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Influence of Pilgrimage on The Macro- Benthic Invertebrate Biodiversity of Stream Ban- Ganga, Katra, J&K, India

KEYWORDS: pilgrimage, Ban-Ganga, water quality, annelid, arthropoda, mollusca

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ABSTRACT *The aim of this study was monitoring of benthic fauna to study the impact of pilgrimage on the stream Ban-Ganga. Selected physico-chemical water quality parameters were also analyzed at the selected five stations framed for the study. Phylum Annelida was the dominant group followed by Arthropoda and Mollusca at all the stations. Station III and IV, which were under the most anthropogenic stress showed the maximum abundance of pollution indicator groups while the Station I showed the abundance of EPT. Concomitantly, the variations in the limnological parameters were also recorded.*

INTRODUCTION

Assessment of changes in aquatic ecosystems can be effectively monitored using benthic fauna, as they play an important role in the transfer of materials from primary production through the detrital pool into higher trophic levels. Historically, invertebrates have received considerable attention in the study of running water ecosystems (Cummins, 1992). In particular, relationships between macroinvertebrate community structure and environmental variables have been the subject of numerous investigations. Invertebrate communities are also good indicators of water quality conditions (Resh, 1995). Furthermore, studies of temporal variation in the community structure of streams (Fisher et al., 1982; Scrimgeour & Winterbourn, 1989) have indicated that physical disturbances can be an important determinant of community structure in lotic systems (Sousa, 1984; Resh et al., 1988). Presently, therefore, an endeavor has been made to study the macro- benthic invertebrate bio- diversity of the stream Ban- Ganga in Katra in order to chart out the impact of anthropogenic stress on the stream.

MATERIALS AND METHODS

Study area:

Ban- Ganga, a shallow water stream originates from Trikuta hills of Shivalik

Himalayas. The path of stream flowing and flanking the path leading to the holy shrine of Mata

Vaishno Devi (which is being visited by lakhs of pilgrims annually) is the most celebrated one. The path has been divided into 5 stations on the basis of various pollutants they receive:

1. Station 1: clean and pollution free.
2. Station 2: receives pony dung
3. Station 3: has bathing and washing activities, receives effluents from various dhabas situated on its bank. Flour balls are added by pilgrims to feed fishes.
4. Station 4: receives huge amount of kitchen waste from Gulshan Langer that caters thousands of pilgrims daily.
5. Station 5: station is quite far-away and has no anthropogenic interference.

Benthic Analysis:

The soil samples were collected with sampler, washed through a sieve of 1 mm × 1mm mesh size to collect the benthic organisms. The washed sediment with the benthic macro-invertebrates were poured into a white enamel tray and sorted in the laboratory. For effective sorting, moderate volume of water was added into the container to improve visibility.

Forceps were used to pick large organisms while smaller ones were sorted out using soft brush. The macro-invertebrates were poured into a wide mouth labeled plastic container and preserved with 5% formalin solution. The preserved benthos were later identified to their lowest taxonomic group under light and stereo dissecting microscope and counted. The identification was done using the keys (Ward and Whipple, 1959, Needham, 1962, Tonapi, 1980).

Water Analysis:

Water samples were collected from each station for the determination of physico- chemical parameters following APHA (1975):

Temperature: by mercury bulb thermometer
FCO2: by titrimetric method
DO: by modified Winkler's Azide method
Cl^- : by Argentometric method

RESULTS AND DISCUSSIONS

Results

A. Macro benthic diversity

The results of benthic analysis tabulated in table 1 indicated that the stream is chiefly populated by three phyla viz; Annelida (represented by 4sps. of oligochaetes and 1 sp. of Hirudinea), Arthropoda (represented by 2sps of Coleopterans, 1 sp of Trichopterans and 5sps., of Ephemeropterans) and Mollusca (represented by single species).

Presence of different groups of benthic organisms, when viewed along the profile from head to mouth, further revealed that:

Station I:

was inhabited by Coleoptera (2 sps.), Odonata (1 sps.), Ephemeroptera (5 sps.), Trichoptera (1 sp), Diptera (2 sp), Oligochaeta (2 sp.), and Mollusca (1 sp.) except Hirudinea which was totally unrepresented here.

Station II:

showed the presence of Coleoptera (2 sps.), Ephemeroptera (3 sps.), Trichoptera (1 sp), Odonata (1 sps.), Diptera

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(4 sp), Oligochaeta (3 sps.), and Mollusca (1 sp.). Few number of leeches were also observed but for a brief period.

Station III:
this station also lacked Hirudinea throughout the study period and exhibited the presence of Coleoptera (2 sps.), Ephemeroptera (3 sps.), Trichoptera (1 sp), Odonata (1 sps.), Diptera (5 sp), Oligochaeta (4 sps.), and Mollusca (1 sp.).

Station IV:
found the representation mainly of Diptera (5 sp), Oligochaeta (4 sps.), Hirudinea (1sp.), Mollusca (1 sp.), Ephemeroptera (1 sps.), and Odonata (1 sps.). This station exhibited the complete absence of Coleopterans and Trichopterans throughout the study period.

Station V:
showed the presence of almost all benthic groups except Trichoptera whereas Ephemeroptera (4 sps.), Diptera (5 sps.) and Oligochaeta (3 sps.) exhibited their marked presence. Hirudinea Coleoptera, Odonata and Mollusca were represented by single species each.

B. Water quality
Results of analysis of the water quality parameters tabulated in table2, revealed that

Water Temperature showed on increase descending towards station V which could be increase in the anthropogenic influences. Highest water temperature at St IV could be due to the fact that this site receives huge amount of kitchen waste from langer. Because of the additive effect of waste run off which is known to be thermally more heated the unusually high temperature of the station is easily explainable (Panda et al., 1991).

Dissolved oxygen
was highest at St I as compared to other stations which speaks of its unpolluted condition while lowest at St IV which receives large amount of kitchen wastes and sewage as already stated.

Free carbon dioxide
also increased along the longitudinal profile but maximum was recorded from St IV due to high sewage load. Also, the high temperature increases the decay and decomposition process thus causing a rise in carbon dioxide level.

Chlorides were
found in high amount at all the stations except for St I which could be due to its unpolluted status, while highest chloride was recorded at St IV. Presence of animal excreta and domestic sewage could be reasoned for high chloride content (Kumar 1990).

Discussions
It is clear from the findings that in stream Ban- Ganga out of 3 major groups phyla Annelida contributed the most followed by Arthropoda and Mollusca. As the benthic fauna is bio- indicator of ecological conditions of any aquatic system (Sarang and Sharma, 2009), their presence or absence depicts the impact of anthropogenic stress at a particular site (Sharma and Chowdhary, 2011).

Abundance of group Annelida could be due to availability of soft bottom for borrowing and availability of food materials (Schenkova et al., 2001 and Nijboer et al., 2004). It could also be due to the organic matter enrichment and deposition of algae and mosses on large stones and other hard substrates as these provide feeding materials to the members of this group (Battish and Sharma, 1997; Baturina, 2012). Also, the prevailing physico- chemistry of water provided them the suitable conditions.

Among arthropods, abundance of diptera could be due to the reason that this group has hemoglobin pigment in the blood that enables them the broad oxygen tolerance (Laguaze 're et al., 2009). Also, the group is found in all water types from cleanest situations to the most polluted ones (Paine and Gaufin, 1956). The representatives of diptera found during the present study are regarded as the pollution indicators and their maximum number was found at St III and IV, the sites under anthropogenic stress which ultimately can be explained on the basis of less DO more FCO2 and Cl- (table 2). Least abundance of Ephemeroptera, Trichoptera at such sites could be due to their sensitivity to environmental stress (Hall et al., 2006). Yap et al., 2003 also regarded EPT as the bio indicators of clean ecosystems. Abundance of Coleopterans at the upper reaches of the stream further confirmed that this group is the inhabitant of clean waters (Olomukuru and Dirisu, 2014)

Besides, other faunal groups, Molluscs also form an important faunal component (Sarvankumar et al. 2009). Although phylum Mollusca had the least contribution to the overall benthic fauna, yet was mainly represented by class Gastropoda. Gastropods play a vital role at the debris interface as they consume living and decaying plant and animal materials (Brendan et al., 2007). Presence of Gastropods could be related to some levels of pollution (Garg et al., 2009 and Sharma et al., 2013).

Conclusion
So, on the basis of the collected macro – benthic invertebrates, it can be said that the stream Ban- Ganga was a clean water stream being rich in diversity but the increasing anthropogenic stress has deteriorated the conditions by favoring the pollution resistant species at the expanse of pollution sensitive species.

Table1: representation of macro- benthic invertebrates along the various stations of stream Ban- Ganga during the years 1994 & 1995.

Stations & species	Station I	Station II	Station III	Station IV	Station V
Annelida					
Oligochaeta					
Tubifex sp.	-	-	+	+	+
Limnodrilus sp.	+	+	+	+	+
Lumbriculus sp.		+	+	+	+
Nais sp.	+	+	+	+	+
Hirudinea	-	+	-	+	+
Leech	-				

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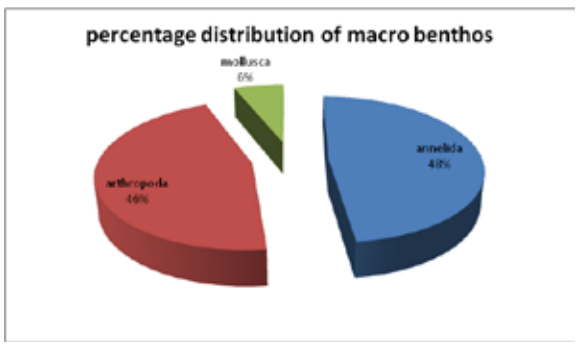
Arthropoda	+				
Coleoptera					
Psephenus sp.	+				-
Ectopria sp.	+	+	+	+	+
Trichoptera		+	+	-	-
Hydropsyche sp.		+	+	-	
Ephemeroptera	+				+
Centroptilum sp.		-	+	-	+
Cingymule sp.	+	+	+	-	+
Ephemerella sp.	+	+	+	+	-
Heptagenia sp.		-	-	-	
Leptophlebia sp.	+				+
Odonata		+	+	+	
Anax sp.	+				+
Diptera		+	+	+	+
Chironomous sp.		+	+	+	+
Pentaneura sp.	-	+	+	+	+
Psychode sp.	+	+	+	-	+
Simulium sp.		-	+	+	
Tabanus sp.	+				
	+				
	-				
Mollusca					
Gastropoda					
Gyraulus sp.	+	+	+	+	+

Table 2: showing the physico-chemistry of stream Ban -Ganga

Stations→ Parameters↓	St I	St II	St III	St IV	St V
Water temp(° c)	20.4	21.04	20.09	23.26	22.68
DO (ppm)	6.66	5.88	5.66	3.79	5.12
FCO2(ppm)	3.92	5.10	5.56	8.11	7.15
Cl-(ppm)	7.95	8.87	9.42	12.5	11.2

Figure 1: Showing percental distribution of various benthic at different stations of stream Ban – Ganga



REFERENCE

Adoni, A.D., (1985) Workbook on limnology. Pratibha Publishers, C – 10, Gour Nagar Sagar- 470003, India: 216. | APHA (1975) Standard methods for the examination of water and waste water, 12th Amer. Publ. hlth. Assoc. Inc., New York. | Battish S.K. and M.Sharma (1997) Fresh water oligochaetes with new records from India, Geobios new reports 16: 80-84. | Baturina M. (2012) Distribution and diversity of aquatic Oligochaeta in small streams of the middle taiga. Turk J. Zool., 36(1): 75-84. | Brendan P, K.J.C. Castilla, L. Prado, P. York, E. Schwindt, A. Bortolus, (2007) Spatial variation in molluscan assemblages from coralline turfs of Argentinean Patagonia. J. Moll. Stu., 73:139-146. | Cummins, K.W. (1992) Invertebrates. In Calow, P. &G. E. Petts (eds), The Rivers Handbook. Blackwell Science, Oxforsd: 234- 250. | Fisher, S. G., L. J. Gray, N. B. Grimm & D. E. Busch, 1982. Temporal succession in a desert stream ecosystem following flash flooding. Ecol. Monogr. 52: 93–110. | Tonapi, G.T., (1980) Freshwater animals of India. An EcologicalApproach. Oxford and IBH publishing co., New Delhi, Bombay, Calcutta, 341. | Garg R.K., R.J. Rao and D.N., Saksena (2009) Correlation of molluscan Diversity with physico-chemical characteristics of water of Ramsagar reservoir, India. Inter. J. Biodivers. Conserv. 1(6): 202-207. | Ward, H.B., G.C., Whipple (1959) Freshwater Biology. (2nd Edn.) John Wiley and Sons, Inc. New York, 1248. | Hall L.W., W.D. Killan and R.D. Anderson (2006) Characterization of benthic communities and physical habitat in the Stanislaus, Tuolumne, and Merced Rivers, California. Environmental Monitoring and Assessment, 115, 223- 264. | Needham J.G. and Needham P.R. (1962) Fresh water biology. Holden Day Inc. San Francisco. | Kumar, N., (1990). Altitude related Limnological variations in some ponds of Jammu province. Ph. D thesis , University of Jammu, Jammu. | Nijboer R.C., M.J. Wetzel and P.F.M. Verdonschot (2004). Diversity and distribution of Tubificidae, Naididae, and Lumbriculidae (Annelida: Oligochaeta) in the Netherlands: an evaluation of twenty years of monitoring data. Hydrobiologia 520: 127-41. | Olomukoro, J.O and, A.R. Dirisu (2014) Macroinvertebrate Community and Pollution Tolerance Index in Edion and Omodo Rivers in Derived Savannah Wetlands in Southern Nigeria, 7,(1),19 -24 | Paine, George H. (1956) Gaufin, Arden R Aquatic Diptera as Indicators of Pollution in a Midwestern Stream Ohio Journal of Science: Volume 56, Issue 5 (September, 1956) 291- 304 | Panda, R.B., B.K. Sahu, B.K. Sinha and A. Nayak (1991). A comparative study of diurnal variation of physico-chemical characteristics of river, well and pond water at Rourkela industrial complex of Orissa. J. Ecotonical Environ. Monit, 1(3) 206-217. | Resh, V. H .(1995) Freshwater benthic macroinvertebrates and rapid assessment procedures for water quality monitoring in developing and newly industrialized countries. In Davis, W. S. & Resh, V. H., A. V. Brown, A. P. Covich, M. E. Gurtz., H. W. Li, G. W. Minshall, S. R. Reice, A. L. Sheldon, J. B. Wallace & R. C. | S. Lagauze` re, L. Pischedda, P. Cuny, F. Gilbert, G. Stora, J.-M. Bonzom (2009) Influence of Chironomus riparius (Diptera, Chironomidae) and Tubifex tubifex (Annelida, Oligochaeta) on oxygen uptake by sediments. Consequences of uranium contamination. Environmental Pollution, 157(4): 1234-1242. | Sarang, N. and Sharma L.L. 2009. Macro benthic fauna as bio indicator of water quality in Kishore sagar Lake, Kota (Rajasthan) India. International Lake Environment Committee 13th Conference Paper (Wuhan). | Schenková J., Komárek O. and Zahrádková S., 2001. Oligochaeta of the Morava and Odra River basin (Czech Republic): species distribution and community composition. Hydrobiologia 463: 235-240. | Scrimgeour, G. J. & M. J. Winterbourn, 1989. Effects of floods on epilithon and benthic macroinvertebrate populations in an unstable New Zealand river. Hydrobiologia 171: 33–44. | Sharma, K. K. and Chowdhary S., 2011. Macro invertebrate assemblages as biological indicators of pollution in a Central Himalayan River, Tawi (J&K), International Journal of Biodiversity and Conservation, 3, 5, 167-174. | Sousa, W. P., 1984. The role of disturbance in natural communities. Ann. Review Ecol. Syst. 15: 353–391 | T. P. Simon (eds), Biological Assessment and Criteria. Lewis Publishers, England, 167–177. | Yap C.K., Rahim A., Ismail A. and Tan S.G., 2003. Species Diversity of Macrobenthic invertebrates in the Semenyih River, Selangor, Peninsular Malaysia, Pertanika J. Trap. Agric. Sci., 26, 2, 139-146. |