International Journal of Biodiversity and Conservation Vol. 5(4), pp. 209-214, April 2013
Available online http://www.academicjournals.org/IJBC
DOI: 10.5897/IJBC11.268
ISSN 2141-243X ©2013 Academic Journals

Full Length Research Paper

Benthic insect diversity in the sewage fed pond of Aligarh Region

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Accepted 6 February, 2012

The paper deals with the study of benthic insect diversity of a sewage fed pond of Aligarh. Although, insects are common components of the benthic communities, their role in the dynamics of the aquatic ecosystem and their contribution to biomass production is not well known. The compostion and abundance of benthic insects are commonly used as bioindicator to determine the impact of water pollution. The present study was carried out during the period of 2009 to 2010. The overall density in the pond constitutes twenty species. Among these species, five species belongs to order Diptera, and six species are of the Order Hemiptera, four species from Coleoptera, three species from Tricophtera and two species from Ephemeroptera. Different biological indexes were used to determine the diversity, dominance, species richness and evenness of the observed benthic insect. The Shannon-Weiner diversity index in the selected water body indicated that Chautal pond is moderately polluted. The results emphasized the importance of benthic insect population which plays an important role as pollution indicator, fish food, and important component of food chain.

Key words: Benthos, insect, pollution, diversity indices.

INTRODUCTION

Benthic macro invertebrates are the animals that lack backbone, occupy the bottom of water body and are generally visible with the naked eyes. Benthos are sensitive to watershed condition and exhibit sufficient stability in assemblage structure over time to make them useful as long term monitor of stream health (Richards and Minshell, 1992) and indicator of water quality (Gauffin and Tarwell, 1952; Wilhm and Dorris, 1968; Resh, 1995). Hynes (1961) reported that the density of benthos in a water body is a useful index of water quality, though; density may fluctuate widely with changes in seasons and space. Some benthic forms are often considered to be best indicators of organic pollution because of their constant present, relatively long life span, sedentary habits and different tolerance to stress habitat (Webber et al., 1989). The benthic insects act as a secondary producer in aquatic ecosystem. They are important in food web of aquatic ecosystem. Aquatic insects also play a role in the processing of organic matter (Cummins et al., 1984). Measurement of marine benthic species diversity and the pattern of change in the diversity of soft-sediment marine benthic communities with depth have now been debated in the literature for several decades (Rex et al., 2000; Levin et al., 2001).

The distribution and diversity of benthic insect fauna vary in different season as well as warmer temperature and additional light provides them with more food than is available in deeper water. They have ecological as well as economic importance because they are consumed mainly by fish, mammals, crustacean, and birds and also serve as human food. Some of the insects have parasitological importance due to being hosts to parasitic organisms, which are agricultural pests. The study of these organisms is important due to the fact that the occurrence of some species is related to polluted areas, while for others, the presence of clean, unpolluted water is essential for their occurrence. Freshwater benthic

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insect have been known to play significant roles in the public and veterinary health and thus, needs to be scientifically explored more extensively. In the present paper, some of the basic observations on the benthic insect diversity of a derelict water body have been presented.

MATERIALS AND METHODS

This study which was carried out in February, 2009 to January, 2010 covered a sewage fed pond in Aligarh as shown in Figure 3. The sediment samples were taken seasonally. The benthic insect's collection was done at day time between 8.00 to 10.30 am.

Collection, separation and identification of benthos

The bottom fauna was collected by bottom mud scraper with tow line and was used to collect the samples from the bottom to a depth of about 15 cm in a quadrat by hand picking. Three replicate samples were used from each site for benthic study. Benthic insects' samples were diluted with tap water and slurry was prepared in a bucket and sticks, leaves and debris were removed. Slurry was passed through a B.S. no. 30 (500 µm) mesh sieve and B.S. no. 72 (200 µm) mesh sieve arranged former above the latter so that smaller organisms (meio) were retained on the smaller sieve. Organisms were preserved in 70% ethyl alcohol solution for qualitative and quantitative analysis. Quantitative estimation of benthic insects was based on numerical counting, that is, unit per square meter (ind.m^{-2}).

Individuals were identified up to genus or species level as could be possible and number of each type was noted. The qualitative analysis of macro invertebrates samples was made with the help of Edmondson (1959), Needham and Needham (1962), Pennak (1978) and Tonapi (1980).

Statistical treatment of data

For statistical treatment of data, Species diversity indices were calculated using the Shannon-Wiener index and Menhinick (1964) index. Shannon-Wiener's index (Shannon, Weaver, 1949) is thus highlighted as:

$$H= (\Sigma\ pi \ln pi)$$

Where; Pi= n/N, n= total number of individual of a taxon, N= total number of individuals of all taxa.

Menhinick's index is explained (Menhinick, 1964) using the formula:

$$Dmn = S/\sqrt{N};$$

Where; S= Total number of species and N= total density of all the species

RESULTS

During the present study, a total of twenty species of benthic insects belong to 5 genera were observed (Table 1). The most abundant order having maximum density in all the season was Diptera followed by Hemiptera, Coleoptera, Trichoptera and Ephemeroptera. Table 2 showed the variation in abundance of benthic insects in different months. Amongst the Dipterans the *Chironomus* larvae was the most dominated followed by *Coroxid*, *Pentaneura, Culex*, *Berosus*, *Noptonecta*, *Hydrophilus*, *Haliplus*, *Hespercorixa* (*Dysticus*, *Chironomus* pupa, *Belostoma*, *Sigara*, *Hebrus*, *Helius*, *Caenis*, *Phryganea*, *Baetis*, *Polycentropus* and *Limnephilus* (Table 1). *Chironomus larva* during winter was the most abundant (43.5%) and diverse group of benthic insects. Density of Dipterans ranged from 402 (autumn) to 1083 org/m^2 (winter). Hemiptera minimum density 206 org/m^2 in summer and maximum 460 org/m^2 in winters. Coleoptera densities ranged between minimum 160 during summer to maximum 351 org/m^2 during winter season. Tricophtera is least abundant lies between the range of 5 org/m^2 in the season of spring whereas maximum 9 in the month of winter. The population density of Ephemeroptera showed a range maximum of 8 org/m^2 in autumn and minimum of 4 in spring (Table 2 and Figure 2). This group contributed least because it was highly sensitive to the water condition and concentration of dissolved oxygen and mostly found in fresh water but only some species of this group can survive in eutrophic condition of water body. Low Shannon-Wiener indices were recorded, varying between H = 0.098 to H= 2.52. Species dominance index, that is, Simpson's index varied between (dSimp = 0.737 to dSimp = 0.901). Marglef's richness (1958) index recorded minimum in January d- = 2.44 and was maximum in March d- = 3.07. Dominance index was low D = 0.098 in October but was found to be maximum D = 0.262 during February (Table 3). Dipteral contributed high percentage (51%) followed by Hemiptera (25%), Coleoptera (22%), Tricophtera (1%), Ephemeroptera (1%) (Figure 1).

DISCUSSION

The distribution and abundances of benthic insect in this pond may be attributed to the availability of food, shelter and oviposition sites. Benthic aquatic insects are sensitive indicators of environmental changes because they express long term changes in water and habitat quality rather than instantaneous condition (Johnson et al., 1993). Similarly, physical disturbances in terms of water flow, temperature, ion concentration and substrates are the major factors determining the composition and abundance of benthic invertebrates (Ward and Stanford, 1979). The density of benthic insect becoming high during winter may be influenced by water temperature variation (Stanford and Ward, 1982). The abundance of Ephemeroptera, Plecoptera, Trichoptera and Chironomidae indicates the balance of the community, since Ephemeroptera, Plecoptera, Trichoptera are considered to be more sensitive and Chironomidae less sensitive to environmental stress (Plafkin et al., 1989). A community considered to be good in biotic condition will display an even distribution among these four groups,

Table 1. Seasonal fluctuation of benthic insect fauna (org/m^2) recorded in sewage fed pond.

Group	Species	Summer	Spring	Autumn	Winter
Diptera	Chironomus Larva	31.85	22.98	19.6	43.5
	Chironomus pupa	1.28	2.14	3.37	2.19
	Helius Larva	1.15	0.61	1.37	1.02
	Culex Larva	7.32	9.57	10.68	4.32
	Pentanura	10.99	11.11	10.91	5.61
	Noptonecta insulata	8.04	6.62	6.17	7.77
Hemiptera	Coroxid	7.51	8.08	11.42	5.54
	Belostoma	1.12	2.52	1.65	2.98
	Hebrus sp.	1.72	1.64	1.714	1.13
	Sigara	2.16	0.91	1.37	1.02
	Hespercorixa	5.26	5.97	4.8	5.63
	Hydrophilus	5.48	7.66	5.65	2.84
Coleoptera	Dysticus	2.38	5.86	4.85	3.85
	Berosus	5.79	8.23	8.05	5.93
	Haliplus	6.42	4.82	6.68	5.75
	Limnephilus larva	0.28	0.153	0.17	0.2
Tricophtera	Phryganaea larva	0.37	0.3	0.4	0.15
	Polycentropus larva	0.31	0.268	0.17	0.1
Ephemeroptera	Baetis	0.25	0.26	0.34	0.15
	Caenis	0.25	0.27	0.57	0.2

Table 2. Seasonal variations of different groups of benthic insect fauna.

Genus	Winter	Autumn	Summer	Spring
Diptera	1083	402	420	403
Coleoptera	351	221	160	231
Tricophtera	9	6	8	5
Hemiptera	460	237	206	224
Ephemeroptera	7	8	5	4

Table 3. Monthly variations in different biological indexes of the benthic insect fauna.

Months	Dominance	Simpson_1-D	Shannon_H	Margalef d
March	0.1611	0.8389	2.247	3.075
April	0.1294	0.8706	2.356	2.944
May	0.2154	0.7846	2.109	2.73
June	0.1294	0.8706	2.331	2.74
July	0.1188	0.8812	2.375	2.894
August	0.1029	0.8971	2.477	2.768
September	0.1268	0.8732	2.394	2.774
October	0.09852	0.9015	2.52	2.874
November	0.1167	0.8833	2.423	2.748
December	0.1986	0.8014	2.172	2.51
January	0.2144	0.7856	2.145	2.448
February	0.2628	0.7372	1.893	2.61

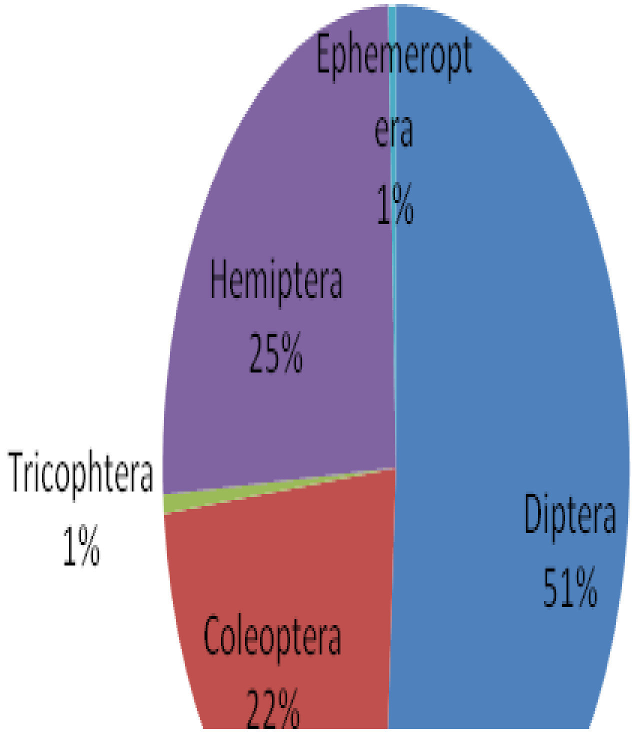

Figure 1. Percent contribution of different groups of benthic insect fauna.

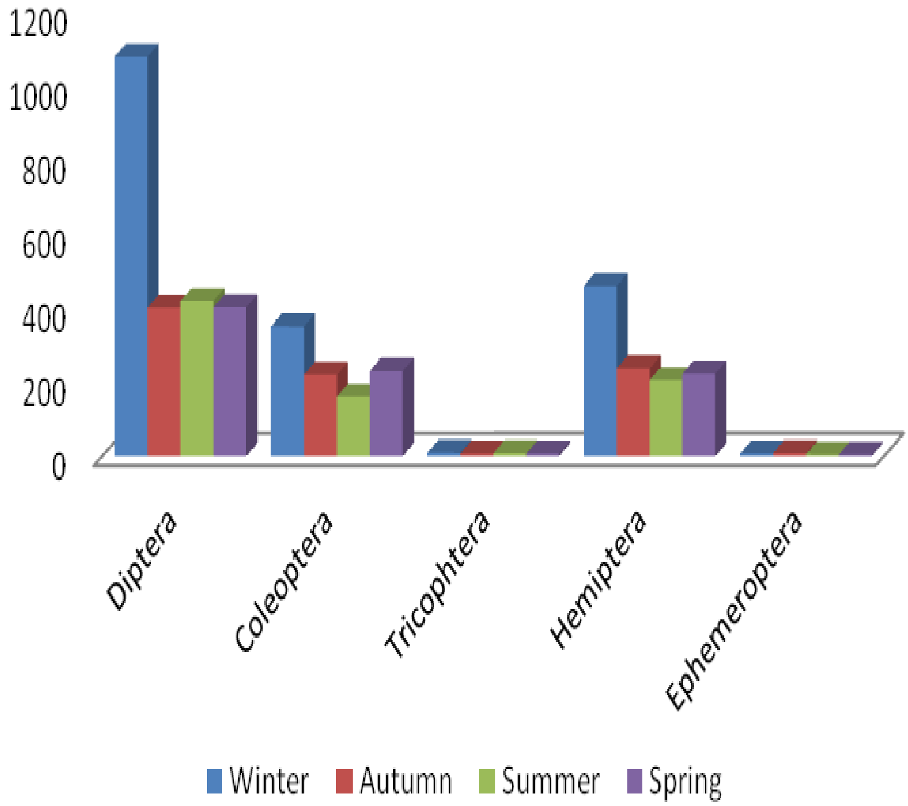

Figure 2. Seasonal variation of different groups of benthic insect fauna.

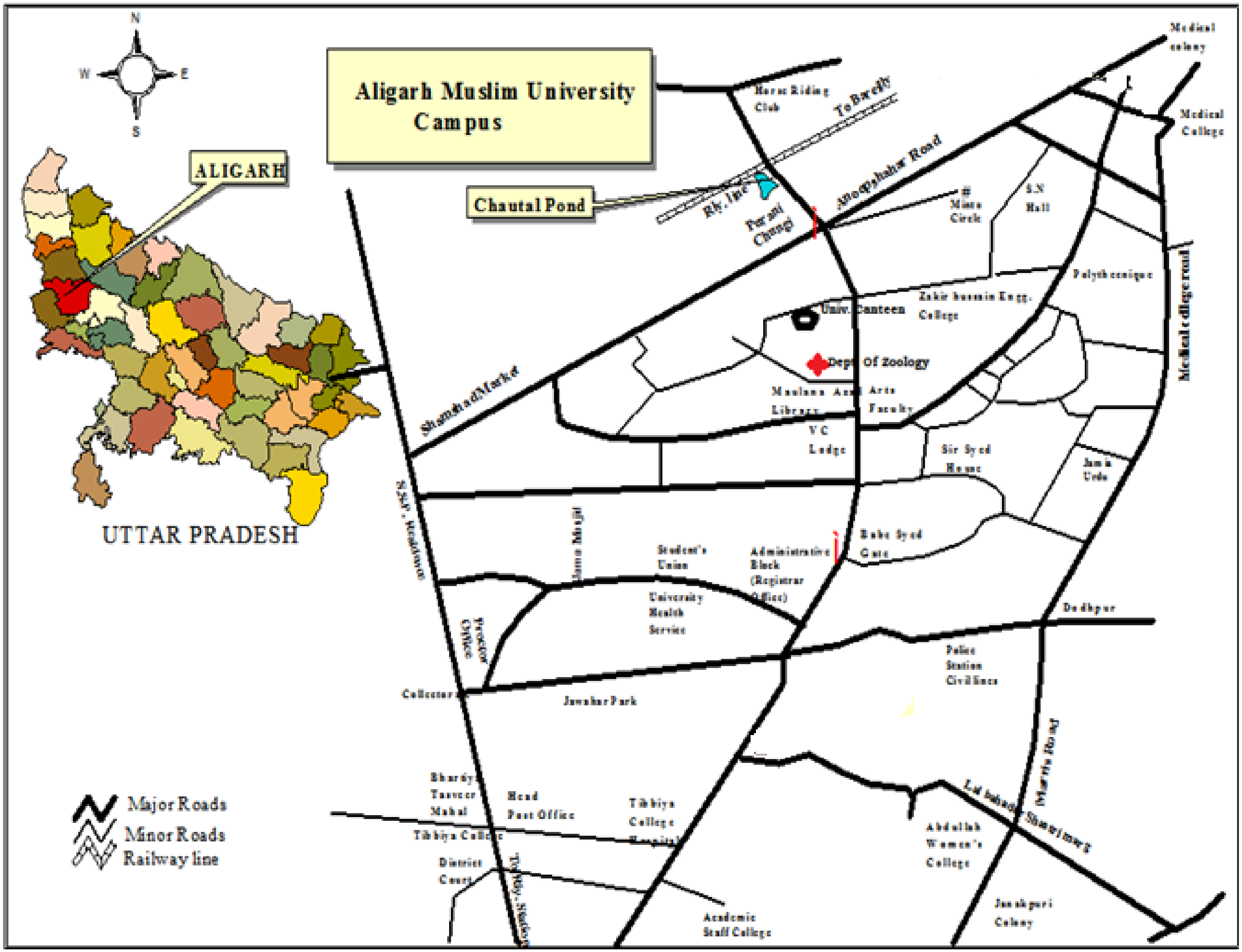

Figure 3. Map showing the study area.

while communities with disproportionately high numbers of Chironomidae may indicate environmental stress (Plafkin et al., 1989). Reasons for the apparent popularity of aquatic insects in current bio-monitoring practice are that they are ubiquitous species, rich, long lived and ability to integrate temporal condition. According to Hynes (1960) and Olive (1976) nymphs and larvae of stoneflies, mayflies and caddis flies are integral components of the benthic fauna of the most relatively undisturbed streams. Some kinds of *Chironomids* are blood red (this color is lost when the specimen is preserved). The red coloration comes from hemoglobin that allows the larvae to store oxygen and survive in situations with low dissolved oxygen. Benthic insect is most dominating in winter season because during winter season the predation pressure is low as well as, the capacity of water to holding oxygen is high which makes suitable condition for benthic insects as a result of which the density is high (Jhingran, 1975; Adoni, 1985). The presence of higher density of *Chironomus* larvae indicated polluted condition of water body. These aquatic insects provide a very good natural food for most of the insectivorus coldwater fishes. If the Shannon – Weiner diversity index proposed that diversity index is > 4 in clean water, between 3 and 4 in mildly polluted water and < 2 in heavily polluted water (Shekhar et al., 2008), it implies that in the selected water body, Chautal pond is moderately polluted. Metcalfe-Smith (1996) also observed that the higher value of Shannon-Weiner diversity index is supposedly as a result of the greater diversity it has in healthier environments.

REFERENCES

Adoni AD (1985). Workbook on Limnology. Pratibha Publishers, C-10 Gour Nagar, Sagar- 470 003, India. p. 216.

Cummins KW, Merrit RW, BurtonTM (1984). The role of aquatic insect in processing and cycling of nutrients. In: Resh VH, Rosenberg DM (eds) The ecology of aquatic insects. Praeger, New York. pp. 134-163.

Edmondson WT (1959). Ward and Whipple's Freshwater Biology, 2nd Ed. John Wiley & Sons Inc., New York. 1248 pp.

Gauffin AR, Tarzwell CM. (1952). Aquatic invertebrates as indicators of stream pollution. Public Health Rep. 67:57-64.

Hynes HBN (1960). The Biology of Polluted Waters. Liverpool University Press, Liverpool, UK. 202 pp.

Hynes HBN (1961). The invertebrate fauna of a Welsh Mountain Stream. Arch. Hydrobiol. 57:344-388.

Jhingran VG (1975). Fish and Fisheries of India. Hindustan Publishing Corporation, India, Delhi. 727 pp.

Johnson RK, Wiederholm T, Rosenberg DM (1993). Freshwater biomonitoring using individual organism, population and species assemblages of benthic macro-invertebrates. In: Rosenberg DM, Resh VH (eds). Fresh water biomonitoring and benthic macro-invertebrates. Chapman and Hall, New York. pp. 40-158.

Levin LA, Etter RJ, Rex MA, Gooday AJ, Smith CR, Pineda J, Stuart CT, Hessler RR, Pawson D, (2001). Environmental influences on regional deep-sea species diversity. Ann. Rev. Ecol. Syst. 32:51-93.

Marglef R (1958). Perspective in ecological theory. Univ. Chicago Press 122, Chicago, USA.

Menhinick EF (1964). A comparison of some species individuals diversity indices in samples of field insects. Ecology 45:859-861.

Metcalfe-Smith JL (1996). Biological water quality assessment of rivers: use of macro invertebrates community. In: Petts G, Calow P (eds), River restoration. Blackwell Science, Oxford. pp. 17-43.

Pennak RW (1978). Freshwater invertebrates of United States, 2nd Ed. Johan Wiley and Sons Inc., New York. 803 pp.

Resh VH (1995). Fresh water macro invertebrates and rapid assessment procedure for quality of water monitoring in developing and newly industrialized countries. In Bilogical Assessment and criteria. Davis WS, Simon TP (eds), Lewis Publishers, England. pp. 167-177.

Rex MA, Stuart CT, Coyne G, (2000). Latitudinal gradients of species richness in the deep-sea benthos of the North Atlantic. Proceedings of the National Academy of Sciences of the United States of America 97(8):4082-4085.

Shannon CE, Weaver V (1949). A mathematical theory of Communication. Uni. Press, TIlinois. Urban. pp. 101-107.

Shekhar STR, Kiran BB, Puttaiah ET, Shivraj Y, Mahadevan KM (2008). Phytoplankton as index of water quality with reference to industrial pollution. J. Environ. Biol. 29(2):233-236.

Tonapi GT (1980). Fresh water animals of India. Oxford and IBH Publishing Co., New Delhi. 341 pp.

Ward JV, Stanford JA (1979). Ecological factors controlling stream zoo-benthos with emphasis on thermal modification of regulated streams. In: Ward JV, Stanford JA (eds) Ecology of regulated stream. Plenum, New York. pp. 35-53.

Webber EC, Bayne DR, Seesock WC (1989) – Macro invertebrate communities in Wheeler reservoir (Albama) tributaries after prolonged exposure to DDT contamination. Hydrobiology 183:141-155.

Wilhm JL, Dorris TC (1968). Biological parameters for quality criteria. Bioscience 18:477-481.