International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 11-12-2021, Accepted: 27-12-2021, Published: 12-01-2022
Volume 7, Issue 1, 2022, Page No. 42-45

Aquatic insect (Coleoptera and hemiptera) diversity in relation to physico-chemical parameters in Dora beel, Assam, India

Barsha Bhagabati[1], Sasanka Sekhar Ghosh[2*], Karobi Saikia[3], Parag Deka[1]
[1] Department of Zoology, Pandu College, Guwahati, Assam, India
[2] Department of Zoology, Cotton University, Assam, India
[3] Department of Zoology, University of Science and Technology, Meghalaya, India

Abstract
Dora beel is one of the three most important beel of the South Kamrup region. The beel has a recorded population of over 50 fish species, more than 25 bird species, and over 40 species of macrophytes. Although aquatic insects play an important role in maintaining this ecologically important wetland, there is no record of studies related to aquatic insects in this wetland. The study is an attempt to enumerate the aquatic insect population of the wetland. During the study, 6 species belonging to 3 families of order Coleoptera and 8 species belonging to 6 families of order Hemiptera were recorded. The DO level recorded was on the lower side, indicating organic pollution and thus steady degradation of the wetland.

Keywords: aquatic insects, wetland, coleoptera, hemiptera, conservation

Introduction
The loss of biodiversity faced by the world, is a major global issue, and going by the current rate of decline in species population-which has been forecasted for progressing into extinction is unparalleled in history (Barnosky *et al*., 2011; Pimm and Raven, 2000) [8, 28]. According to Sanchez-Bayo & Wyckhus Kris (2019) [29], the estimate of the current proportion of insect species decline is 41% which is twice as high as that of vertebrates, and the pace of local species extinction which is at 10% is eight times higher, confirming the previous findings (Dirzo *et al*., 2014) [15]. Moreover, every year, about 1% of all insect species are added to the list, which sees a biodiversity decline resulting in an annual 2.5% loss of biomass worldwide (Bayo & Wyckhus Kris, 2019) [29]. Yet, until recently, the attention of this loss by both the scientific and public community has been accorded to the more appealing vertebrates, particularly mammals and birds (Ceballos and Ehrlich, 2002; Manne *et al*., 1999) [10, 24], whereas insects are routinely underrepresented in biodiversity and conservation studies despite their paramount importance to the overall functioning and stability of ecosystems worldwide (Fox, 2013) [19]. Assam is rich in aquatic resources, having about 3.65 lakh hectares of water area, with its wetlands exhibiting high faunal diversity supported by sub-tropical climate, suitable ecological and geographical conditions, and auto-stocking capacity (Barman and Baruah, 2015) [7]. But most of its research on the bio resources of these wetlands leaves out one of the most important components, its aquatic insects. There are over 85000 species of aquatic insects under 13 orders (Huryn, 2019; Dijkstra, 2014) [20, 16]. Aquatic insects are known to play a very significant role in the processing and cycling of nutrients and contribute to the secondary production of the freshwater ecosystem they inhabit (Star and Wallace, 2021) [32]. They are an important part of the trophic structure of the freshwater ecosystem as they belong to several specialized feeding groups such as shredders, filter feeders, depositor collectors, and predators (Barman and Gupta, 2015; Badal, 2010) [7, 3], along with being food sources for vertebrate and invertebrate predators (Star and Wallace, 2021) [32]. Aquatic insects are considered a very good indicator of water quality because of their wide range of environmental disturbance tolerant levels (Crowder and Cooper, 1982) [11]. In recent times, they are used as biological tools and biological indicators to determine the water quality based on the type and number of species present along with physicochemical parameters of the water body (Barman and Gupta, 2015) [7]. Despite its immense contribution to the freshwater ecosystem, the information available on the abundance and diversity of aquatic insects in Assam is scanty (Choudhury and Gupta, 2015). The present study was carried out to contribute to the research gap on the taxonomy and diversity of aquatic insects of the region.

Study site
Dora beel is a wetland of the South Kamrup district of Assam, India. Southern Kamrup region is rich in flood plain wetland diversity, with Dora beel being one of the three most important wetlands in the region, the other two being Chandubi and Salsala wetlands. The wetland lies between 26°04’48” N latitude to 26°05’27” N latitude and 91°26’37”E longitude to 91°27’37” E longitude. It is located on the south bank of the river Brahmaputra and is located nearby the Kulsi (Kolohi) tributary under Palashbari Revenue Circle (https://nenow.in/opinion/save-dora-beel-save-river-dolphin.html). In the monsoon period, the beel is connected to the Kulsi River. Dora beel is an Oxbow wetland of the river Kulsi that has a remarkable impact on the Dolphin Population of the river because of its characteristics as an established breeding ground of fishes. It is a naturally made ecosystem and assumed ox-bow shaped, oblong, and irregularly shaped shoreline and a floodplain wetland in the south bank of river Brahmaputra. Though the

water retention type of the beel is found to be perennial but marked drying up of the wetland has been observed during (winter) the study period. The wetland supports around 10 villages namely, Rajapukhuri, Nahira, Bhakatpara, Tezpur, Rampur, Majpara, Kuldung, Dhantola, Bortari, and Khidirpukhuri (Das, 2015) [13]. The depth of the wetland varies between 1-6 meters during the dead storage to full storage level.

Materials and Methodology

The study was conducted from December 2018 to November 2019. The sampling zones were stratified based on the occurrence and density of macrophytes species (vegetation type) and presence of insects, following the procedure laid out by Barman and Baruah, 2015 [7]. The wetland was divided into five zones namely North zone, South zone, Central zone, East Zone, and West Zone. Independence was ensured by randomly having the replicate sampling within the sampling zone separated from one another by enough space and time to ensure that they do not affect one another. Aquatic insects were collected at the above-mentioned five sampling zones in three replicates (Dalal and Gupta, 2016) [12]. A nylon pond net (mesh size: 500 mm; diameter: 30 cm; depth: 15 cm) was used to collect the aquatic insects on the water surface. To collect aquatic insects from the substratum in the wetland an 'all-out search' method was employed (Subramanian and Sivaramakrishnan, 2007) [33]. The samples were collected by submerging the net and sweeping it through the water column. Again the net was bumped against the bottom substrate to dislodge and collect the organisms from the sediment. For the collection of a benthic insect community, the bottom mud scraper with a tow-line was used. For a sampling of insects from the vegetated zone, a small sieve and hand-operated 'D' framed sweep net of the size 50 cm length, 25 cm breadth with mesh size 200 µm was used as per Junk (1977) [22]. After collection organisms were washed and scrubbed from the larger substrate materials. In the laboratory, the organisms were sorted from the finer residual debris by elutriation and handpicking from a white enamel pan and transferred to fresh 70% alcohol. Insects were identified with the help of a simple dissecting microscope and a stereo zoom microscope following standard keys (Bal and Basu, 1994a; Bal and Basu 1994b; Biswas and Mukhopadhyay, 1995; Epler, 2006; Epler, 2010; Khan and Ghosh, 2001; Subramanian and Sivaramakrishnan, 2007) [4, 5, 9, 17, 18, 23, 33].

Physico-Chemical parameters

Air temperature (AT) was measured using a mercury bulb thermometer (Dalal and Gupta, 2016) [12]. Dissolved oxygen (DO) was estimated using Winklers' method and other water parameters were analyzed following APHA (2005) [2], Trivedy and Goel, (1984) [34].

Statistical analysis

Statistical analysis is done with the help of PAST statistical software version 4.03

Results

Physico-chemical parameters

The physico-chemical parameters during the four seasons of the year is depicted in Table 1.

Table 1: Physico-chemical parameters of Dora beel (2018-19)

Parameters	Monsoon	Retreating Monsoon	Winter	Pre Monsoon
Air Temp C°	32.52 ± 3.91	29.2 ± 2.55	18.6 ± 1.08	23.44 ± 2.079
Water Temp C°	28.38 ± 1.22	26.22 ± 0.42	17.8 ± 0.46	19.94 ± 2.34
pH	7.14 ± 0.17	6.87 ± 0.05	6.7 ± 0.18	6.86 ± 0.005
DO (mg/L)	5.52 ± 0.08	5.26 ± 0.13	5.28 ± 0.13	5.24 ± 0.19
FCO_2	2.24 ± 0.18	1.96 ± 0.05	1.8 ± 0.22	1.7 ± 0.1
Water depth (m)	3.48 ± 0.86	2.012 ± 0.09	1.2 ± 0.1	1.525 ± 0.22

Aquatic Insects (Coleoptera and Hemiptera)

During the study, 6 species belonging to 3 families of order Coleoptera and 8 species belonging to 6 families of order Hemiptera were recorded (Table 2). The alpha diversity indices are presented in Table 3

Table 2: Aquatic insects (Coleoptera and Hemiptera) found in Dora beel (2018-2019)

Order	Family	Scientific Name
Coleoptera	Hydrophilidae	*Berosus pulchellus* M'cleay, 1825, *Helochares pallens* (Macleay, 1825), *Coelostoma stultum* Walk, 1858
	Dysticidae	*Laccophilus* sp. *Cybister (Cybister) ventralis* (Sharp, 1882)
	Gyrinidae	*Orectochilus (Patrus) productus* Regimbart, 1883
Hemiptera	Corixidae	*Micronecta siva* (Kirkaldy, 1897)
	Notonectidae	*Anisops bouvieri* (Kirkaldy, 1904)
	Hydrometridae	*Hydrometra greeni* Kirkaldy, 1898
	Nepidae	*Ranatra filiformis* (Fabricius, 1790), *Ranatra varipes* (Stål, 1861)
	Belostomatidae	*Lethocerus indicus Diplonychus rusticus* (Fabricius, 1781)
	Gerridae	*Neogerris parvula*

Table 3: Diversity Indices of the aquatic insects of Dora Beel

	Pre Monsoon	Monsoon	Retreating Monsoon	Winter
Individuals	251	235	173	71
Shannon_H	2.479	2.492	2.497	2.39
Evenness_e^H/S	0.8522	0.8628	0.8673	0.7797

Discussion

The productivity of the freshwater community is regulated by the dynamics of its physicochemical and biotic environment (Wetzel, 2001) [37] and therefore it is important to study the seasonal variation of physicochemical properties of water (Deka, 2015) [14]. During the study, it was observed that Dora beel maintains a low average water temperature. All metabolic and physiological activity including life processes such as feeding, reproduction, movements, and distribution of aquatic organisms is greatly influenced by water temperature (Sivakumar and

Karuppasamy, 2008) [31]. The temperature variation recorded during the study were within the acceptable range (FEPA, 1991) [25]. The dissolved oxygen level (DO) is also maintained at a lower level but it is above the threshold level required for the sustainable living of the aquatic insects. Deficient DO levels indicate poor water quality and thereby stand as an indicator of organic pollution. The free carbon dioxide (FCO2) levels are also recorded to be on the lower side. Low levels of FCO2 may be attributed to its quick utilization by the autotrophs including phytoplankton and macrophytes (Adoni and Vaishya, 1985) [1]. The pH value shows fluctuations in the range between weak acidic to near neutral in Dora beel. The higher pH of water recorded in summer and monsoon months may be attributed to high phytoplankton density, which utilizes CO2 during photosynthetic activity (Wani and Subla, 1990) [36]. The autumn and winter fall of pH may be due to low activity of photosynthesis and a higher rate of decomposition (Deka, 2015) [14]. During the study, 6 species belonging to 3 families of order Coleoptera and 8 species belonging to 6 families of order Hemiptera were recorded. The total number of individuals recorded was highest in the pre-monsoon season and lowest in the winter season, which is because water level reaches its lowest point during the winter season, with it being dead zero in certain areas of Dora beel. The α-diversity indices indicate a good species diversity in Dora beel. The Shannon_H index for diversity has a range of 0-5, with good community composition falling with the range of 1.5-3.5 (Turkmen and Kazanci, 2010) [35].

In the present study, the index varied from 2.479 to 2.39 during the study period which indicates a good species diversity. Accordingly, the evenness also showed a healthy variation from 0.85 to 0.77 during the study period, which suggests that the species are evenly distributed.

Thus, the studied structure and composition of the aquatic insect communities are well reflected with the variation shown in the physicochemical water parameters of the beel.

Conclusion

Aquatic insects are an important part of the freshwater ecosystem and they are regularly included in freshwater ecological research.

The Dytiscidae family members of the order Coleoptera play an important role in mosquito control (Jaiswal, 2013) [21] and so does aquatic hemipterans such as those belonging to Belostomatidae & Nepidae families (Ohba *et al*., 2006; Saha *et al*., 2007) [26]. However, the important role they play in managing the aquatic ecosystem is often not recognized.

The lower levels of DO in Dora beel are reflective of organic pollution and any more changes in the physicochemical properties of water can adversely affect the community structure of aquatic insects in the Beel.

This will in turn lead to the productivity decline of Dora beel and ultimately its degradation.

Thus urgent steps are required to document the aquatic insect diversity of the freshwater ecosystem of the region as its presence or absence can indicate whether the system is healthy or not (Prakash and Verma, 2020) [27] and take necessary remedial steps thereafter.

Acknowledgement

The authors would like to thank the Department of Biotechnology, Government of India for providing financial support for the research through ongoing project no. BT/PR25157/NER/95/1317/2017.

Conflict of Interest

The authors declare that there is no conflict of interest.

Reference

1. Adoni A, Vaishya AK. Phytoplankton productivity: Seasonal, diel and vertical periodicity in a central Indian reservoir. In Proccedings of National, Symposium on Pure and Applied Limnology, (ed) Adoni Sagar, 1985, 219-229.
2. APHA. Standard methods for examination of water and wastewater. 21st Edn, Washington D.C, 2005.
3. Badal S. Correlation between significant physico-chemical components and fresh water macro-invertebrate faunal diversity of Sagar Lake. *Ph. D thesis*, Dr H. S. Gour A Central University, Sagar, (M.P.), 2010.
4. Bal A, Basu RC. Insecta: Hemiptera: Mesovelidae, Hydrometridae, Veliidae and Gerridae, Zoological Survey of India, Culcutta. State fauna Series 3, Fauna of West Bengal,1994a:5:511-534.
5. Bal A, Basu RC. Insecta: Hemiptera: Belostomatidae, Nepidae, Notonectidae and Pleidae, Zoological Survey of India, Culcutta. State fauna Series 3, Fauna of West Bengal,1994b:5:535-558.
6. Barman A, Baruah B. Macrophyte preference and aquatic entomofaunal diversity of Kapla beel, a Fresh water wetland of Barpeta district of Assam, India. Asian Jorurnal of Science and Technology,2015:6: 1205-1210.
7. Barman B, Gupta S. Aquatic insects as bio-indicator of water quality-A study on Bakuamari stream, Chakras hila Wildlife Sanctuary, Assam, North East India. Journal of Entomology and Zoology Studies,2015:3(3):178-186.
8. Barnosky AD *et al*. Has the Earth's sixth mass extinction already arrived? Nature,2011:471:51-57.
9. Biswas S, Mukhopadhyay P. Insecta: Coleoptera: Hydrophilidae. Zoological Survey of India, Calcutta. In: State fauna Series 5: Fauna of West Bengal,1995:6a:143-168
10. Ceballos G, Ehrlich PR. Mammal population losses and the extinction crisis. Science,2002:296:904-907.
11. Crowder LB, Cooper WE. Habitat structural complexity and the interaction between bluegills and their prey. Ecology,1982:63:1802-1813
12. Dalal A, Gupta S. A comparative study of the aquatic insect diversity of two ponds located in Cachar District, Assam, India. Turkish Journal of Zoology,2016:40:392-401
13. Das I. Degradation of wetland environment: a case study of Dora Beel of Kamrup District, Assam. IOSR Journal of Humanities and Social Science,2015:20(1):23-29.
14. Deka P, Goswami MM. Heleoplankton productivity at lower trophic level in two types of aquaculture ponds, Guwahati, Assam. International Journal of Fisheries and Aquatic Studies,2015:3(1):57-61.
15. Dirzo R, Young HS, Galetti M, Ceballos G, Isaac NJB, Collen B. Defaunation in the Anthropocene. Science,2014:345:401-406.
16. Dijkstra KDB, Monaghan MT, Pauls SU. Freshwater

biodiversity and insect diversification. Annual Review of Entomology,2014:59:143-163.
17. Epler JH. Identification Manual for the Aquatic and Semi-Aquatic Heteroptera of Florida, Division of Water Resource Management. Florida Department of Environmental Protection, 2006.
18. Epler JH. The water beetles of Florida. An identification manual for the families. State of Florida, Department of Environmental Protection Division of Environmental Assessment and Restoration Tallahassee, 2010.
19. Fox R. The decline of moths in Great Britain: a review of possible causes. Insect Conservation Divers,2013:6:5-19.
20. Huryn AD, Wallace JB. Habitat, life history, secondary production, and behavioral adaptations of aquatic insects. In An Introduction of Aquatic Insects of North America, 5th ed.; Merritt, R.W., Cummins, K.W., Berg, M.B., Eds.; Kendall Hunt Publishing Company: Dubuque, IA, USA, 2019, 65-116.
21. Jaiswal D. Aquatic Insects of Lakes in and around Hyderbad (Hempitera and Coleoptera). The zoological Survey of India, Occasional. (Published by the Director, Zoological Survey of India, Kolkata),2013:350:1-51.
22. Junk WJ. The Invertebrate fauna of floating vegetation of Bong Barapet, a reservoir in Central Thailand. Hydrobilogica,1977:53:229-238.
23. Khan RA, Ghosh LK. Faunal Diversity of Aquatic insects in Freshwater Wetlands of South eastern West Bengal. Occasional, Records of Zoological Survey of India, 2001, 194.
24. Manne LL, Brooks TM, Pimm SL. Relative risk of extinction of passerine birds on continents and islands. Nature,1999:399:258-261.
25. Nigeria. Federal Environmental Protection Agency. Guidelines and Standards for Environmental Pollution Control in Nigeria. Federal Environmental Protection Agency (FEPA), 1991.
26. Ohba SY, Nakasuji F. Dietary items of predacious aquatic bugs (Nepoidea: Heteroptera) in Japanese wetlands. Limnology,2006:7(1):41-43.
27. Verma AK, Prakash S. Limnological studies of Semara Taal, a wetland of district Siddharthnagar, Uttar Pradesh, India. Journal of Fisheries and Life sciences,2020:5(1):15-19.
28. Pimm SL, Raven P. Extinction by numbers. Nature,2000:403:843
29. Sanchez-Bayo F, Wyckhus Kris AG. Worldwide decline of the entomofauna: A review of its drivers. Biological Conservation,2019:232:8-27
30. Saha N, Aditya G, Saha GK. Prey preferences of aquatic insects: potential implications for the regulation of wetland mosquitoes. Medical and veterinary entomology,2014:28(1):1-9.
31. Sivakumar K, Karuppasamy R. Factors affecting productivity of phytoplankton in a reservoir of Tamilnadu, India. American-Eurasian Journal of Botany,2008:1(3):99-103.
32. Starr SM, Wallace JR. Ecology and Biology of Aquatic Insects. Insects,2021:12:51. https:// doi.org/10.3390/ insects12010051
33. Subramanian KA, Sivaramakrishnan KG. Aquatic Insects of India-A field guide. Ashoka Trust for Research in Ecology and Environment (ATREE) Small Grants Programme, 2007.
34. Trivedy RK, Goel PK. Chemical and Biological Methods for Water Pollution Studies. Environmental Publication, Karad, India, 1984, 211-215.
35. Turkmen G, Kazanci N. Applications of various biodiversity indices to benthic macro invertebrate assemblages in streams of a national park in Turkey. Review of Hydrobiology,2010:3:111-125.
36. Wani IA, Subla BA. Physico-chemical features of two shallow Himalayan lakes. Bulletin of. Environmental Science,1990:8:33-49.
37. Wetzel RG. Limnology: lake and river ecosystems. Gulf professional publishing, 2001.