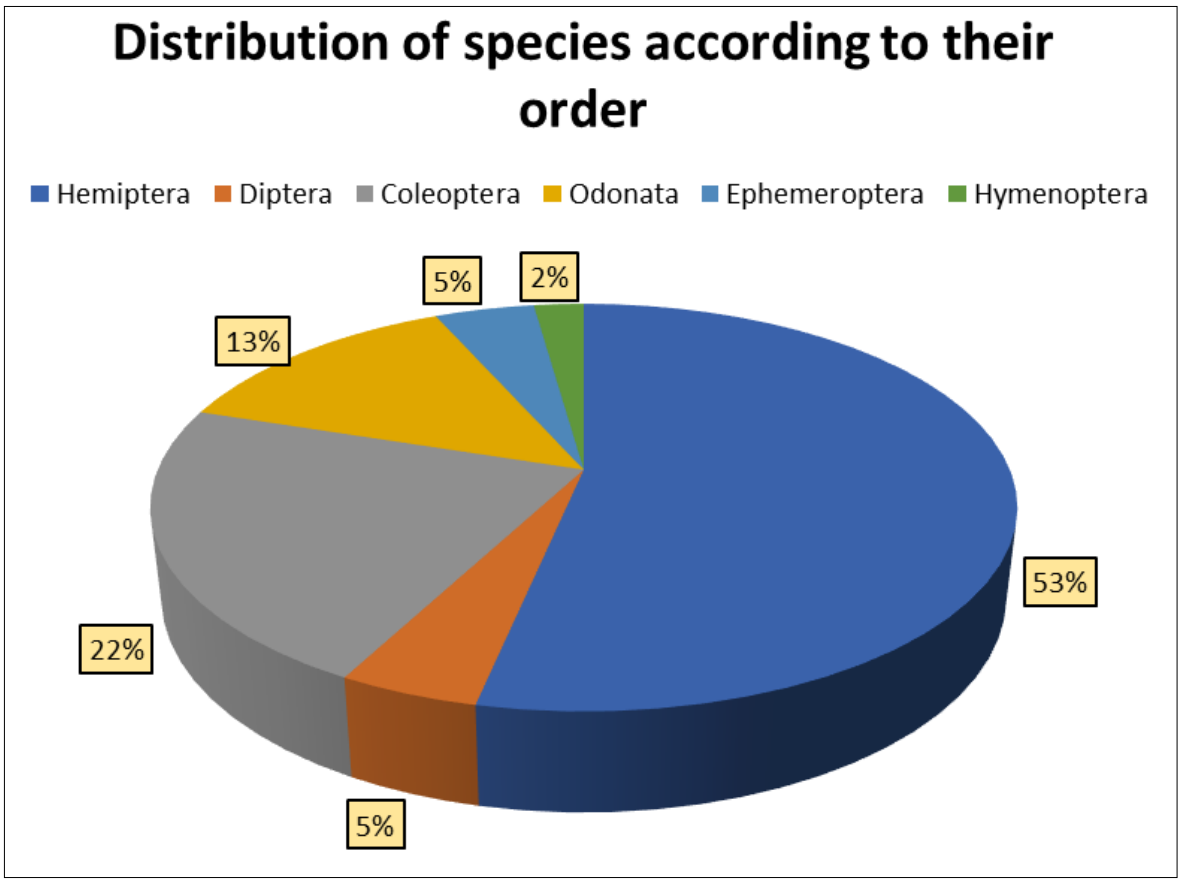

Fig 2: Order wise distribution of aquatic insects species


Gerris lacustris


Ranatra sp.


Nepa apiculata


Belostoma sp.


Cybister chinensis


Diplonychus rusticus

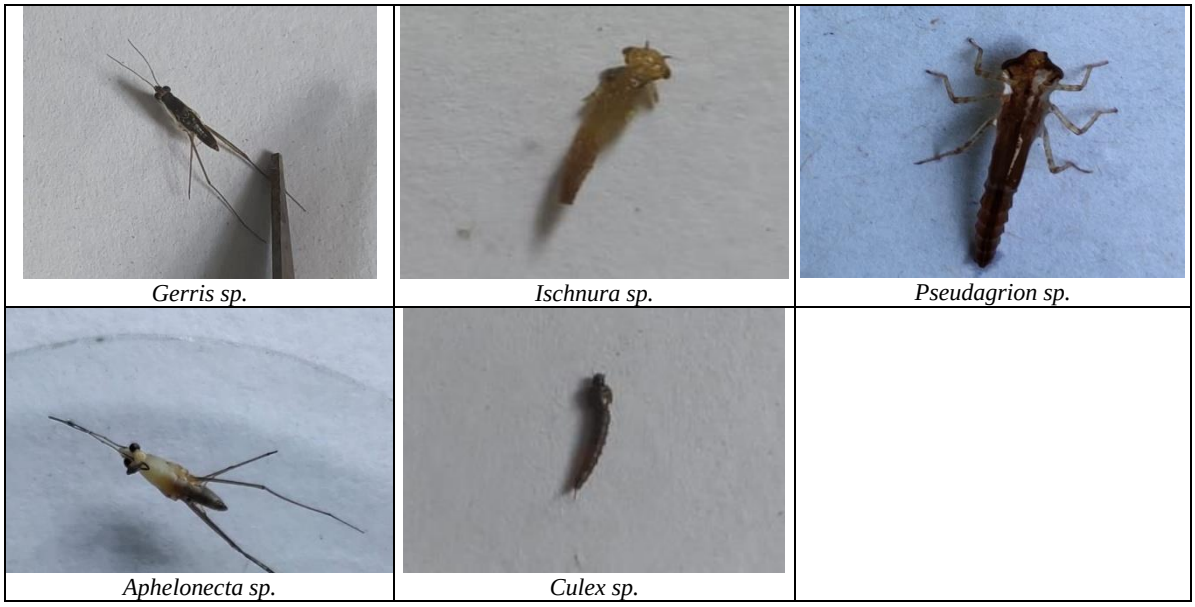

Plate 1: Images of aquatic insects of Samaguri beel.

Thus, from the present study, it was found that the order Hemiptera is the most abundant and diverse one which is followed by Coleoptera and Odonata. Hymenoptera is the least abundant order among all followed by Ephemeroptera and this may be the reason that they are highly sensitive to pollution. A study conducted in a temple pond near Silchar, Cachar District, Assam, in different seasons recorded 7 families, 11 genera, and 14 species of Hemipteran insect [20]. A survey was conducted from February to May in the year 2016 in three permanent ponds in Guwahati city, Assam and they reported 25 different species belonging to 6 orders and 13 families and the order Hemiptera represented the highest number of species (15 species) followed by coleopteran (4 species) and other orders such as Odonata (2 species), Diptera (2 species), Hymenoptera (1 species) and Ephemeroptera (1 species) [21]. However, a study conducted in West Bengal by some researchers found the insects of Odonata and coleopteran to be the most common, and another study carried out from January to March in the year 2018 in the Kaliabor subdivision of Nagaon district, Assam observed that Hemiptera (9 families including 15 genera) represents the highest number of species followed by Coleoptera (3 families including 4 genera), Odonata (2 families having 4 genera), Diptera (2 families including 2 genera), Ephemeroptera (1 family having 1 genus) and Hymenoptera (1 family including 1 genus) [22]. Chetri *et al*., (1997) investigated the aquatic insect diversity of Deepar beel and found that the number of species of the order Hemiptera was highest (17 species) followed by Coleoptera (7 species) [23]. In the same Beel, Choudhury *et al*., (2015) conducted another survey from March to November in the year 2013 they recorded 17 species and 8 families of the order Hemiptera and 7 species and 5 families of the order Coleoptera [24]. Deepa and Rao, (2007) found eight species belonging to four families and five genera of the order Hemiptera from Pocharam Lake, Andhra Pradesh [25]. Bhattacharya *et al*., (1998) described 8 species in association with Eichhornia crassipes in some freshwater wetlands of West Bengal [26]. Another study was conducted in two pond ecosystems at Gauhati University Assam from July 2007 to June 2008. A total number of 14 species were recorded belonging to seven families [27]. According to a study conducted by Gupta *et al*. (2013) in an oxbow lake (Phulbari anua) in Cachar, Assam from February to April 2010 found that there were 9 species belonging to 9 families and 4 orders [28]. The number of recorded species in the present study signifies the rich diversity of aquatic in the Samaguri beel.

Conclusion

This is the preliminary investigation of the aquatic insect diversity of Samaguri beel, Nagaon, Assam. The current study concludes that Samaguri Beel is rich in aquatic insects even after being unexpectedly faced with several anthropogenic interruptions such as overfishing, use of toxic chemicals like DDT, dynamite, and carbide by local people, dumping waste materials and washing clothes with detergent in the beel, etc. Moreover, there is very limited information about the diversity and abundance of aquatic insects in freshwater bodies in Assam and thereby requires further studies in this area. The present study shall help the future researchers by providing baseline data for research and improvement of conservation planning for aquatic resources.

Competing Interests

All the authors agree to the publication of this paper and they don't have any conflict of interest with any party. They have no involvement that might raise questions of bias in this reported work or its conclusions.

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References

1. Hershey AE, Lamberti GA, Chaloner DT, Northinton RM. Aquatic insect ecology. Ecology and Classification of North American Freshwater Invertebrates, 2010, 659-694.

2. Dalal A, Gupta S. Rapid bioassessment of Magura haor (Floodplain wetland), Cachar District, Assam, India using aquatic insects. Current World Environment,2015:10(1):296.
3. Dunba MJ, Warren M, Extence C, Baker L, Cadman D, Mould DJ, Hall J, *et al*. Interaction between macroinvertebrates, discharge and physical habitat in upland rivers. Aquatic Consevation: Marine and freshwater Ecosystem, 2010, S31-S44.
4. Gullan PJ, Cranston PS. The Insects: An Outline of Entomology. Wiley-Blackwell, 2010.
5. Carignan V, Villard MA. Environmental Monitoring. France, 2004, 567-581.
6. USU. Extension UtahState university. Logan: utah state university, 2020.
7. Kovacs M. Biological indicators in environmental protection. new york: Eills Horwood Limited, 1992.
8. Mittermeier RA, Mittermeier CG, Gil PR. Megabiodiversity: Earth's Biologically Wealthiest Nations. Mexico: CEMEX, 2005.
9. WCMC, World Conservation Monitoring Centre. Freshwater Biodiversiy: a preliminary global assessment. England: WCMC - World Conservation Press, 1998.
10. Kubendran T, Krishnan SM, Selvakumar C, Sindhu AK, Nair A. Composition and Trophic Categorization of Aquatic Insects and Bio-monitoring Potential of Selected Hill Streams of Western Ghats, India. International Journal of Ecology And Environmental Science, 2018.
11. Balachandhdran C, Dinakaran S, Chandran MDS, Ramachandra TV. DIVERSITY AND DISTRIBUTION OF AQUATIC INSECTS IN AGHANASHINI RIVER OF CENTRAL WESTERN GHATS, INDIA. Banglore: Energy and wetland rsearch group, 2012.
12. Subramanian KA, Sivaramakrishnan KG. Habitat and microhabitat distribution of stream Insect communities of the western ghat, 2005, 89(6).
13. Thirumalai G. A Checklist Of Aquatic And Semi-Aquatic Hemiptera (Insecta) Of Karnataka. Tamil Nadu: Southern Regional Station, Zoology Survey Of India, 2004.
14. Sivaramakrishnan KG, Venkataraman K, Moorthy RK, Subhramanian KA. Aquatic Insect Diversity and Ubiquity of the streams of the Western Ghats, India. Journal Of The Indian Institute of Science, 2000, 537-552.
15. Nautiyal P, Mishra AS. Distributional patterns of bentic macroinvertebrate fauna in different ecoregions of India. Uttarakhand: transmedia, Srinagar, 2011.
16. Smakhtin V, Arunachalam M, Behera S, Chatterjee A, Das S, Gautam P, *et al*. Developing procedures for assessment of ecological status of india river basins in the context of environmental water requirements. India: IWMI, 2007.
17. Sivaramakrishnan KG, Job SV. STUDIES ON MAYFLY POPULATIONS OF COURTALLAM STREAMS. Calcutta: Proceedings of a Symposium on Ecology of Animal Populations, Zoological Survey of India, 1981.
18. NESAC ISRO. Assam wetlands needs protection. assam: the sentinel, 2021.
19. Patil PN, Sawant DV, Deshmukh RN. Physico-chemical parameters for testing of water–A review. International journal of environmental sciences,2012:3(3):1194-1207.
20. Das K, Gupta S. Seasonal variation of Hemiptera community of a temple pond of Cachar District, Assam, Northeastern India. Journal of threatend taxa, 2012, 3050-3058.
21. Hasan I, Haloi DJ, Chetri S, Begum S. Biodiversity of aquatic insect population in three permanent ponds of Guwahati, Assam, India. International Journal Of Fisheries And Aquatic Studies, 2016, 271-275.
22. Mahanta M, Das GC, Saikia D, Saikia P, Goswami H. A study on the diversity of aquatic insect communities of Kaliabor Subdivision, Nagaon, Assam. International Journal of Scientific Research in Science and Technology, 2018, 1894-1896.
23. Chetri G, Sheikh MS, Kalita J, Dutta A. Population abundance of aquatic insects in Deepar Beel Assam. Insect Environment, 1997, 14-15.
24. Choudhury D, Gupta S. Aquatic insect community of Deepor beel (Ramasar site), Assam, India. Journal of Entomology and Zoology Studies, 2015, 182-192.
25. Deepa J, Rao C. AQUATIC HEMIPTERA OF POCHARAM LAKE, ANDHRA PRADESH. Zoo's Print Journal, 2007, 2937-2939. DOI:10.11609/JOTT.ZPJ.1599.2937-9
26. Bhattacharya D, Aditya AK, Haldar P. Insect fauna associated with large waterhyacinth in fresh water wetlands of west bangal. Proceedings of the National Seminar on Environmental biology. Delhi: Daya Publishing house, 1998, 145-147.
27. Hazaika R, Goswami MM. Aquatic Hemiptera of Gauhati University, Guwahati, Assam, India. Journal Of Threatend Taxa, 2010, 778-782.
28. Gupta S, Narzary R. Aquatic insect community of lake, Phulbari anua in Cachar, Assam. journal of environment biology, 2013, 591-597.