**RESEARCH ARTICLE**

# Assessment of trophic status of Ambazari Lake, Nagpur, India with emphasis to Macrozoobenthos as Bioindicator

**Lonkar SS[1*], Kedar GT[2] and Tijare RV[1]**

[1]*Dept. of Zoology, Govt. Institute of Science, Nagpur , Maharashtra, India*

[2]*Dept. of Zoology, Govt. of Mah's Ismail Yusuf College, Jogeshwari (E) Mumbai-60, India*

**Correspondence - sslonkarmail@gmail.com gtkedar@rediffmail.com*

**Manuscript details:**

Received: 01 January, 2015
Revised : 12 February, 2015
Accepted: 22 February, 2015
Published : 30 March, 2015

**Editor: Dr. Arvind Chavhan**

**Cite this article as:**
Lonkar SS, Kedar GT and Tijare RV (2015) Assessment of trophic status of Ambazari lake, Nagpr, India with emphasis to Macrozoobenthos as Bioindicator, *Int. J. of Life Sciences*, 3(1): 49-54.



## ABSTRACT

Assessment of macrozoobenthos and physicochemical parameters of Ambazari Lake of Nagpur from October 2010 to Sept. 2012 helps to reveal the trophic status of the lake. pH of Ambazari lake represented alkaline nature of lake. Macrozoobenthic diversity represented 28 species belonging to Phylum Annelida (22.68%), Arthropoda (21.63%) and Mollusca (55.68 %) represented by oligochaetes, decapodes, odonates, dipterans, gastropods and pelecypodes respectively.
Seasonally, group Mollusca dominated the lake in summer season while winter season revealed the abundance of all the groups in more or less similar trend . Higher values of macrozoobenthic diversity as well as nutrients such as Sulphate, Phosphate and Nitrate values indicated oligomesotrophic status of lake.

**Key words:** Macrozoobenthos, physico-chemical, bioindicator, trophic status, Ambazari lake, India.

## INTRODUCTION

Aquatic Benthic macro-invertebrates are invertebrates that live on the bottom of water body during all or part of their life cycle. They often go unnoticed because of their size and habitat but are an extremely important part of aquatic ecosystems and serve as a link in the food web between decomposing leaves, algae, fish and other vertebrates (Cummins, 1974). They act as the secondary producers and form a part of food web of aquatic ecosystem. They also play an important role in transferring energy from the first trophic level to second trophic level in freshwater ecosystems.

The diversity and abundance of benthic inhabitants of a particular water body is much influenced by physico chemical status of water body which do show seasonal alternations depends on cascade of

events (Kodarkar, 1995). Because of their extended residency period in specific habitats and presence or absence of particular benthic species in a particular environment these can be used as bio-indicators of specific environment and habitat conditions. Aquatic macro-invertebrates are sensitive indicators of environmental changes in streams because they express long-term changes in water and habitat quality rather than instantaneous conditions (Cummins *et al.,* 1984). The proposed study was aimed to assess the trophic status of Ambazari lake with particular emphasis on the structure of macrozoobenthos and physico-chemical environment of the lake.

***Study area***

Ambazari lake situated to the south west of Nagpur city is almost a natural reservoir formed in the Basin of Nag River (Pathak, 2005). It is located at $21^0$ 09' N and $79^0$ 07'E, at an average elevation of 350 m above MSL (Fig.1). The catchment area of the lake is 1551.36 ha (NMC, 2009) which lies in the Northwest of the lake from where storm water feeds the lake.

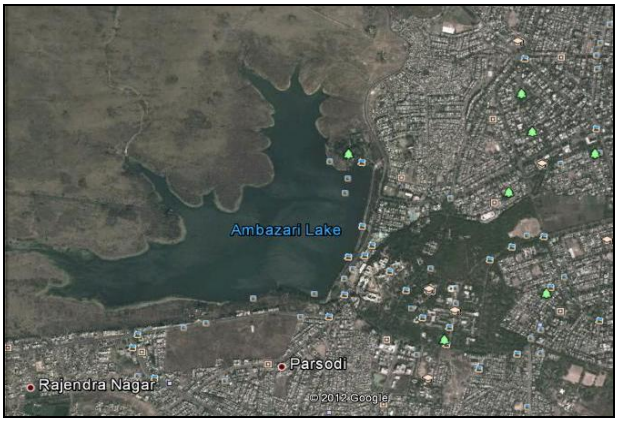


**Fig. 1 : Ambazari Lake, Nagpur**

***Study Stations***

Study was carried out collectively at four different sites as per preferably importance. (i) Old pump house- This site is to the East segment of lake. (ii) CRPF Pump house- This site is to the South segment of the lake and is undisturbed. (iii) MIDC Pump house- This site is to the West segment of lake. It is inlet of the lake and good grazing ground for cattle. (iv) Garden- This site is located at the North segment of lake having beautiful garden at its shore. It is tourist attraction during post-monsoon as migratory birds reside here.

## MATERIALS AND METHODS

The present study was carried out during October 2010 to Sept 2012. The collection of water samples and biotic fauna was done collectively at four sites in morning hours on monthly basis. Water sample was collected in plastic water samplers of two liter capacity. Analysis of parameters like air temperature, water temperature, pH and D.O. was done on the spot and the rest were determined in the laboratory. Analysis was followed by standard methods (Adoni, 1985; APHA, 1965).

Macrobenthic samples were collected with the use of Ekmans dredge (6''x 6''x 6''). The collected samples were sieved through 500 micron copper sieve. Samples were preserved in formalin, (Hellawell, 1978) and identified with standard keys of Naidu and shrivastav (1979); Needam (1962); Tonapi (1960). However for quantitative analysis species wise individual counting was done on the basis of two year seasonal average. The number of benthos per unit area was calculated as follows.

$$Benthos\ \frac{no}{m2} = \frac{N}{A \times S} \times 100$$

Where, N=Number of organisms collected per sample.

A=Bitting area of samples (15×15 cm)
S=Number of samples taken.

## RESULTS AND DISCUSSION

Averages of seasonal variation of physicochemical parameters are represented in Table 1. Air temperature was maximum in summer months, while water temperature was maximum in monsoon months; similar trend was also recorded by Swarnalatha and Rai (1998) in Banjara lake. In ambazari lake the average pH values ranged around 8.2, it represents alkaline nature of lake. Webber and Stumm (1963) have concluded that the pH of raw water sources mostly lies within the range 6.5 to 8.5. pH of inland waters in India lie in the alkaline range without much variation (Ghosh and George 1989).

In Ambazari lake the conductivity was observed in the range of 501 µS/cm to 571 µS/cm. Minimum conductivity ( 501.9 µS/cm) in rainy season may be due to dilution of salts and its variation in

concentration (Welch, 1952). According to Brown (1971) conductivity of the inland water should range between 150 to 450 µS/cm to flourish good flora and fauna but conductivity in Ambazari lake is slightly high above the range.

Dissolved Oxygen (D.O.) was found to be maximum (5.6 mg/l) in winter and minimum (4.6 mg/l) in summer. Maximum D.O. in winter might be due to low atmospheric temperature and intensive photosynthetic activity while minimum D.O. in summer may be due to high temperature and low solubility of oxygen in water (Kaushik and Saxena 1989).

Total hardness of Ambazari lake was recorded in the range of 172.3 to 245.5 mg/l. According to Sawyer (1960) water with hardness from 150.0 to 300.0 mg/l is considered as hard with hardness thus Ambazari lake water is hard with hardness. Hardness is directly proportional to its ionic balance.

Biological Oxygen Demand (B.O.D) recorded was 9.9 mg/l in summer and minimum 6.3mg/l in monsoon. Maximum B.O.D. in summer may be due to high microbial activities and decline form in monsoon and winter may be due to retard microbial activity. Similiar trend was also observed by Harne (2010) in three lakes of Bhadrawati.

Chemical Oxygen Demand (C.O.D.) recorded was 29.1 mg/l in summer and 21.8 mg/l in monsoon. With increased temperature the oxygen consumption by the living planktonic communities is also increased (Boyd, 1973) and increased organic matter may require more oxygen to oxidize under increased thermal condition as suggested by Ambasht and Sharadendu (1988). The maximum permissible value of C.O.D is 10 mg/l for drinking water (Edward, 1972). C.O.D. value of Ambazari lake exceed the limit.

In the present study the free ions such as Phosphate and Sulphate were notably higher in summer season while lowest in monsoon season. Higher concentration in summer is probably due to activity of biodegradation. Whereas dilution and utilization by aquatic plants gradually brought down the concentration in monsoon, Munawar (1970). Higher concentration of Nitrate observed in monsoon, is due to surface runoff, drainage, siphon runoff, storm water (Seitzniger, 1988).

Phylum Annelida represented *Limnodrillus hoffestry, Nais communis, Aelosoma bengalensis* and *Limnodrillus variegatus* of class Oligochaeta while *glossiphonia sp.* of class Hiudinea. Two year seasonal average distribution was recorded as 450.6 n/m$^2$ (winter), 186.3 n/m$^2$ (summer) and 268.6 n/m$^2$ in monsoon. Maximum number of Oligochaeta diversity was observed in winter and minimum in summer. Similar trend was also observed by Anitha *et al*. (2004) in Mir Alam lake of Hyderabad and Ojha *et al.* (2010).

The most frequently used community to determine the water quality in the streams is the macro invertebrates. (Rosenberg and Resh, 1993).

**Table 1:** Average of Seasonal Variations of Physico-chemical parameters in Ambazari Lake Oct 2010 to Sep 2012

| Sr. No. | Parameters | Winter | | | Summer | | | Monsoon | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | | S.D. | Mean | | S.D. | Mean | | S.D. |
| 1 | Temperature atm. | 27.6 | ± | 2.99 | 38.1 | ± | 4.54 | 36.4 | ± | 3.67 |
| 2 | Temperature water | 22.5 | ± | 2.55 | 28.8 | ± | 4.27 | 30.0 | ± | 2.05 |
| 3 | Ph | 8.2 | ± | 0.12 | 8.1 | ± | 0.16 | 8.1 | ± | 0.21 |
| 4 | Conductivity | 511.9 | ± | 11.40 | 571.0 | ± | 27.87 | 501.9 | ± | 19.74 |
| 5 | D.O. | 5.6 | ± | 0.25 | 4.6 | ± | 0.63 | 5.2 | ± | 0.29 |
| 6 | Hardness – Total | 172.3 | ± | 5.36 | 245.5 | ± | 26.27 | 190.3 | ± | 24.54 |
| 07 | B.O.D. | 7.0 | ± | 0.29 | 9.9 | ± | 1.18 | 6.3 | ± | 1.11 |
| 08 | C.O.D. | 21.8 | ± | 3.89 | 29.1 | ± | 2.80 | 21.8 | ± | 1.49 |
| 09 | Phosphate | 0.5 | ± | 0.22 | 2.0 | ± | 0.57 | 1.6 | ± | 0.51 |
| 10 | Sulphate | 14.7 | ± | 3.85 | 28.1 | ± | 2.64 | 20.8 | ± | 2.82 |
| 11 | Nitrate | 0.1 | ± | 0.02 | 0.4 | ± | 0.12 | 1.0 | ± | 0.23 |

**Table-2:** Avearage of Seasonal Variation of Macrozoobenthos in Ambazari Lake during Oct 2010 to Sep 2012

| **Macrozoobenthos Species** | | Winter | Summer | Monsoon |
|---|---|---|---|---|
| | | **Average** | **Average** | **Mean** |
| **Phulum-Annelida** | | 450.8 | 186.3 | 268.6 |
| **Class-Oligochaeta** | | 446.6 | 179.3 | 268 |
| Family-Tubificidae | *Limnodrillus hoffemeistry* | 144.6 | 52.3 | 88.3 |
| Family-Naididae | *Nais communis* | 130.5 | 52.5 | 59.1 |
| Family-Aelosmatidae | *Aeolosoma bengalensis* | 84.1 | 47.7 | 49.7 |
| Family-Lumbricidae | *Lumbricus variegates* | 87.4 | 26.8 | 70.9 |
| **Class-Hirudinea** | | 4.2 | 7 | 0.6 |
| Family-Glossiphonidae | *Glossiphonia sp.* | 4.2 | 7 | 0.6 |
| **Phylum-Arthropoda** | | 444.9 | 209.6 | 208.7 |
| **Class-Arachnida** | | 21.3 | 2.9 | 8.3 |
| Family-Hydrachnidiae | *Hydracarina sp.* | 21.3 | 2.9 | 8.3 |
| **Class-Crustacea** | | 14.5 | 35.5 | 29.1 |
| **Order-Decapoda** | | | | |
| Family-Gelechiidae | *Paratelphusa jaquemonti* | 8.5 | 20.9 | 17.1 |
| Family-Gelechiidae | *Gelasimus sp.* | 6 | 14.6 | 12 |
| **Class-Insecta** | | 409.1 | 171.2 | 171.3 |
| **Order-Odonata** | | 12.6 | 5.4 | 9.5 |
| Sub order-Anisoptera | *Dragonfly nymphs* | 7.2 | 3.1 | 5.4 |
| Sub order-Zygoptera | *Damselfly nymphs* | 5.4 | 2.3 | 4.1 |
| **Order-Diptera** | | 393.5 | 126.3 | 121.9 |
| Family-Tendipididae | *Chironomous sp.* | 188.7 | 70.5 | 49 |
| Family-Culicidae | *Anopheles sp.* | 15.6 | 5.7 | 7 |
| Family-Culicidae | *Culex sp.* | 66.5 | 24.4 | 29.5 |
| Family-Syrphidae | *Eristalis sp.* | 24 | - | 1.9 |
| Family-Limnoniidae | *Rhapidolabis sp.* | 27.1 | 0.3 | 8.3 |
| Family-Tabanidae | *Tabanus sp.* | 71.6 | 6.3 | 21.5 |
| Family-Muscidae | *Musca autumnialis* | - | 19.1 | 4.7 |
| Order-Hemiptera | | 3 | 39.5 | 39.9 |
| Family-Nepidae | *Nepa sp.* | 1.7 | 22.6 | 22.8 |
| Family-Nepidae | *Ranatra elongate* | 1.3 | 16.9 | 17.1 |
| **Phyllum-Mollusca** | | 490.8 | 1134.6 | 596.6 |
| **Group-Gastropoda** | | 354.3 | 829.2 | 451.7 |
| Family-Viviparidae | *Vivipara bengalensis* | 57.9 | 131.5 | 55.8 |
| Family-Thiaridae | *Melania striatella tuberculata* | 51.1 | 143 | 106.9 |
| Family-Thiaridae | *Melania scabra* | 64.6 | 136.7 | 100.6 |
| Family-Lymnaeidae | *Lymnea lutiola* | 65.3 | 87 | 67.6 |
| Family-Planorbidae | *Indoplanorbis exustus* | 65 | 145.4 | 69 |
| Family-Pachilidae | *Faunus ater* | 50.4 | 185.6 | 51.8 |
| **Group-Pelecypoda** | | 136.5 | 305.4 | 144.9 |
| Family-Unionidae | *Lamellidens correanus* | 52 | 116.3 | 55.2 |
| Family-Unionidae | *Lamellidens marginalis* | 45.5 | 101.8 | 48.3 |
| Family-Unionidae | *Parreysia corrugata nagpoorensis* (Lea) | 39 | 87.3 | 41.4 |
| **Number of Species(S)** | | **27** | **27** | **28** |
| **Total(N)** | | **1386.3** | **1530.5** | **1073.7** |

These organisms offer valuable information regarding their surrounding conditions and can be used to evaluate the physical, chemical and biological impact and their cumulative effect (Karr and Chu, 1999). Qualitative study of macro benthos was done in Ambazari lake of Nagpur city from Oct. 2010 to Sept. 2012. The study represented 28 species of macro benthos belonging to three phyla viz. Annelida(22.68%), Arthropoda (21.63%) and Mollusca (55.68 %) ( Table 3 and Fig.2).

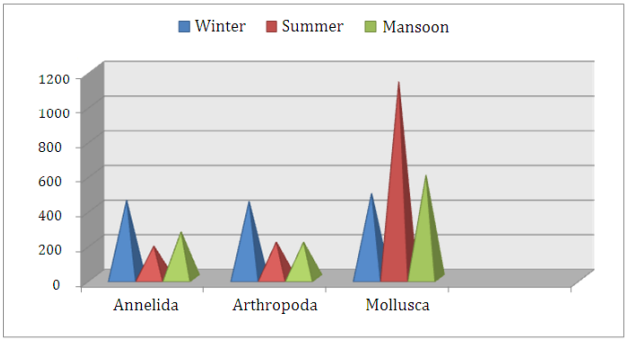


**Fig.2:** Seasonal average of macrozoobenthos (N0. /$m^2$) at Ambazari Lake, Nagpur.

**Table 3:** Percentage wise distribution of Macro-zoobenthos in Ambazari lake

| Sr. No. | Group of Macrozoobenthos | Percentage |
|---|---|---|
| 1 | Annelida | 22.68% |
| 2 | Arthropoda | 21.63% |
| 3 | Mollusca | 55.68 % |

The Oligochaeta adapted to every kind of water and are found in algae, aquatic vegetation, floating rotten materials and in bottom mud (Wetzel *et al*., 2000). Many environmental studies have focused on the use of freshwater oligochaetes as indicator of trophic condition (Chapman *et al.,* 1982). Oligochaeta prefer organically rich environment and remain dominant in severally polluted condition (Hawks,1979).

Arthropoda is one of the most widely represented phyla in fresh water habitat and different groups have different ecological adaptations. Ambazari lake represented crustaceans, Insects and Arachnids of phylum Arthropoda. The two year seasonal average value of arthropoda ranged as 444.9 no/$m^2$ (winter), 209.6 no/$m^2$ (summer) and 208.7 no/$m^2$ (monsoon).

Insects are the species which are less to moderate tolerant to the changes in physico-chemical compositions of water and substratum. (Fraser, 1936). Presence of *Chironomous sp.* and *Eristalis sp.* indicate sites affected with anthropogenic activities, washing, cattle grazing and open defecation resulting in the condition of pollution. Chironomus larvae have also been used as pollution indicators by number of workers (Gaufin, 1957; Curry, 1962). In the present study phylum Mollusca represented group Gastropoda and Pelecypoda. The phylum ranged as 490.8 no/$m^2$ (winter), 1134.6 no/$m^2$ (summer) and 596.6 no/$m^2$ (monsoon). They were found dead on the shore in large number during summer.

Throughout the study period Phylum mollusca dominated the lake(55.68%) followed by Annelida (22.68 %) and Arthropoda (21.63%) respectively (Fig 3). winter season shows more or less similar trend of all the macrozoobenthic density while mollusks mostly dominated summer season followed by monsoon (Fig. 2). Higher molluscan density in the summer season might be due to soft and organically rich bottom and alkaline nature of water. Silt matter are known to support thriving populations of macro invertebrates because of reduction in water current as such the substrate trends to make mollusks indistinguishable from their typical lentic habitat. Whitton (1975). Anwar and Siddiqui (1988) recorded peak of benthic invertebrates in summer. In the present study the Molluscan fauna was distributed from shore line to 3 m depth in all type of sediments.

From the results of present study it is clearly evident that the macro-benthic community is dominated by molluscan population. The availability and distribution of chironomous larvae in the lake indicate pollution conditions that have been attributed to be relative to many factors (Bowman, 1976). Higher values of macrozoobenthic diversity as well as nutrients such as Sulphate, Phosphate and Nitrate values indicated oligomesotrophic status of lake.

## REFERENCES

Adoni AD (1985) Work book on limnology, Indian MAB Committee, Deptt. of Environment, *Pratibha publications,* Sagar, India.

Ambasht RS and Sharadendu (1988) Morphometry and physico-biotic characteristics of Varanasi Ponds. *Proc. Nat. Acad. Sci.* 59(b):421-426.

Anitha G, Kodarkar MS, Chandrashekar SVA and Grace G Nalini (2004) Studies on macro-zoobenthos in Mir Alam

Lake, Hyderabad, Andhra Pradesh, *J. Aqua. Biol.,* 19 (1): 61-68.

Anwar S and Siddiqui MS (1988) On the distribution and dynamics of macroinvertebrate fauna of the river Kali in Northern India. *Journal of Environmental Biology,* 9:333-344.

APHA (1965) Standard methods of examination of water & waste water. *American Public Health Association,* 19th Ed. Inc. New York, pp.1170.

Bowman CMT (1976) Factors affecting the distribution and abundance of Chironomids in three shroshire meres, with special reference to larval tracheal system. Ph. D. thesis, Univ. Keele.

Boyd CE (1973) The chemical oxygen demands of water and biological matrix from ponds, *Trans. Amer. Fish. Soc.*, 3:606-611.

Brown RD (1971) The use of biological analyses as indicators of water quality, *J. Environ Health* 34:pp 62-66.Chapman PM, FaarrelMA MA and BrinkhurstRO RO (1982) Relative tolerance of selected aquatic oligochaetes to indivisual pollutants and environmental factors. *Aquatic Toxicology* .2:47-67.

Cummins KW (1974) Structure and function of stream ecosystems. *Bioscience*, 24: 631-641.

Cummins KW, Merritt RW RW and BurtonTM TM (1984) The role of aquatic insects in the processing and cycling of nutrients. In: V.H. Resh and D.M. Rosenberg, (eds) . The ecology of aquatic insects. *Praeger*, New York, pp: 134-163.

Curry LL (1962) A survey of environmental requirements for the midge (Diptera, Tendipedidae). In: Biological Problems in Water Pollution. Transactions of 3rd seminar (Ed. Tarzwell), USDHEW, PHS, Robert, A. raft Sanitary Engineering Centre, Cincinnati.

Edwards RW (1972) *Pollution*, Oxford Biology Readers ,No 31 pp 16

Fraser FC (1936) The fauna of British India, including Ceylon and Burma: *Odonata* 1-3, Taylor and Francis, London.

Gaufin AR (1957) The use and value of aquatic insects as indicators of organic enrichment. Biological problems in water pollution. U.S. Public Health Service, Washington D.C.pp.139-149.

Ghosh A and George AP (1989) Studies on the abiotic factors and zooplankton in a polluted urban reservoir ,Hussain Sagar reservoir, Hyderabad, *Indian Journal of Env. Health,* 37: 49-59.

Harne NV (2010) Studies on the biodiversity and physicochemical status of three water bodies near Bhadravati Dist.Chandrapur, *Ph.D. Thesis* , RTM Nagpur university, Nagpur

Hawks HA (1979) Invertebrates as indicator of river water quality. In Biological indicator of water quality, Ed.A.James and L.Evison Chichester, John Willey and Sons

Hellawell JM (1978) Bilogical surveillance of rivers. Water research centre. Stevnage Laboratory Stevnage, pp332.

Karr JR and EW Chu (1999) Restoring life in running waters-Better Biological monitoring. Washington Island Press. pp. 206.

Kaushik S and Saksena DN (1989) Physico-chemical factors and the aquatic insect density of a pond receiving cotton mill effluent at Gwalior. *Indian J. Ecol*,, 16 (1): 64-67.

Kodarkar MS (1995) Conservation of lakes with special reference to five water bodies in and around Hyderabad. *Indian Association of Aquatic Biologists (IAAB)*, Hyderabad, Publication No.3 pp:82-86

Munawar MC (1970) Limnological studies on fresh water ponds of Hyderabad , India – II .*The Biocenose. Hydrobiologyia* , 36(1): 105-128.

Naidu K Vanamala and ShrivastavaHN HN (1979): Some fresh water oligochaets of Nagpur,India. *Hydrobiologia,*72(1)(1):261-271.

Needam (1962) A guide to study of fresh water biology, Holen day Inc. San francisco, 5th Edition.

NMC (2009) Nagpur Municipal Corporation, detailed project report on, *"The rejuvenation oflakes in Nagpur city"*.

Ojha NK, Navin Kumar Pande,MKMK and Yadav,RN RN (2010) Studies in macrobenthic community of paddy field of rural Chapra, *The Bioscan*, (2): 579-585

Pathak AS (2005) Compact Disc version of Nagpur Distt. Gazetters, Directorate of Govt. Printing, Stationary and Publications, Maharashtra.

Rosenberg DM and Resh VH (1993) Freshwater Biomonitoring and Benthic Macroinvertebrates. New york, Chapman and Hall. p. 488.

SawyerCH (1960) Chemistry of sanitary engineers .Mc Graw Hill Book Company ,New York

Seitzniger SP (1988) Ecology and geochemical significance. *Limnolo Oceonogr.,* 33, 702.

Swarnalatha N and Narsingh Rai A (1998) Ecological studies of Banjara Lake with reference to water pollution, *Journal of Environmental Biology*., 19 (2):pp. 179-186

Tonapi GT (1980) Freshwater animal of India: An ecological approach, Oxford and IBH Publishing company New Delhi pp.341

Webber WJ Jr and Stumm (1963) Mechanism of hydrogen ion buffering in natural water.*J.AmericanWaterWorks Association.*, 155:1553

Welch PS (1952) Limnology,Mc Graw Hill book Company, New York.

Wetzel MJ, Kathman RD RD, Fend SV SV and Coates KA KA (2000) The aphanoneuran and clitellate Annelida occurring in the United States and Canada Acanthobdellida, Aphanoneura, Branchiobdellida, Hirudinea and Oligochaeta, pp 120.

Whitton BA (1975) Zooplanktons and Macro invertebrates, In: Whitton , B.A. (Ed) Studies in river ecology, 2 : Baker Publisher Limited London, 87-118.