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Research Article

TRENDS IN THE DISTRIBUTION OF MACROBENTHIC FAUNA OF RIVER TAWI IN THE VICINITY OF JAMMU CITY IN VIEW OF CONSTRUCTION OF BARRAGE ACROSS THE RIVER

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ABSTRACT

River Tawi is one of the most important sources of drinking water for the people of Jammu city as about 26 mgd (million gallons per day) water from three water treatment plants Sitlee (20mgd), Dhountli (4mgd) and Boria (2mgd) is pumped from the river to cater to the needs of drinking water in Jammu. Not only this, recently it has become the focus of water infrastructure development scheme of J&K state Govt. As suggested by various studies, structures such as dams, barrages, weirs etc. change the ecological scenario of a water body in long or short term as they wholly or partially convert a lotic system to a lentic one. A similar project has been started on river Tawi, as a barrage is being constructed on the river which will convert a part of river to an artificial lake. This pondage cum lake is proposed as an integrated tourism project which further will be used for various purposes. Water from the reservoir will be used to augment the Ranbir irrigation canal (source of water River Chenab) during the dry period, serve as a source of attraction for birds, also thought to help in bringing down the temperature of the city to some extent and also help in recharging ground waters. Along with these agricultural and ecological roles, the project will also act as a tourist spot as it will provide the recreational facilities like fishing, boating, water sports etc. Anthropogenic stress is already piling on the river as reported by Jammu and Kashmir State Pollution Control Board (JKSPCB), nearly 18 sewage channels keep on dumping filth, polythene, other waste and polluted water of the city, into the Tawi. Along with this waste from the Gujjar Nagar (Jogi Gate crematorium), agricultural discharges from the catchment areas, religious waste and encroachment on the banks have further worsened the problem. In view of this, a study was conducted on the impact of anthropogenic stress on the river in view of ongoing construction of barrage on the river. Four stations were selected on the river two upstream Gujjar Nagar bridge (Station-I) & Near Mosque (Station-II), one on the site of barrage (Station-III) and one downstream the barrage ahead of Bhagwati Nagar bridge (Station-IV) and impacts were expressed in terms of qualitative and quantitative trends in the distribution of macrobenthic invertebrates which are one of the most important tools in assessing riverine ecosystem health.

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INTRODUCTION

Riverine systems are one of the most important ecosystems that provide multitude of services to mankind. Oldest and biggest of civilizations have thrived on the banks of big rivers and the trend continues as a large chunk of world population is concentrated along the banks of rivers or river deltas. Unfortunately, the rapid increase in human population owing to fertile agriculture friendly lands of river deltas and easily available water for irrigation along with various advancements of science in various fields, has increased human interference in riverine ecosystems and man has evolved innovative ways for the use of aquatic resources, discovered uses which were unknown previously. Extensive and careless tapping of riverine resources has led to substantial habitat fragmentation in small and large rivers causing biodiversity crisis. Continuous disturbance to natural flow regime of a river by humans results in general suppression and sometimes permanent loss of environmental heterogeneity and biodiversity along with loss of productive capacity of biotic resources (Warren and Liss, 1980). Therefore, studies are required not only for the conservation and restoration of biodiversity against anthropogenic disturbances but also to assess the response of aquatic organisms to ecological gradients, which is very important to separate the effects of pollution from the effects of natural daily and seasonal physico-chemical variables (Rossaro

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and Pietrangelo, 1993).It will go a long way to evolve better bio-assessment tools for studying the integrity of lotic systems. Macroinvertebrate respond sensitively to environmental alterations that further change composition and community structures (Rosenberg and Resh, 1993 & Charvet *et al*., 2000). Therefore studies on the distribution patterns of macroinvertebrate assemblages based on their environmental relationships are of utmost importance. Macrobenthic invertebrates are very commonly used as bioindicators due to their relatively predictable reactions to anthropogenic influences in aquatic ecosystems (Covich *et al*., 1999), low or negligible mobility, relatively static habitat preference and easy availability for study purposes. Quantitative and qualitative aspects of macroinvertebrate populations in various lentic and lotic ecosystems has been studied in the past by various workers especially in J&K state (Sharma, 2000; Sawhney, 2004; Mushtaq, 2007; Sawhney, 2008, Chowdhary, 2011, Sharma *et al*., 2011). Present study focusses on the trends of macroinvertebrate distribution and abundance in River Tawi in response to the construction of barrage and pollution load in the stretch of river Tawi in the vicinity of Jammu city.

Study Area

The study was carried out during the period of one year August 2013 to July 2014 on four stations on River Tawi which is a major River in Jammu region. It is the left bank tributary of river Chenab originating from Kali Kundi glacier at an altitude of nearly 4000 meters located on the south west of Bhaderwah in the Doda district of J&K state. The flow of water in the river has been decreasing in recent years as the source glacier (Kali Kundi glacier) has been retreating. It flows through some parts of Doda district, Udhampur reaches Jammu from where it finally merges into Chenab in Pakistan. It lacks any proper macrophytic growth and is very prone to flash floods. It has religious significance too and is known as "Surya Putri". Currently under profound anthropogenic stress, river flows severely polluted especially in the vicinity of Jammu city as it passes almost through the centre of city and divides it into two parts. Five bridge sites and encroachment on the banks are one of the most conspicuous pollution sites along with various sewage canals and nullahs entering the river various sites. Another recent development is the construction of barrage across the river. Thus, in this context, a study of the trends in the distribution of macrobenthos was made.

METHODOLOGY

The bottom soil samples from already specified four stations of river were collected using an Ekman dredge having an area of 232 cm^2. The soil samples collected were sieved immediately using no. 40 mesh size sieve (256 mesh per cm^2). The organisms retained were segregated and their abundance was calculated as number per square meter according to the formula*. Preserved samples of macrobenthic invertebrates were identified according to Ward and Whipple (1959), Tonapi (1980), Adoni (1985) and Pennak (1978). 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 macrobenthic organisms/m^2.
O = no. of organisms counted.
A = area of metallic samples in square meter.
S = no. of samples taken at each stations

RESULTS AND DISCUSSIONS

Qualitative analysis: Qualitatively River Tawi was found to be relatively poor as only three phyla were represented in the macrobenthic fauna. Eleven genera belonging to three phyla were reported:Phylum Arthropoda represented by Class insecta (Order Diptera and Coleoptera), Phylum Annelida represented Class Oligochaeta and Phylum Mollusca represented by class Gastropoda.

Arthropoda was dominant qualitatively with 6 taxa belonging to single class Insecta: *Chironomous* sp. *Pentaneura* sp., *Eristalis* sp., *Tabanussp*. (Order Diptera), *Berosus sps. and Hydroglyphus sps.* (Order Coleoptera). The second in order was Mollusca represented by three taxa belonging to single class Gastropoda: *Physa* sp., *Lymnea* sp., and *Gyraulus* sp. And finally, Annelida was represented by only two taxa from class Oligochaeta: *Tubifexsp*. and *Pheretima* sp.

Quantitative analysis: Quantitatively, group Arthropoda contributed the maximum followed by Annelida and then, Mollusca. Population boom of arthropods were mostly contributed by *Chironomids* while *Tubifexsp*. were numerically abundant from the phylum Annelida and *Physa sp.* led the Phylum Mollusca. As established already and thoroughly studied, presence of absence of macroinvertebrates species and their numerical abundance in a water body depicts the status of that water body. Alarming numerical abundance of chironomids suggest the anthropogenic influence, high levels of pollution tolerance and wide adaptability to DO extremes. Low numerical abundance of Coleopterans as compared to Dipterans can be attributed to the wide range of adaptability of Dipterans (Verma and Saksena, 2010). Numerical abundance of *Tubifex sp*. among Annelids can be attributed to organic matter enrichment at the study stations. Abundance of *Physa sp*.could be attributed to the presence of soft substratum and ability to survive under harsh conditions such as unstable temperature and water pollution (Sharma *et al*., 2013).

Seasonal trend: Macrobenthic invertebrates showed two maximas, in summers and winters dominated by different orders. Monsoon season recorded the minimum availability of macrobenthic invertebrates. The decreased availability of macrobenthic invertebrates during monsoons (July- August) can be attributed to unstable substratum due to flushing (Ysebaert *et al*. 2003) as Tawi is very prone to flash floods. Arthropoda dominated by *Chironomids* showed winter maxima which can be attributed to comparatively high DO, low water level in winters, low water velocity, lower temperature causing accumulation of organic matter due to slow decomposition (ChandraKiran, 2011) while Mollusca dominated by *Physa sp*. showed summer maxima which can be attributed to substratum rich in organic matter that provides easy food availability, reproduction site for the individual (Jose and Salas, 2007). Annelids also showed summer maxima but were found throughout the year.

Station-vise trend: Comparative study of Station I & IV showed highest number of macroinvertebrates while Station-III reported the lowest number. Low number of benthic macroinvertebrates at Station-III can be attributed to disturbed

flow regime of river at the station due to construction of barrage (Bredenhand & Samways, 2009). Physical disturbance to river bed due to dredging, sand extraction, bulldozers, tractors and trucks supplying construction material along with various machines like stone crushers etc. being used and repetitively diverging the water course during dry season at this station and bund barriers for aid in construction work (Bunn & Arthington 2002). High number of macroinvertebrates at Station I & IV is attributed to high organic pollution at these sites due to many sewage canals entering the river at or near these stations, garbage and other organic waste.

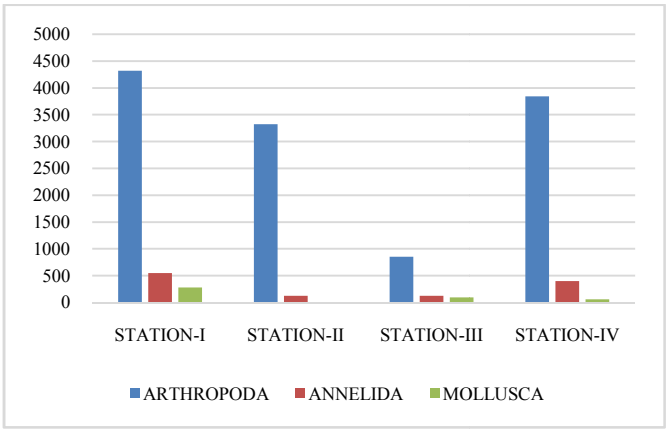

Fig A Chart showing the comparative abundance of Arthropoda, Annelida and Mollusca at all four study stations during the study period (Aug., 2013 to July 2014).

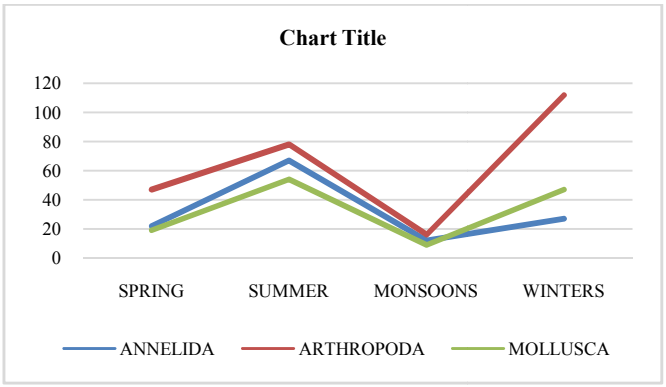

Fig B Seasonal maxima and minima of macrobenthic phyla in river Tawi during the present study (Aug., 2013 to July, 2014):

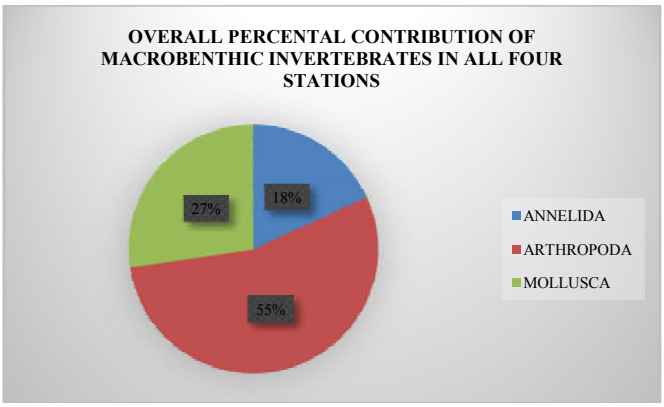

Fig C Percental contribution of Macroinvertebrate phyla (Qualitative) to the benthic community of river Tawi during the present study (Aug., 2013 to July, 2014):

CONCLUSION

From the above results, it can be safely concluded that river Tawi is under stress which is being reflected in the trends of macrobenthic fauna of the river. Construction of barrage has not only altered the physical as well the biological aspects of river but also slowed down the natural process of self-cleansing of the river. Although the project is still ongoing, so extent of damage can only be fully assessed after completion of project and periodical studies later. But still, qualitative and quantitative distribution of benthic macro-invertebrates clearly indicated deteriorating water and sediment quality of the river and the eutrophication process which has been hastened by the construction of barrage and disturbance to river bed. Thus, this barrage is definitely not in favour of health of river Tawi. A sustainable approach and effective pollution control measures are needed on the part of people and Govt. in order to save this river along with its flora and fauna.

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