ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 8, Issue, 02, pp.26994-26999, February, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

MACROZOOBENTHIC COMMUNITY AS BIOLOGICAL INDICATORS OF POLLUTION IN ANCHAR LAKE OF KASHMIR

***,[1]Muzamil Bashir, [2]Rajendra Chauhan, [3]Salma Khan, [3]Mohammad Farooq Mir and [4]Nasrul Amin**

[1,]Baraktullah University, Bhopal (M.P), India
[2]Govt M.L.B Girls P.G (autonomous) College, Bhopal (M.P), India
[3]Director Research Cell Bhoj Open university bhopal
[3,5]Hydrobiology Research Laboratory, S.P. College Srinagar, India

ARTICLE INFO

Article History:
Received 17th November, 2015
Received in revised form
05th December, 2015
Accepted 29th January, 2016
Published online 27th February, 2016

Key words:

Macrozoobenthic community,
Ancharlake,
Water quality,
Bioindicators.

ABSTRACT

A detailed limnological study of the anchar lake in Kashmir was conducted during March2015 to June2015. Six study sites were selected for the collection of samples. The physico-chemical parameters of water and population density of three phyla viz, Arthropoda, Annelidaand Mollusca were determined. The ionic composition of water of the Ancharlake varied in close relationship with the catchment pattern of the concerned water body. The Ancharlakereceiving all sorts of allochthonus material from the catchment had the highest conductivity. The water of the Lake was well buffered with pH > 7. A total of 21 taxa of macrozoobenthos were recorded from the system. Arthropodawas most dominant group constituting 45.7%, followed by Annelida 35.9% and Mollusca which contributed 18.4% of total macrozoobenthos. The bottom sites were dominated by insects belonging to orders Ephemeroptera, Tricoptera and Diptera. Significant changes in macrozoobenthic communities were primarily due to changes in water quality. As elsewhere, macrozoobenthic communities proved to be good indicators of water quality and should be used as bioindicators in long-term monitoring of this Lake.

Citation: **Muzamil Bashir, Rajendra Chauhan, Salam Khan, MohammadFarooq Mir and Nasrul Amin, 2016.** "Macrozoobenthic community as biological indicators of pollution in Anchar lake of Kashmir", *International Journal of Current Research,* 8, (02), 26994-26999.

INTRODUCTION

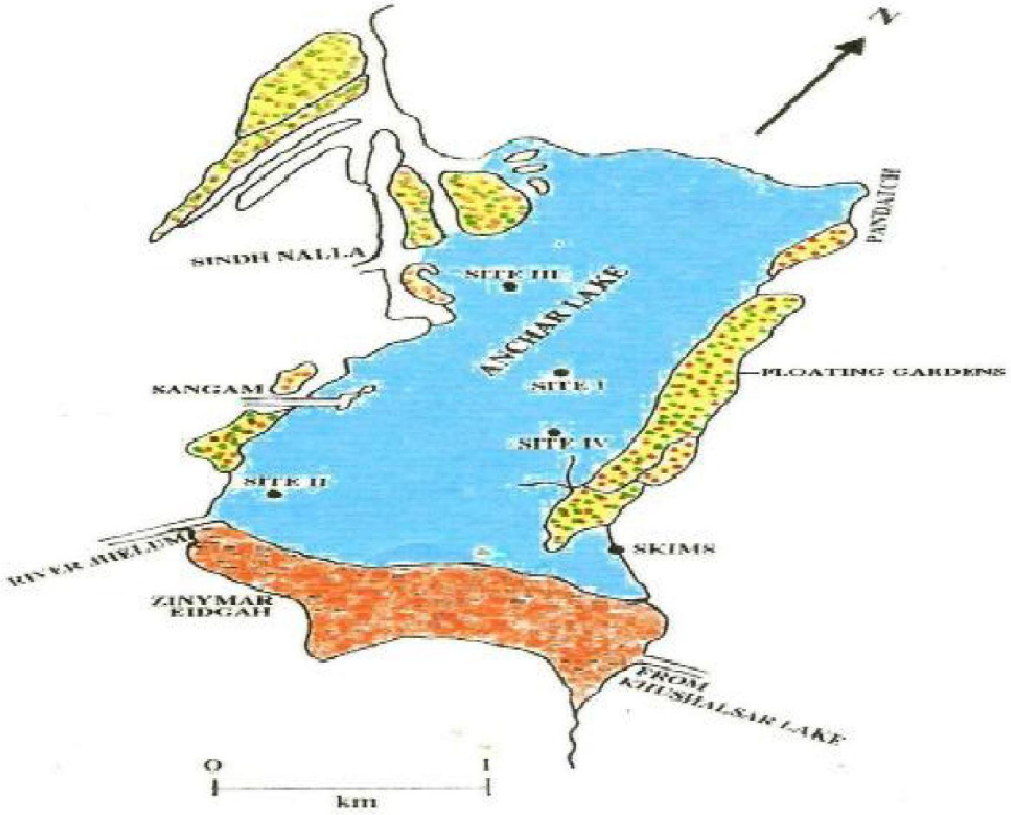
The valley of Kashmir lying in the middest of Himalayan range is located at an altitude of 1500-1700 m. s. l. Kashmir valley is situated between 31^0 17′ and 34^0 5′ North latitude and 72^0 70′and 80^0 30′ East latitude. The Total geographic area of the state is 4920 Sq. kms. The valley is surrounded by the mountainous ranges of central Himalaya, characterized by snow covered lofty peaks which bifurcates near Kullu into Zanskar range (North-West branch) and Pir-Panjal range (extended further to North-West). The mountain ranges rising to a height of 5550 m in the south, where the Banihal-Pass (Jawahar tunnel) provides an exit from the valley. Numerous but varied freshwater ecosystems existing in the valley are of great aesthetic, cultural, socio-economic and ecological value besides playing an important role in the conservation of genetic resources of both plants and animals. These water bodies are also important for the sustainable economy of the state in as much as they provide food, fodder, fish, wildlife, green manure, vegetables, medicinal plants, timber and other useful products, besides being a potential source of recreation. The major freshwater natural lakes of Kashmir include Dal Lake, Manasbal lake, Trigam Lake, Nigeen Lake, Khushalsar Lake, Wullar Lake, Anchar Lake and Nilnag Lake. The valley of Kashmir is also known as "Valley of Lakes" due to abundance of lakes and these lakes which are principle component of its beauty and acts as a source of tourist attraction. The rapidly expanding human populations and the fast urbanization in addition to natural siltation threatening these ecosystems as well as their naturalresourses. Anchar Lake plays an important role in the regeneration and conservation of biological resources besides irrigation, water supply, transportation, fishery and wildlife. At the same time, it is becoming the victim of cultural eutrophication, which in turn is due to the increase in anthropogenic pressures in its catchment area (Zutshi *et al*., 1980; Pandit, 1999). Population explosion, rapid rate of encroachments and increased utilization of lake waters for irrigation and disposal of sewage and sewerage from the adjoining settlements, development of floating gardens

****Corresponding author: Muzamil Bashir,***
Baraktullah University, Bhopal (M.P), India.

(Radhs) for agriculture are greately responsible not only for the deterioration of the lakes environment but also for the shrinking of its size which produced severe impact on the biotic setup. At present the main problem of the lake is the cultural eutrophication, the excessive increase in the primary production and the development of algal blooms.

Study Area

Ancharlake is situated in Srinagar district near SKIMS Soura. The Anchar lake plays an important role in the conservation of biological resources besides irrigation; water supply; fishery and wildlife. At the same time, it is becoming the victim of cultural eutrophication, which in turn is due to the increase in anthropogenic pressures in its catchment area (Zutshi *et al*., 1980; Pandit, 1999). In order to have a true picture about the limnological characteristics of the Ancharlake six study sites were selected for the present study. Site I, Site II, Site III Site IV Site V, Site VI.



MATERIALS AND METHODS

Physico-chemical parameters

The seasonal variation of Physico-chemical factors of water were studied from March2015 to June 2015. Monthly samples were collected from the lake by dipping one litre polythene bottle just below the surface of water. Temperature, pH, Conductivity were recorded on the spot. For the estimation of Dissolved oxygen, water samples were collected in glass bottles and fixed at the sampling site in accordance with Winklers method (A.P.H.A, 1998). Free Co_2, hardness, alkalinity and chloride were determined by titrimetric methods (Mackereth, 1978).

Macrozoobenthos

For collection of macrozoobenthicinvertebrates, sediment samples were collected from six different sampling sites using Ekman dredge having an area of 225cm^2. The sediment sample were sieved and benthic organisms retained in the sieve were picked with the help of forceps and then preserved in 4% formalin. Benthos sampling was done on monthly basis. Preserved samples were then identified according to standard works (Edmondson, 1959, Pennak, 1978, Adoni, 1985 and Tonapi, 1980). The abundance of these organisms was calculated as number per square meter by applying the following formula:

N= O/A.S x 10,000 (Welch, 1948)

Where,
N = No. of macrozoobenthic organisms/m^2.
O = No. of organisms counted.
A = Area of sampler in square meter.
S = No. of samples taken at each stations.

RESULTS AND DISCUSSION

Physico chemical parameters

The physico-chemical characteristics of water have a great role over the distribution and abundance of living organisms.

Table 1. Mean and standard deviation of the physico-chemical characteristics of water of Ancharla Lake

Parameter	Mean and Standard deviation					
	Site I	Site II	Site III	Site IV	Site V	Site VI
Air Temperature °C	21±6.86	21±6.38	22±6.93	22±6.77	22±6.77	21±6.40
Water temperature °C	11±1.16	16±4.63	17±5.78	17±5.04	17±4.72	17±4.26
Conductivity (µS/cm)	153.6±21.95	170.6±19.26	178±21.65	171.1±13.02	162.8±15.07	171.3±18.33
pH	7.4±0.26	8.4±0.47	7.4±0.20	7.7±0.62	8.4±0.53	7.7±0.29
FCo2 (mg/l)	9.6±1.36	2±1.41	6±1.89	4.2±5.23	1.8±2.61	5.1±1.25
DO (mg/l)	10.5±2.86	8.5±0.90	7.7±0.70	7.6±0.96	6.8±1.15	7.6±0.29
Total Hardness (mg/l)	167.5±86.70	119.5±67.77	96.6±42.26	131±73.50	155±62.20	113.3±56.45
Calcium (mg/l)	68.4±37.99	55.3±21.94	47.8±25.98	50.3±28.02	57.8±26.32	39.1±19.36
Magnesium (mg/l)	31.6±16.92	15.5±12.64	15.1±11.33	19.5±12.24	23.5±13.44	17.9±9.35
Chloride(mg/l)	8.4±2.25	10±3.31	11.7±3.06	10.2±2.41	12.6±2.85	10.3±2.15
Alkalinity (mg/l)	159.6±15.97	122.1±21.33	131.3±41.21	116.3±29.59	110.3±15.76	103.5±12.73

Table 2. Population density and percentage of Macrozoobenthic invertebrates in Anchar lake during the study period

Groups	Macrozoobenthic					% Age composition		
Arthropoda	3	5	4	0	4	5	7	%
Annelida	1	8	7	5	3	5	9	%
Mollusca	1	0	5	0	1	8	4	%

Table 3. Population density of phylumArthropoda (ind/m^2) recorded in Anchar lake

S.No.	Species	Site I	Site II	Site III	Site	Site V	Site VI
Arthropoda							
Order: Ephemeroptera:							
1.	Baetis sp.	2684	440	0	0	176	484
2.	Ecdyonurs sp.	2068	0	264	264	0	0
3.	CanisSrinagri	_	0	176	0	264	308
4.	Epeorus sp.	308	0	0		264	308
Order: Tricoptera:							
1.	*Hydropsyshae sp.*	352	176	0	0	0	0
2.	*Limnephilus sp.*	1848	0	0	0	0	0
Order: Coleoptera:							
1.	Elmidae sp.	352	0	0	0	0	0
Order: Diptera:							
1.	Simulium sp.	1100	0	0	484	0	0
2.	Bezzia sp.	1496	0	0	0	0	0
3.	Tiploidy sp.	132	0	0	0	0	0
4.	Limnonlli sp.	880	0	0	0	0	0
5.	Diamessa sp.	2552	0	0	0	0	1012
6.	Chironomous sp.	_	1144	1012	1716	1012	0
Order: Amphipoda :							
1.	*Gammaruspulex*	3432	1232	1980	1980	1540	1232
Order: Plecoptera:							
1.	Perilidae sp.	748	0	0	0	0	0
Total Arthropoda		17952	2992	3432	4444	3256	3344

Table 4. Population density of phylum Annelida (ind/m^2) recorded in Anchar lake

S.NO.	Species	Site I	Site II	Site III	Site IV	Site V	Site VI
Annelida							
Class: Oligochaeta:							
1.	*Tubifex sp.*	176	1540	1848	1232	1540	0
2.	*Limnodrillus sp.*	220	836	1012	528	528	0
Class: Hirudinea:							
3.	*Erpobdella sp.*	1980	1188	1672	1540	1540	1364
Total Annelida		2376	3564	4532	3300	3608	1364

Table 5. Population density of Phylum mollusca (ind/m^2) recorded inAnchar lake

S.NO.	Species	Site I	Site II	Site III	Site IV	Site V	Site VI
Mollusca							
Class: Gastropoda:							
1.	Lymnaea sp.	1452	308	220	792	836	528
Class: Pelecypoda:							
1.	Corbicula sp.	748	176	396	1144	968	484
2.	Promenetus sp.	1056	176	176	1100	0	0
Total Mollusca		3256	660	792	3036	1804	1012
Total macrozoobenthos		23584	7216	8756	10780	8668	5720

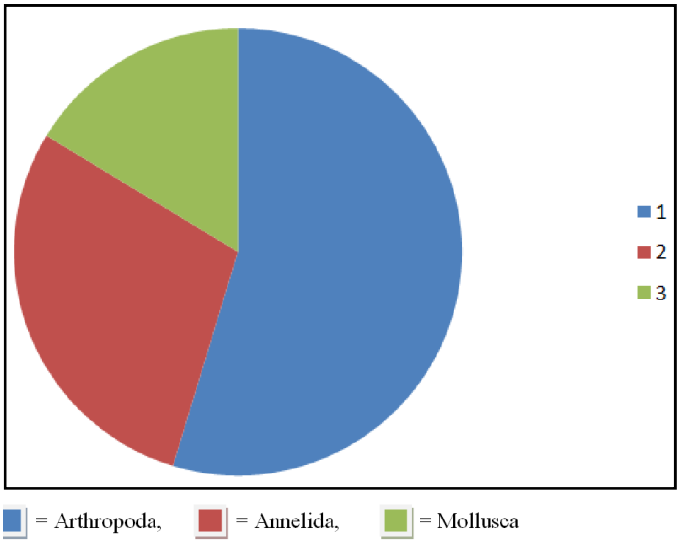


Fig. 2. Percent composition of macrozoobenthos inhabiting

Considerable seasonal variations in respect of certain physico-chemical parameters and macrozoobenthic invertebrate population in the lake were observed and are represented in (Tables 1, 2 and 3). During the period of present investigation, the air temperature of the lake ranged between a minimum mean value of 21 ^{o}C (S.D-6.8) at sites I, II,VI and maximum mean value 22^{o}C (S.D-6.9) at sites III, IV and V. The water temperature showed close relationship with the air temperature and ranged between a minimum mean value of 11^{o}C (S.D-1.1) at site I and maximum mean value 17^{o}C (S.D- 5.7) at sites III, IV, V and VI. In general, the seasonal increase or decrease of water temperature is related to the variation in the atmospheric temperature in different seasons of the valley. The ionic composition of water varied in close relationship with the catchment characteristics of the concerned water body. While the site I recorded the lowest conductivity, with a mean value of 153.6 µS/cm (S.D-21.9). The Jhelum receiving all sorts of allocthonus material from the catchment and having diversified catchment had the highest conductivity mean value 178 µS/cm (S.D-21.6) at site III. The increase in the conductivity values showed a close relationship with the human activity in the catchment of the concerned water bodies. The water of the whole lake system was well buffered and pH> 7 was recorded at all the study sites. The mean value of pH calculated for the investigated water body showed on alkaline trend ranging from minimum 7.4mg/l (S.D-0.26) at site I, III and to maximum 8.4mg/l (S.D-0.53) at site II and V during the study period. pH is principally a function of amount of Ca, Mg, Carbonate and Co_2 in the water. The lower pH of the river Jhelum clearly indicates that the impact of the domestic sewage on the water as the decomposition of the organic matter results in the decrease in the pH value and increase in the Carbon dioxide and bicarbonate content of the water. The alkalinity of the Ancharlake ranged from a minimum mean value 103.5 (S.D-12.7) at site VI and 156.6(S.D-15.9) at site I was mainly due to bicarbonates of Calcium and Magnesium. Higher alkalinity during summer months at all the sites might possibly, due to dilution owing to huge accumulation of water. Carbon dioxide is an important component of the buffer system in the river. The carbon dioxide ranging from a minimum mean value of 1.8mg/l (S.D-2.6) at site V and maximum mean value 9.6mg/l (S.D-1.3) at site I. lakes rich in carbon dioxide were comparatively more alkaline and increase its concentration resulted in an increase in alkalinity. The Total Hardness of the lake ranged between a minimum mean value of 96.6mg/l (S.D-42.2) at site III to a maximum mean value of 167.5mg/l (S.D-86.7). The hardness seemed to be influenced by the anthropogenic activity in the catchment area. Calcium was the dominant cation in the Anchar lake at site I, ranged between a minimum mean value of 39.1mg/l (S.D-19.3) at site VI and maximum mean value 68.4mg/l (S.D-37.9) at site I because of the calcium rich dominant rocks in the catchment areas. On the other hand, Magnesium hardness depicted highest mean value of 31.6mg/l (S.D- 16.9) at site I and lowest of 15.1mg/l (S.D-11.3) at site II. The Dissolved oxygen in the catchment area ranged between a minimum mean value of 6.8mg/l (S.D-1.1) at site V, and a maximum mean value 10.5mg/l (S.D-2.86) at site I. The mean concentration of chloride fluctuated between 8.4mg/l (S.D-2.2) at site I and 12.6mg/l (S.D-2.8) at site V. The site II, III, IV and VI depicted significantly lower concentration as against other sites. The presence of relatively high oxygen seems to be a function of good periphytic algal population liberating oxygen during photosynthesis (Reid, 1961 and Hynes 1979). A comparison of the physicochemical data represented by earlier workers (Vass, 1977; Pandit, 2001 and Yousuf, 2006).

Macrozoobenthos

A total of 21 species of macrozoobenthos were recorded during the period of present investigation. Arthropoda was the dominant group, comprising 15 species, followed by Annelids with 3 and Mollusca with 3 species. The maximum diversity (19 species) and population density (23584ind/m^2) was recorded at site I and minimum diversity (8 species) and population density (5720 ind/m^2) at site VI (Table 5). In general, the density of macrozoobenthic invertebrates are followed the spatial order as SiteI> Site IV > Site III >SiteV> Site II and Site VI . Among these phyla, Arthropoda was the most dominant (54.7%) and were followed by Annelida (28.9%) and mollusca (16.4%) (Table 2) and (Figure 2). At sites where human pressures were present (anthropogenic stress, Municipal sewage and domestic waste) taxa tolerant to pollution, such as Chironomidae, Oligochaeta and Hirudinea increased in abundance, while non-tolerant ones decreased (eg. some Ephemeroptera families). This change in the benthic composition has already been observed in other lakes, where anthropogenic impacts were most evident. Phylum Arthropoda was represented by class Insecta which was contributed by order Diptera, Tricoptera, Ephemeroptera, Coleoptera, Plecoptera and Amphipoda. The maximum density of insects was (17952ind./m^2) at site I and minimum density was (2992ind./m^2) at site II and at site III, it was (3432ind./m$^{2)}$, at site IV, it was (4444ind./m^2), at site V, it was (3256ind./m^2), at site VI it was (3344ind./m^2) (Table 3). Ephemeroptera and Trichoptera do not tolerate organic enrichmen (Takeda, 1999). The dipterans in the Anchar lake included *Chironomus sp.* And *Diamessa sp.* presence of bioindicators, *Chironomous sp.* indicates the effect of pollution. The numerical abundance of *Chironomous sp.* throughout the year indicates the pollution status of the lake as chironomids are the common inhabitants of polluted waters, water rich in nutrients and water poor in oxygen (Callisto, 2005; Clemente, 2005; Olomukoro, 2006 and

Manoharan, 2006). Phylum Annelida was represented by class Oligochaeta and Hirudinea. The peak oligochaeta was observed at site III due to the presence of numerically abundant *Tubifex sp.* (1848ind/m^2).The maximum density of Annelida was (4532ind./m^2) at site III and minimum density was (1364ind./m^2) at site VI (Table 4). The density of annelids increased in polluted areas. The members of Oligochaeta are usually favored by the organic environment and remain dominant in severally polluted conditions with special emphasis on *Tubifexsp*. which inhabit areas with strong sewage pollution and anoxic waters (Hawkes,1979). Presence of good organic detritus content contributed the maximum quantity of oligochaetes (Phylum Mollusca was the minor contribution to the overall population density of macrozoobenthos and was represented by class Gastropoda and class pelecypoda. The maximum density of Mollusca was (3256ind./$m^{2)}$ at site I and minimum density was (660ind./m^2) at site II (Table 5). The occurance and abundance of mollusca may be due to soft and organically rich bottom, alkaline nature of water and higher concentrations of calcium and bicarbonate alkalinity as has been reported by earlier workers (Aldridge, 2007; Garg*et al*., 2009; Manoharan, 2006). Amount of sunshine, water quality and amount of aquatic vegetation, depth, temperature, oxygen level and substrate have been suggested to affect the composition and seasonality of macrozoobenthic invertebrates (Dermott, 1985 and Rao, 1985). This all has been found true for all the classes of benthos in a stream as their density showed variation with sites having variation in temperature, Co_2 content, nature of substrate and inorganic and organic load.

Conclusion

The lake shows 21 species, out of them insects were well dominant at whole study area because of their potency to tolerate the organic pollution. The present study concludes that the presence of some pollution indicator species such as *Tubifexsp. Limnodrilussp.* (among Annelida) *Chironomous sp. Gammaruspulex* (among Arhropoda) *Lymneasp.* and *Corbicula sp*. (among Mollusca) directly points to the shifting status of the lake from non-polluted to polluted. Municipal sewage and domestic waste showed alarming shift or total elimination of sensitive biotic community form the habitat. As the human population continues to grow, it will contribute significantly towards the process of river biodegradation. This biosurvey of the macrozoobenthic invertebrate fauna gives an important insight into the health of the lake and appends the knowledge and understanding of the management strategies involving biomonitoring as a significant tool in the lake restoration studies.

Acknowledgments

The authors are very thankful to the Head, Hydrobiology Research Laboratory, Govt. S. P. College Srinagar for providing the necessary facilities and timely guidance whenever we were in great need and during the sampling periods. We also acknowledge the help provided by the research scholars of the Hydrobiology Research laboratory.

REFERENCES

Akhter. P., Sarwar, S. G. andYousuf, A. R. 1992. Abiotic features of two interconnected lakes of Srinagar, Kashmir. p. 219-223.In: Current Trends in Fish and Fishery Biology and Aquatic Ecology. (A. R. Yousuf, M. K. Raina and M. Y. Qadri, eds.). SahyogPrakashan 7/1, Pant nagar, Jangpora, New Delhi.

Ahangar I. A., M. Farooq Mir, D. N. Saksena and M. A. Ahangar. (2012). Zooplankton Diversity with Relation to Trophic Status In Anchar Lake, Kashmir. *Int. J. Curr. Res*. 4(7):46-48

Ahangar I. A., M. Farooq Mir, D. N. Saksena and M. A. Ahangar. (2012). Survey and Study of Phytoplankton Ecology in Anchar Lake, Kashmir, (India). *Int. J. Curr. Res*. 4(7):40-45

Ahangar I. A., M. Farooq Mir, D. N. Saksena and M. A. Ahangar.(2012). Crustacean Community in Anchar Lake.*Bull. Environ. Pharmacol.Life Sci*. 4(7):40-45

Ahangar I. A., D. N. Saksena and M. F. Mir.(2012).Seasonal variation in zooplankton community structure in Ancharlake. *Univ. J. Environ. Res. Tech.* 2(4):305-310

Balkhi, M. H., Yousuf, A. R. and Qadri, M. Y. 1987. Hydrobiology of Ancharlake, Kashmir.*Comp. Physiol. Ecol.,* 12 (3): 131-139.

Bhat, S. A., Rather, S, A. and Pandit, A.K.2001. Impact of effluents from SKIMS, Soura on Ancharlake.*J.Res.Dev*.,1: 31-38.

Burns, N. M. 1976. Temperature, oxygen and nutrient distribution patterns in Lake Eric (1970).*J. Fish. Res*. Board Canada., 33:485-511

Charu, P. and Savita, D. 2006. Seasonal variations in Physico-chemical Characteristics in Upper lake of Bhopal. *Asian J. Exp. Sci.,* 297-302

Das, S. M. and Akhter, S.1970. A report on the freshwater Cladocera from Dallake, Kashmir. *Kashmir Sci*.,7: 133-137.

Edmondson, W. T. 1970.Phosphorus, nitrogen and algae in Lake Washington after diversion of sewage. Science, 196: 690-691

Ishaq, M. and Kaul, V. 1988.Ca++ and Mg++ in Dal Lake, a high altitude Marl lake in Kashmir Himalayas. Int. Revue. Ges.Hydrobiol.,73 (4): 434-439.

Kaul, V. andHandoo, J. K. 1987. Chemical parameters useful in the evaluation of eutrophication and ecological state of lakes of Jammu and Kashmir. p. 363-367. In: Environmental Issues and Researches in India.(S. K. Agarwal and R. K. Garg,eds.).Himanshu Publications, Udaipur, India

Pandit, A. K. 1999.Freshwater Ecosystems of the Himalaya. Parthenon Publications,New York, London.

Pandit, A. K. andQadri, S. S. 1990. Floods threatening Kashmir wetlands. *J. Environ Manag*.,31 (4): 299- 311.

Pandit, A. K. 1993. Dal lake ecosystem in Kashmir Himalaya: Ecology and management. P.131-202. In: Ecology and Pollution of Indian lakes and reservoirs (P. C. Mishra and R. K. Trivedy, eds.). AshishPublishing House, New Delhi, India.

Pandit, A. K. and Yousuf, A. R. 2002.Trophic status of Kashmir Himalaya lakes as depicted by water chemistry. J.Res. Dev., 2: 1-12

Qadri, M. Y. and Yousuf, A. R. 1978.Seasonal variation in the physico-chemical factors of a subtropical lake of Kashmir. J. Inland Fish Soc.India,10: 89-96.

Qadri, M. Y. and Yousuf, A. R. 1979.Physico-chemical features of Beehama spring.*Geobios*,6:212-214.

Rather, S. A. Bhat, S. A. and Pandit, A. K. 2001. Water quality of Hokarsar, a typical Wetland of Kashmir. *J. Res. Dev*., 1: 36-43.

Sahu, K. and Mehta, A. 2007. Physico-chemical and Bacteriological studies of Daphrin Hospital Discharge at Sagar, MadhayaPradesh.*Asian J. Exp.Sci*., 21:309-314

Suthura S. S., Pathak D. and Singh R. 2002. Physico- chemical properties of some freshwater bodies of Hanumangarh and Srignganagar district of Rajhasthan. *Poll.Res*., 24(3), 695-698

Yousuf, A. R., Pandit, A. K. and Qadri, M. Y. 1992.Changes in the physical and chemical limnology of Lake Manasbal, Kashmir, from 1976-1988. P. 199-206. In: Current Trends in Fish and Fishery Biology and Aquatic Ecology. (A. R. Yousuf, M. K. Raina and M. Y. Qadri, eds.). SahyogPrakashan, New Delhi.

Yousuf, A. R. 1995. Changing relationship between human society and aquatic ecosystems in Kashmir Himalaya.In:Society and Culture in the Himalaya. (K. Warikoo, ed.).pp. 55-65. Har Anand Publications, New Delhi.

Zutshi, D. P., Subla, B. A., Khan, M. A. and Wanganeo, A. 1980. Comparative limnology of nine lakes of Jammu and Kashmir Himalayas. *Hydrobiol*., 72 (1-2):101-112.

Zutshi, D. P. and Vass, K. K. 1973. Variations in the water quality of some Kashmir lakes.*Trop.Eco*., 14(2):182-196.

****