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DIVERSITY OF FISHES IN RELATION TO ABIOTIC STATUS OF VAISHAV STREAM KULGAM, KASHMIR

Bilal Ahmad Naikoo, Ranju Gupta & S. M. Zuber
Department of Life Science, Dr. C.V. Raman University, C.G., India-495001
Govt. Degree College (Boy's) Anantnag Kashmir, Jk -192101

ABSTRACT
The fish fauna inhabiting Vaishav stream in relation to its abiotic status was carried out on monthly basis from Jan.-2015 to June 2015. Samples were collected at three sites – Watoo, Kulgam and Arwani. During the present investigation a total of seven species of fishes were recorded – *Schizothorax plagiostomus*, *S. esocinus*, *S. labiatus*, *Typhlophysa kashmirensis*, *T. marmorata*, *Salmo trutta* fario and *Oncorhynchus* mykiss. The species diversity was peak during summer month (march-June) and decline during winter months (Jan-Feb). Dissolved oxygen was found highest during winter due to low biological activities. Turbidity greatly affects fish fauna and other aquatic life by interfering with sunlight penetration and reduces photosynthesis. The other abiotic factors responsible for changing the diversity of fish fauna are discussed in detail.

KEY WORDS: Fish fauna, S*hizothorax, Diversity*, Vaishav stream, DO pH.

INTRODUCTION

Kashmir "Paradise on Earth" is a cherished abode of crystal clear water which runs through lakes, rivers and streams besides snow clad mountains and spring fed vast meadows, small mountain tarns and alpine forests which adorn it. Above all nature has gifted the valley a vast array of both lentic and lotic water resources. The lotic habitats include numerous streams like Jhelum, Vaishav, Rambiara, Lidder, Dudhganga, Sindh etc., which form a mesmerising network throughout the length and breadth of the valley. All these streams harbour a number of indigenous fishes like *Schizothorax* spp., *Glyptothorax* spp., *Triplophysa* spp., *Barbus* spp., *Labeobarbus* spp., *Corbitis* spp., *Silurus* spp., *Crossochilus* spp., *Nemachilus* spp. etc as well as the exotic trout viz., *Oncorhynchus mykiss* and *Salmo trutta fario*. Fish constitutes slightly more than half of the total number of approximately 54,711 recognized vertebrate species (Nelson, 2006). Of these 8411 are fresh water species and 11650 are marine. Fishes play an important role in the economy of a nation. Besides being a cheap source of highly nutritive protein; it contains essential nutrients like ω3-fatty acid, unsaturated fatty acids etc required by the human body (Skokie and Otoboteker, 1999).Subsequently fish is an important cash crop in many regions of world and programmes for managing their lentic and lotic abodes are being taken up by the respective governments for enhancing the fishery potential of these inland waters. All living organisms have tolerable limits of water quality parameters in which they perform optimally. A sharp drop or an increase within these limits has adverse effects on their body functions (Kiran, 2010). Needless to mention due to unregulated and ill management of technological wastes, the aquatic ecosystems have been rendered as mere sinks and consequently many workers (Zubair and Ahrar, 2013; Adil *et al*.,2013 and Dar and Saima, 2014) have worked on the physicochemical parameters of these life sustaining systems. So, good water quality is very essential for survival and growth of fish. Although fish communities may have a high degree of natural variability, they can be useful indicators of ecosystem health (Moyle , 1994). As we know fish is an important protein rich food resource and there has been sharp increase in demand of fish products due to increasing population pressure. Thus to meet the demand of present food supply, fish production needs to be increased manifold for which water quality management is required to be taken up on priority basis. It is in this context that the present study on fishes has been undertaken with a view to obtain the baseline data on such an important group of animals serving as an important link in the aquatic food chain and being very good and sensitive bio-indicators to monitor the trophic status of the water body.

MATERIALS & METHODS

Description of study area

Vaishav stream is an important left bank tributary of the river Jhelum with an altitude of 2,250 m. It drains most of the northern face of the Pir Panjal. It has a catchment area of 1,230 km^2. During the passage through the Pir Panjal, Vaishav forms the famous cascade of Aharbal. It lies at an altitude of 2266 metres above sea level. It has its origin from a perennial Oligotrophic Kounsarnag lake located in the mountainous range of pir Panjal ,having an area of 1.37 km^2 at an elevation of about 3,670 metres above sea level and extending between the geographical co-ordinates of 33º 30′ 12.30″ N latitude and 74º 49′ 59.30″ E in Pir Panjal Range. It merges with the river Jhelum at Sangam. The Kounsarnag Lake is about 30 kms from the Aharbal water fall. During its passage from the Aharbal water fall it gets divided into a number of branches below Kulgam which joins the river Jhelum at Sangam. The present work

deals with the diversity and distribution of fishes with relation to water quality of stream Vaishav. For the sake of convenience the methods used for the study are described under the following two heading;

Fish collection and their distribution pattern

A through survey of the study area was done to collect the fishes. Distribution pattern of fishes was carried out randomly. Three sites were selected along the course of Vaishav stream. Fishes were collected from the selected sites during the study period from January 2015 to June 2015 with the help of local fishermen using different types of nets namely gill nets, cast nets and Dragnets. Immediately photographs were taken prior to Preservation of species, since formalin decolorizes the fish colour on long preservation. Formalin solution was prepared by diluting one part of concentrated formalin or commercial formaldehyde (10% formalin). Species brought to the Laboratories were fixed in this solution in separate jars according to the size of species. The fishes collected and fixed were labelled giving serial numbers, exact locality from where collected; date of the collection, the common local name of fish used in this region was labelled on each jar. Identifications were carrying out in the laboratory.

Physico-chemical analysis of water

For physico-chemical analysis, water samples were collected in polythene bottles just below the surface of water during morning hours between 8 to 11 am and further transported to the laboratory immediately for further analysis. Water temperature was measured at the time of sampling using mercury thermometer. DO was fixed in stoppared bottles on spot, pH was measured with standard pH meter, conductivity was measured using conductivity meter; turbidity was measured using turbidity meter, while the analysis of other parameters were done in the laboratory with in 24 hrs according to the methods suggested by American Public Health Association APHA and CSIR (1974).

RESULTS & DISCUSSION

The diversity of fisheries mainly depends upon the physico chemical characters of water and the type of ecosystem. A total of seven species of fishes were identified (Table: 1). Among 7 species of fishes, the family *Cyprinidae* was the most abundant in the assemblage composition with 69.68 % followed by, *Balitoridae* 16% and with *salmonidae* 13.65%. Among the seven species of fishes *Schizothorax plagiostomus* were the most dominant with 39.5% followed by *S. labiatus* with19.18%, *S. esocinus* with 11%, *T. marmorata* with 10%, *Salmo trutta fario* with 8.13%, *T. kashmirensis* with 6.3% and *Oncorhynchus mykiss* with 5.52%. *S. trutta fario* and *Oncorhynchus mykiss* was completely absent at Site-III, being present only at Site-I and Site-II, that revealed its preference for cold, well oxygenated upland water, especially large streams in mountainous areas. *Schizothorax plagiostomus, S. labiatus, S. esocinus* were present at Site-III which reveals their tolerance to polluted waters. Areas with more pollution load have communities dominated by tolerant species. Similar results on distribution pattern were obtained by Hayes *et al.* (2010) on fish distribution patterns and their association with environmental factors in the Mokau River. The diversity and distribution of fishes in Vaishav stream shows variation at different study Sites during the study period (Table 1). The present study showed that the fish diversity of the study area is reducing from upstream to downstream as the water quality deteriorates and the deteriorated water quality eventually creates extinction of several species. These consequences create instability in the socio-economic sector of the study area. The species diversity was at its peak in summer and low in the winter probably due to snowfall during winter.

TABLE 1: fish species of stream Vaishav Kulgam, Kashmir

S No.	Fish Species	Local Name	Site I	Site II	Site III
1	*Shizothorax plagiostomus* Heckel(1838)	Khont	40	38	58
2	*Shizothorax labiatus* McClelland (1842)	Chush	19	17	30
3	*Shizothorax esocinus* Heckel (1838)	Churru	12	14	12
4	*Typhlophysa marmorata* Heckel (1838)	Ara Gurun	7	28	0
5	*Typhlophysa kashmirensis* Hora (1922)	Ara Gurun	3	19	0
6	*Salmo trutta fario* Linnaeus (1758)	Trout	12	15	1
7	*Oncorhynchus mykiss* Walbaum (1792)	Trout	9	10	0

TEMPERATURE

The temperature of a water body plays an important role in the regulation and distribution pattern of biotic communities. It also alters the physico- chemical conditions of the water viz; pH, conductivity and various forms of alkalinity. Temperature of the surface waters often has an impact on chemical concentration. A rise in temperature of the water leads to the speeding up of the chemical reactions in water and reduces the solubility of gases. At elevated temperature metabolic activity of the organisms increase creating more and more demand for oxygen, but at the same time the solubility of oxygen decreases. In the present study water temperature, fluctuated between a minimum of 1^{o}C in the month of February to a maximum value of 20^{o}C in the month of May. The air temperature on the other hand, revealed a maximum of 23^{o}C in the month of May and a minimum of 2^{o}C in the month of February. In general consideration the variation between air and water temperature at various sites was recorded about 1-2^{o}C.The variation in the temperature of the present study is in broad agreement with the findings of Javid *et al (2012).*and Farhana *et al.*(2013)who studied the physico-chemical characteristics of water of Kashmir.

pH

pH is an abbreviation for the French expression, “Pouvoir Hydrogene,” meaning “the power of Hydrogen.” It measures the H^{+} ion concentration of substances and gives the results on a scale from 0 to 14. Water that contains

equal numbers of H^+ and OH^- ions is considered neutral (pH 7). If a solution has more H^+ than OH^- ions, it is considered acidic and has a pH less than 7. If the solution contains more OH^- ions than H^+ ions, it is considered basic and has a pH greater than 7. In natural waters, pH shows diurnal and seasonal changes due to variation in photosynthetic activity wherein pH increases due to utilization of carbon dioxide in the process. In the present study, pH ranged from 7.0 to 8.5. The minimum pH of 7.0 was observed during the month of May, and maximum pH of 8.5 was observed in the month of April. Based on the affinity of the organisms towards a particular range of pH they are either classified as acidophilic or alkaliphilic. On the basis of pH, Venkateshwarlu (1983) has classified the waters into (i) Acidobiontic (pH<5.5),(ii) Acidophilous (pH<5.5 to 6.5),(iii) Indifferent (pH : 6.5 to 7.5), (iv) Alkaliphilous (pH : 7.5 to 9.00) and Alkalibiontic (pH > 9.00). According to the Venkateshwarlu (1983) classification, Vaisahav stream falls under the category of Alkaliphilous.

CONDUCTIVITY

Conductivity describes the ability of an aqueous solution to carry an electric current (APHA, 1998). The amount of ions or total dissolved salts in water is an indicator of conductivity, meaning conductivity increases as the concentration of ions increases (Zuber, 2015). Conductivity is typically reported in micro-Siemens per centimetre (µs/cm). Solutions with mostly inorganic compounds tend to be better conductors while solutions with organic compounds do not conduct currents well (APHA, 1998). According to Wilcox's (1955) classification, waters having conductivity values < 250µmhos belongs to excellent class, 250-750µmhos is good, 750-2000µmhos is permissible, 2000-3000µmhos is doubtful and >3000µmhos is unsuitable. In the context of this classification, the water of Vaishav stream belongs to excellent class. In the present study EC ranged between 48.7 to 120.6µmhos/cm. High electrical conductivity was recorded during rainy season. This may be due to greater ionic concentration of the inlet flow (Prithwiraj and Sudip Barat, 2003).

TURBIDITY

Turbidity is the optical property of a water sample that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample. Turbidity may be caused when light is blocked by large amounts of silt, microorganisms, plant fibres, sawdust, wood ashes, chemicals and coal dust. Higher turbidity decreases water temperature because suspended particles absorb more heat. Higher turbidity also reduces the photosynthesis. Turbidity often increases during rainfall. In the present study the turbidity was recorded highest (47.2) at site-III and lowest (8.9) at site-I. Light's ability to pass through water depends on the amount of suspended material present. Any substance that makes water cloudy will cause turbidity. The most frequent causes of turbidity in streams and rivers are plankton and soil erosion from logging, mining, and dredging operations. Turbidity greatly affects fish fauna and other aquatic life by interfering with sunlight penetration and reduces photosynthesis in plant resulting in lower oxygen concentrations and large carbon dioxide concentrations. Similar results were made by Patra *at el*., (2011) while studying physico chemical characteristics and ichthyofauna of Karala River.

DISSOLVED OXYGEN (DO)

Dissolved oxygen is a measure of the amount of oxygen gas dissolved in water, and available for use by plants and aquatic species. Oxygen gas naturally mixes with water through surface interaction. The presence of oxygen is a positive sign and the absence of oxygen is a sign of severe pollution. Dissolved oxygen (DO) is vital for the continued existence of organisms in a water body. Waters with consistently high dissolved oxygen are considered to be stable, capable of supporting many different kinds of aquatic life. Dissolved oxygen is one of the essential limnological factors in stream water metabolism. In any aquatic ecosystem, dissolved oxygen is of most paramount importance because it is vital for the survival of most forms of aquatic life besides being the most reliable criterion in assessing the trophic status and the magnitude of eutrophication (Edmondson, 1966). Its concentration in natural water depends on the physical, chemical and biological activities in the water body (Zutshi and Vass, 1978). Oxygen is used by the living organisms in the water for their survival. The source of oxygen in water is dissolved oxygen from atmosphere and also photosynthesis by phytoplanktons. In the present study the highest value of DO of 18.1mg/l was recorded at Site I during the month of February and the lowest value of 10.5 mg/l was recorded at Site I during the month of May. The high DO level during winter can also be attributed to low biological activity (Vass *et al.*1977). Further, higher dissolved oxygen recorded in winter is due to lower water temperature, since dissolution of oxygen shows inverse relationship with temperature (Gurumayum *et al.*, 2000).The low values of DO in summer are due to low dissolution at high temperature and is also due to use by decomposers in the water body. Similar results were made by the Hannan,(1979),Badge and Verma (1985), Kaur *et al*.(2000) and Rather *et al.*,(2001) in various water bodies of different states in India.

ALKALINITY

Alkalinity plays an important role in determining the ability of water to support aquatic life. Biologists use it as a measure of water fertility. Total alkalinity in the Vaishav stream was more in the rainy season with the highest value of 300 mg/l at site I in May against the minimum value of 180 mg/l in February at site III. Alkalinity of water is a measure of weak acid present in water and of the cations balanced against them (Lewenthall and Marais, 1976). Alkalinity in most natural waters is usually due to the bicarbonate ion (Dallas and Day 2004; Zubair & Ahrar, 2013). Other sources of alkalinity include the carbonate ions, the hydroxide ions and a few other minor ions. According to Swingle (1967) total alkalinity is due to phenolphthalein alkalinity and methyl orange alkalinity. Total alkalinity of high range is encountered in water having pH value of 8.4 to 10.5 (Jhingran, 1978). At pH value of 4.5 to 8.3 range carbonate alkalinity is very less and is dominated by the presence of free carbon dioxide and bicarbonate alkalinity (Jhingran, 1978). So alkalinity is a measure of acid that water can absorb before a

designated pH is achieved (Wurts and Durborow, 1992). On the basis of total alkalinity, Moyle (1945) classified water bodies into soft, medium and hard. According to this classification, waters having alkalinity up to 40 mg/l are soft, with 40-90 mg/l are medium and above 90 mg/l are hard. If this criterion of classification is applied, then the Vaishav stream under study falls under the hard water type. Further, Alikunhi (1957) has found that alkalinity greater than 100mg/l is suggestive of highly productive waters.

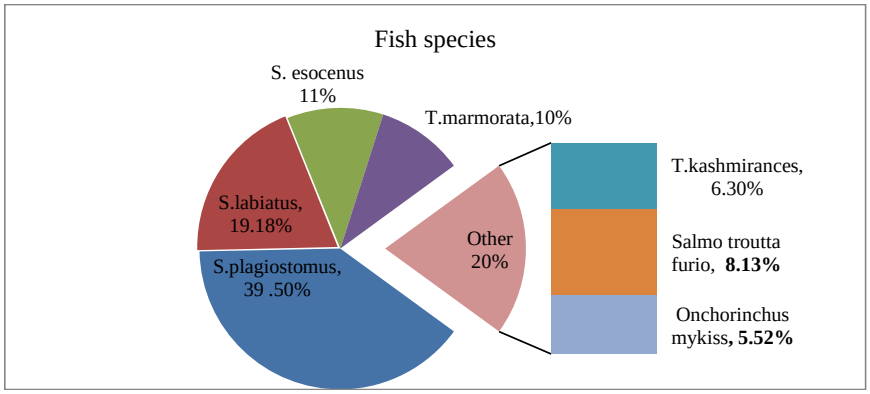

FIGURE 2: Fish species of Vaishav stream Kulgam, Kashmir

Water Quality Parameters	Min	Max	Mean
Air temperature (°C)	2	23	12
Water Temperature (°C)	1	20	11.5
pH	7.0	8.5	7.75
Electrical Conductivity (µS/cm)	48.7	120.6	84.65
Turbidity (NTU)	8.9	47.2	28.05
Dissolved oxygen (DO) mg/l	10.5	18.1	14.3
Total Alkalinity (mg/l)	180	300	240

CONCLUSION

Kashmir is famous for its fresh water which provides habitat to various native and exotic species of fishes. The need of the hour is to protect these fish species and immediate steps should be taken to enhance their number rather than go for the wrong introduction of fingerlings without examining the water quality, food requirements and competition. Since over-fishing is one of the main concerns for the depletion of fish fauna in the stream, therefore, regular monitoring needs to be carried out. Immediate steps should be carried out to regulate the entry of domestic sewage, agricultural effluents into the stream. Kashmir has to develop the base line data of the natural population potential of indigenous fish species especially *Shizothorax*. Intense polluted areas should be identified and effective monitoring and conservation programmes should be immediately implemented.

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