International Research Journal of Biological Sciences _____ ISSN 2278-3202
Vol. **2(8),** 1-4, August **(2013)** *Int. Res. J. Biological Sci.*

Estimating ecosystem health of shallow water pond in lower Irongmara, Barak Valley, Assam, India using ASPT, SPI and BWMP Score

Purkayastha Pinki and Gupta Susmita*
Dept. of Ecology and Environmental Science, Assam University, Silchar 788011, INDIA

Available online at: www.isca.in
Received 18th February 2013, revised 22nd May 2013, accepted 26th July 2013

Abstract

Current study was carried out in a community pond located in lower Irongmara, Barak Valley, Assam. Water of the pond is regularly utilized for domestic purpose, fish culture and rarely for drinking purpose. Present study reported aquatic insect order Hemiptera as the only order throughout the year. Among Hemipterans, family Notonectidae showed highest relative abundance (97%) followed by family Gerridae (3%). Neogerris parvula Stål, Anisops barbata Brooks and Enitheres fusca Brooks are the aquatic insect species recorded from the pond. Except concentration of Phosphate, all other physic-chemical parameters were found within permissible limit. Shannon Diversity index values, ASPT, SPI , BWMP score of pond suggest, despite good ecological potential human induced activities are responsible for degradation of habitat quality. Biological monitoring of any water body using different biotic scores along with physico-chemical analysis of water quality can display total health status of a particular water body.

Keywords: Pond, Physico-chemical parameters, aquatic insects, Hemiptera, diversity, abundance.

Introduction

Water is a vital natural resource that provides habitat to large number of organisms. Its uses may include drinking and other domestic uses, industrial cooling, power generation, agriculture, transportation and waste disposal[1]. Ponds, streams, rivers, marsh etc. form the major sources of fresh water on the earth surface. Though ponds are smaller in size still they cater to the day to day needs of the people particularly of the rural areas. A pond is referred to as a man-made or natural water body which is between 1 m^2 and 2 ha (~5 acres or 20,000 m^2) in area, which holds water for four months of the year or more[2]. Good water quality is necessary for providing us with drinking water that is safe and clean; for providing habitat for aquatic bugs, plants, and animals; for providing recreational opportunities like wading, swimming, and fishing; and for providing a place for us to connect with nature[3]. Primarily the physical and chemical environment shapes community structure of an ecosystem[4]. Characteristics of water bodies influence the quality of water individually and also in combination with various pollutants[5]. Urbanization and industrial activities have done much harm to the natural and aquatic environment[6]. Source of surface water and ground water have become increasingly contaminated due to increased industrial and agricultural activity[7]. Pollution and loss of wetland has disastrous effects on wildlife and biodiversity[8]. Aquatic insects are known as the indicator organisms, used for biomonitoring of environmental health. They serve as food for fishes and other invertebrates and at the same time they act as vectors through which disease pathogens are transmitted to both humans and animals[9,10]. They provide information to environmental managers and decisions makers to take accurate and justifiable actions in regards to the state and quality of water bodies[11]. Now a days, different biotic score systems are widely applied to assess water quality of ponds, lakes, streams as well as rivers. The Biological Monitoring Working Party (BMWP) Score is an index for measuring the biological quality of rivers using species of macro invertebrates as biological indicators[12]. This index has largely superseded previous indices such as the Trent Biotic Index and Chandler Biotic Score, and is widely used by organizations such as the Environment Agency. Similarly, Average Score Per Taxon (ASPT) is also utilized for estimation of water quality[13]. In the present study, an attempt has been made to analyze ecological status of a particular pond, which is prone to continuous human induced disturbances in the form of bathing, cleaning, fishing including unscientific management practices etc.

Material and Methods

Current study was carried out in a community pond (69.597 N, 92.72972 E) located in lower Irongmara, Barak Valley, Assam; figure-1. Water of the pond is regularly utilized for domestic purpose, fish culture and rarely for drinking purpose. Water and aquatic insect samples were collected in three replicates from the pond during post monsoon (September-November 2009), winter (December–February 2010), pre monsoon (March-May 2010) and monsoon (June-August 2010). Physico-chemical parameters such as Air temperature (AT), Water temperature (WT), pH, Electrical Conductivity (EC), Dissolved oxygen (DO), Free CO_2, Total alkalinity (TA), Nitrate (NO_3), Phosphate (PO_4) and ammonium (NH_4) content of water samples were analyzed by standard methods[14,15]. The aquatic insects were collected by kick method whereby the vegetation was disturbed and the circular net (mesh size 60µm) was dragged around the

vegetation for one minute[16,17]. Collected insects were immediately sorted and preserved in 70% ethyl alcohol. They were later identified using Dewinter advance stereozoom Microscope with the help of standard keys[18-24]. A number of identified insects were confirmed in the entomological laboratory of Zoological Survey of India. Average Score Per Taxon (ASPT) and biological monitoring working party (BMWP) scores were determined by standard methods (Pond Action website). Statistical analyses were made by SPSS 10 and Biodiversity professional version 2 for Windows.

Figure-1
Map of the study site

Results and Discussion

Physico-chemical properties of the water of the pond studied (N=12) are shown in table 1. Except concentration of phosphate, all other parameters were found within permissible limit[25-29]. Significant correlations among physico-chemical parameters, diversity and density of aquatic insects are shown in table 2. Aquatic insect order Hemiptera was the only order recorded throughout the study period. Among Hemipterans, family Notonectidae showed highest relative abundance (97%) followed by family Gerridae (3%) as presented in figure-2. Notonectidae being one of the most tolerant families indicate the polluted and adverse nature of aquatic habitat[30]. *Neogerris parvula* Stål, *Anisops barbata* Brooks and *Enitheres fusca* Brooks are the aquatic insect species recorded from the pond. *Enitheres fusca* showed maximum relative abundance (54%) followed by *Anisops barbata* (43%) and *Neogerris parvula* (3%); figure-3. In fact, *Anisops barbata* Brooks, *Enitheres fusca* Brooks were recorded from the pond in each of the season during entire year of study however *Neogerris parvula* was recorded during Post Monsoon only as shown in table 4. Shannon diversity index, Evennness index and Berger-Parker index of dominance calculated for the pond are shown in table-5. The evenness index value (0.97) and Beger Parker dominance value (0.58) suggested more or less even distribution of aquatic insects in the pond studied. Shannon diversity index value (0.33) indicated the polluted nature of the pond along with degradation of habitat structure[31] . Domestic releases into the water body is the main reason behind polluted nature of the waterbody. As the pond is prone to continuous human induced disturbances, it lacks any kind of aquatic vegetation or macrophytes. Overfishing, use of fine mesh nets and removal of macrophytes are the other major reasons behind habitat degradation of this pond. Due to lack of proper scientific awareness, villagers consider macrophytes as unwanted weeds and promote their removal. Hydrophytes provide anchorage, natural hiding places, protection from rapid disturbances of water, provide more oxygen and afford suitable sprawling niche[32,33]. Aquatic insects are also considered as harmful pest in the village and there are many instances of application of pesticides for removal of aquatic insects. BWMP score, ASPT score, SPI score, status of taxa richness as well as Signal score status for the pond are shown in table 3. The ASPT value obtained form the site indicates good ecological potential (GEP) as ASPT greater or equal to the score of 4.5 indicate good ecological potential of the water body[34] But BWMP score reflect poor quality of water[35]. SPI score (SIGNAL) and Taxa richness status also reveal the water quality is affected by human activities such as agricultural pollution[36].

Table -1
Physico-chemical properties of the water of the pond studied (n=12)

Parameters	Mean	Standard dev.	Range
AT(^{0}C)	24.96	0.55	22.67-29.67
WT(^{0}C)	22.69	0.38	21.03-27.83
RF (mm)	227.17	179.19	0-426.67
pH	6.18	0.44	6.00-7.98
EC(ms/ppt)	5.83	0.14	3.977-9.15
Trans (cm)	28.29	7.65	17.33-39.25
DO (mg/l)	7.68	0.84	7.09-9.07
FCO_2(mg/l)	6.66	1.39	5.65-8.00
TA (mg/l)	24.58	2.11	11.00-30.00
NO_3 (mg/l)	1.09	0.09	0.16-1.50
PO_4(mg/l)	2.50	0.03	2.14-2.81
NO_2(mg/l)	0.13	0.01	0.01-0.23
NH_4(mg/l)	0.12	0.01	0.03-0.20

Table-2
Significant correlations among different environmental variables and diversity and density of aquatic insects

Parameters	Pearson Correlation	Parameters	Pearson Correlation
pH Vs Density	.960(*)	NH_4 Vs Diversity	.964(*)

Table-3
ASPT and BWMP scores for the pond studied

ASPT score	BWMP score	SPI score	Taxa richness	Signal Score status
5	10	1	Low	Low

Table-4
Seasonal distribution of aquatic insects recorded from the pond

Species	Post Monsoon	Winter	Pre Monsoon	Monsoon
Enitheres fusca Brooks	+	+	+	+
Anisops barbata Brooks	+	+	+	+
Neogerris parvula Stål	+	-	-	-

Table-5
Shannon diversity index, Evennness index and Berger-Parker index of dominance of aquatic insects in the pond studied

Shannon H' Log Base 10.	Shannon J'	Berger-Parker Dominance (d)
0.336	0.972	0.585

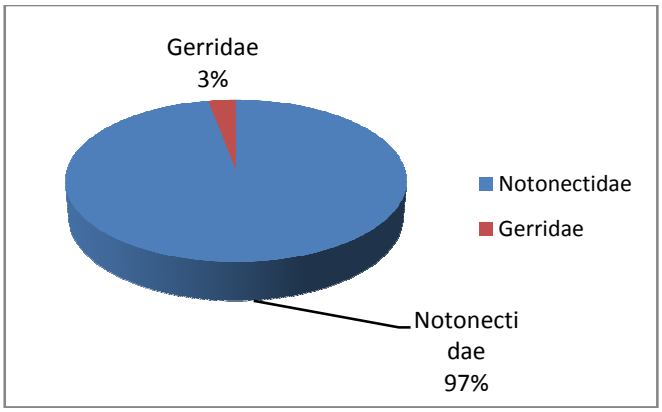

Figure-2
Relative abundance of aquatic insect families recorded from the pond

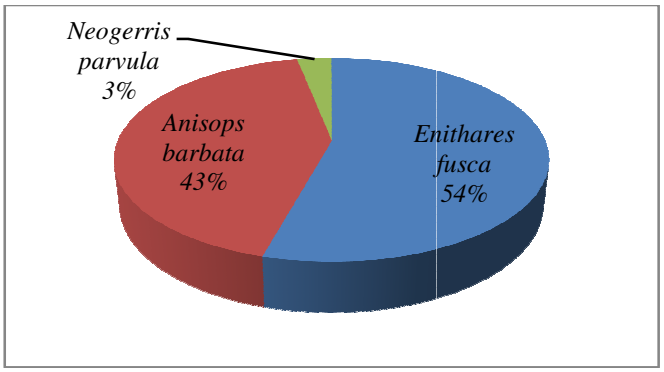

Figure-3
Relative abundance of aquatic insect species recorded from the pond

Conclusion

This study clearly stated that though the pond has good ecological potential, human induced activities have detrimental effect on it. Villagers should be made aware of the scientific ways of pond management so that they can make wise use of water. Present study also revealed that biological monitoring of any water body using different biotic scores along with physico-chemical analysis of water quality can display total health status of a particular water body.

Acknowledgement

Authors are thankful to University Grants Commission, New Delhi for financial support. Authors are also thankful to Head, Dept. of Ecology and Environmental Science for proving Laboratory Facilities.

References

1. Naik S ., Studies on pollution status of bondamunda area of rourkela industrial complex, published thesis, Dept. of Chemistry, National Institue of Technology, Rourkela **(2005)**

2. Biggs J., Williams P., Whitfield P., Nicolet P. and Weatherby A., 15 years of pond assessment in Britain: results and lessons learned from the work of Pond Conservation, Aquatic Conservation: Marine and Freshwater Ecosystems, **15**, 693–714 **(2005)**

3. Dhakal S., Urban Transportation and the Environment in Kathmandu Valley, Nepal, Institute for Global Environmental Strategies, Japan **(2006)**

4. Kulkarni D.A. and Surwase S.S., Studies on Occurrence, Richness and Composition of Zooplankton in Seena river water at, Mohal, Dist- Solapur, MS, India, *International Research Journal of Biological Sciences*, **2(2)**, 25-28 **(2013)**

5. Quadros Goldin and Athalye R.P., Decline of fish diversity in the anthropogenically polluted Thane creek along the Central West Coast of India, *International Research Journal of Biological Sciences*, **1(4)**, 17-21 **(2012)**

6. Nwajei G.E.1, Obi–Iyeke G.E.2 and Okwagi P., Distribution of Selected Trace Metal in Fish Parts from the River Nigeria, *Research Journal of Recent Sciences*, **1(1)**, 81-84 **(2012)**

7. Patil Shilpa G., Chonde Sonal G., Jadhav Aasawari S. and Raut P.D., Impact of Physico-Chemical characteristics of Shivaji University lakes on Phytoplankton Communities, Kolhapur, India, *Research Journal of Recent Sciences,* **1(2)**, 56-60 **(2012)**

8. Hashemi S.A.R., Eskandary G. and Ansary H., Biomass of Fish Species in the Shadegan Wetland, IRAN, *Research Journal of Recent Sciences,* **1(1)**, 66-68 **(2012)**

9. Foil L.D., Tabanids as vectors of disease agents, Parasitol, Today, **5**, 88-96 **(1998)**

10. Chae S.J., Purstela N., Johnson E., Derock E., Lawler S.P. and Madigan J.E., Infection of aquatic insects with

trematode metacercariae carrying Ehrilichia risticii, the case of the Potomac house fever, *J. Med. Entomol.,* **37**, 619-625 **(2000)**

11. Arimoro F.O. and Ikomi R.B., Ecological Integrity of upper Warri River, Niger Delta using Aquatic insects as bioindicators, *Ecol. Indic.,* **395**, 1-7 **(2008)**

12. Hawkes H.A., Origin and development of the Biological Monitoring Working Party score system, *Water Research,* **32**, 964-968 **(1998)**

13. Waterways Ireland, www.waterwaysireland.org **(2008)**

14. Michael P., Ecological Methods for Field and Laboratory Investigations, Tata Mc. Graw-Hill publishing Company Ltd., New Delhi **(1984)**

15. APHA, Standard methods for the Examination of Water and Wastewater, 19th edition, Published by American Public Health association, 1015, fifteen streets NW Washington, D.C. 20 R.C.0015 **(2005)**

16. Brittain J.E., Studies on the lentic Ephimeroptera and Plecoptera of Southern Norway, Norskent, Tidsskr, **21**, 135-151 **(1974)**

17. Subramanian K.A. and Sivaramakrishnan K.G., Aquatic insects for biomonitoring fresh water ecosystems: A methodology manual, Trust for Ecology and Environment (ATREE), Bangalore, India **(2007)**

18. Kumar A., Description of the last instar larvae of Odonata from Dehra Dun Valley (India) with notes on biology, *I. Suborder Zygoptera, Oriental Insects*, **7**, 83-118 **(1973a)**

19. Kumar A., Description of the last instar larvae of Odonata from Dehra Dun Valley (India) with notes on biology, II. Suborder Anisoptera, Oriental Insects, **7**, 291-331 **(1973b)**

20. Thirumalai G., Aquatic and semi aquatic hemiptera (Insecta) of Javadi Hills, Tamilnadu, Zool. Surv. of India, **18**, 63 **(1989)**

21. Thirumalai G., Aquatic and semi aquatic hemiptera (Insecta) of Tamilnadu-1,Dharampuri and Pudukkatai districts, Zool.Surv.India, Occasion **165**, 45 **(1994)**

22. Bal A. and Basu R.C., Insecta: Hemiptera: Mesovellidae, Hydrometridae, Veliidae and Gerridae, In: State fauna series 5, Fauna of West Bengal, India, 511-534 **(1994 a)**

23. Westfall M.J. Jr. and Tennessen K.J.(eds. Merritt R.W. and Cummins K.W.), Odonata, In: An introduction to the aquatic insects of North America,Dubuque , Kendall Hunt Publishing, IA3,164-169 **(1996)**

24. ZSI, State fauna series 10. Fauna of Manipur, (Part -2) Insects, Zoological Survey of India, Kolkata, India **(2004)**

25. Carballo E., Eer A. V., Schie T.V., Hilbrands A., Aldin Agrodok 15: Small-scale freshwater fish farming, Agromisa Foundation and CTA, Wageningen **(2008)**

26. www.fish.mongabay.com **(2013)**

27. www.petstation.com/tropicalfishcare.html **(2013)**

28. www.tropicalfishandaquariums.com **(2013)**

29. http://bcn.boulder.co.us/basin/data/ NEW /info /DO.html (City of Boulder/USGS Water Quality Monitoring, General Information on Dissolved Oxygen **(2013)**

30. Ellis I. and Meredith S., An independent review of the February 2004 lower Darling River fish deaths: Guidelines for future release effects on lower Darling River fish populations, Murray-Darling Freshwater Research Centre, Report No. 7/2004 **(2004)**

31. Turkmen G. and Kazancil N., Application of various diversity indices to benthic macro invertebrate assemblages in streams of natural park, Turkey, Balowis, Ohrid, Republic of Macedonia **(2010)**

32. Bisht R. S. and Das S.M. , Studies on ecology of aquatic entomofauna of Kumaon lakes, Proc. Workshop on high altitude entomology and wildlife ecology , ZSI, Solan **(1979)**

33. Pandit A.K., Pandit S.N . and Kaul V. , Ecological relations between invertebrates and submerged macrophytes into Himalayan lakes, *Pollution Research*, **4(2)**, 53-58 **(1985)**

34. AWBs, Waterways Ireland, Central Fisheries Board and the South East River Basin District For The Surface Water Status Group, Ireland **(2008)**

35. Bartram J. and Balance R. (eds.), Water Quality Monitoring: A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes, Published on behalf of UNEP and WHO by E & FN Spon, London **(1996)**

36. Senior water teacher guide, Autralian government, (http://www.environment.nsw.gov.au/resources/ water watch/SnrTeachGuide/20090500SeniorTeachersGuide.pdf) **(2010)**