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Research article

ECOLOGICAL STUDY ON MACROZOOBENTHIC COMMUNITY OF VERINAG SPRING, KASHMIR

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ABSTRACT: Benthic macroinvertebrate assemblages of Verinag spring in Kashmir corresponding to different catchment and land uses acts as indicators of water quality. Physico-chemical parameters and population density of Annelids, Arthropoda and Mollusca individuals were determined. Diptera was dominating the study area instead of Annelida. The Oxygen Concentration was high and the mean dissolved oxygen was 9.8±0.90 mg/l. The presence of relatively high oxygen value seems to be a function of good periphytic algal population liberating oxygen during photosynthesis. The water of the spring was well buffered with mean pH 7.2±8. Therefore, the pH of the water generally did not exceed 8.0.
Keywords:- Kashmir, Spring, Limnology, Macrozoobenthos, Diptera and Bioindicators.

INTRODUCTION

Surface waters (e.g. rivers, streams and ponds) groundwater and springs are the main sources of water available to the rural settlement dwellers in Kashmir. The qualities of these water bodies vary widely depending on location and environmental factors. Among the factors determining the qualities of natural waters, ground waters and springs in particular, are the chemical composition of the underlying rocks, soil formations and the length of time that the water body has been trapped underground (Van der Merwe, 1962). The valley of Kashmir is known throughout the world for its springs. Verinag spring is the source of the River Jhelum that is the lone drainage system of Kashmir. The spring ooz out on the foot hill of Pirpanjal range. Volumous water is added to Jhelum by this spring. The spring is also the main source of domestic water supply for the villagers.

Macrozoobenthic invertebrate communities change in response to change in physico-chemical parameters and available habitats. Macrozoobenthic invertebrate are a ubiquitous and diverse group of long lived species that react strongly and often predictably to human influences in aquatic ecosystem. Recently a macrozoobenthic invertebrate based biotic index has been proposed to evaluate water quality in freshwater river streams of Eastern Himalaya (Bhat and Pandit, 2010).

MATERIALS AND METHODS

STUDY AREA

The Verinag spring , lying about 26 km south-east of Anantnag town is a deep pool type water body, bound all sides by an octagonal stone wall. The spring is inhabited by exotic trout (*Salmo sp.*). The sediment substrate is of rocky type consisting of pebbles, boulders and course sand. The Verinag spring is facing a lot of tourist influx during summer as it is beautiful spot to visit.

Fig1: Verinag spring: study site

PHYSICO-CHEMICAL PARAMETERS

The seasonal variation of Physico-chemical factors of water were studied from January 2011 to December 2011. Monthly samples were collected from the spring 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 Carbon dioxide, Hardness, Alkalinity, Calcium, Magnesium and Chloride were determined by titremetric methods (Mackereth et al, 1978).

MACROZOOBENTHOS

For collection of macrozoobenthos, sediment samples were collected by 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 forcep and then preserved in 4% formalin. Benthos sampling was done on monthly basis. Preserved samples were then identified according to standard works by 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:

$$N = O/A.S \times 10,000$$ **(**Welch, 1948)

Where,

N = no. of macrobenthic organisms/m^2.
O = no. of organisms counted.
A = area of sampler in square meter.
S = no. of samples taken at each stations.

RESULT AND DISCUSSION

The physico**-** chemical parameters and macrozoobenthic invertebrates of the Verinag spring were observed and are represented in the Tables 1 and 2. The Air temperature of the sampling site during the period fluctuated from a minimum of 5^{o}C to a maximum of 27^{o}C. Water temperature was appreciably lower than the Air temperature and fluctuated from a minimum 9^{o}C to a maximum of 17^{o}C. Significant difference between air and water temperature is related to the continuous oozing of water from underneath. In the present study, dissolved oxygen of the spring water fluctuated from a minimum 8 mg/l to a maximum 10mg/l. The presence of relatively high oxygen value seems to be a function of good periphytic algal population liberating oxygen during photosynthesis.The results are in agreements to the findings of (Reid, 1961 and Hynes, 1979). Conductivity of the spring water fluctuated from minimum 210µS/cm to maximum 499µS/cm.The Coductivity values does not show much significant variation duing different months.High Conductivity of the springs is attributed to the more time for water to interact with the host rock (Jeelani, 2007). Carbon dioxide seemed to be an important component of the buffer in the spring and fluctuated from minimum 22mg/l to a maximum 46mg/l. Springs rich in carbondioxide were comparatively less alkaline and a decrease in its concentration resulted in an increase in alkalinity. Large amount of carbon dioxide is due to exposure of organic matter and bacterial respiration in the soil (Hynes 1979), as well as its passage, percolation through limestone. The pH in the spring ranged between minimum 7.2 to a maximum of 8.8 Therefore, the pH of the water generally did not exceed 8, because of the low biological activity in the spring basins and continuous oozing out of water from underneath. These vales of pH are in agreements to the findings of (Bhat et al. 2002). Low pH of the spring might be attributed to dissolution of carbonic acid from weathering process of the parent rocks, which the spring flows through (Zhou, 2006).Total alkalinity of the spring fluctuated between minimum 121mg/l to a maximum 170mg/l. This is because of bicarbonates of calcium and magnesium. Calcium fluctuated between minimum 11mg/l to a maximum 54mg/l and Magnesium between minimum 2 mg/l to a maximum 8mg/l. Higher values of calcium is due to the presence of calcium rich dominant rocks in the catchment area. The hardness values fluctuated between minimum 20 mgl to a maximum 87mg/l, there by indicating hard water nature of the spring. The results are in agreements to the finding of (Moyle, 1945). The Hardness directly seems related to the source of calcium and Magnesium (Ca^{++} and Mg^{++}). Chloride ranged between minimum 18mg/l to a maximum 40mg/l. The high concentration of chloride seems to be directly related to the human interference as the spring are regularly visited.Small variations in the chloride indicates the source of impurities added to the concentration of chloride in ground water.These results are in agreements to the findings of (Samiullah Bhat et al. 2010).

Table 1:- Range of variation and Standard Deviation of the physico-chemical characteristics of water of Verinag spring during January 2011 to December 2011.

S.No	Parameters	Units	Range of variation		Mean & S.D
			Min	Max	
1.	Air temperature	°C	5	27	17±8.27
2.	water temperature	°C	9	17	11±2.80
3.	Conductivity	µS/cm	210	499	346±86.26
4.	pH	-	7.2	8	7.8±0.23
5.	Free Co_2	mg/l	22	46	31±9.83
6.	Dissolved oxygen	mg/l	8	10	9.8±0.90
7.	Total Alkalinity	mg/l	121	170	139±16.49
8.	Total Hardness	mg/l	20	87	57±24.79
9.	Calcium Hardness	mg/l	11	54	32±16.51
10.	Magnesium Hardness	mg/l	2	8	6±2.18
11.	Chloride	mg/l	18	40	27±7.58

Table 2:- Population density, Mean and Standard deviation of different Macrozoobenthic invertebrates in Verinag spring during January 2011 to December 2011.

S. No.	Species	Population density (ind/m2)	Mean (ind/m2)	Standard deviation
	Arthropoda			
	Ephemeroptera	9392	799.3	121.34
1.	*Baetis sp.*	4664	388.6	98.9
2.	*Ecdyonurus sp.*	4092	341	59.6
3.	*Epeorus sp.*	836	69.6	39.6
	Tricoptera	4620	385	70.51
1.	*Hydropsyche sp.*	704	58.6	50.8
2.	*Limnophilus sp.*	3916	324	71.3
	Coleoptera	748	63.3	109.5
1.	*Elmidae*	748	63.3	109.5
	Diptera	11352	946	376.87
1.	*Simlium sp.*	2024	168.6	188
2.	*Limnonlli sp.*	1672	139.3	105
3.	*Tiploidy sp.*	484	40.3	36.81
4.	*Bezzia sp.*	2596	216.3	54.5
5.	*Diamessa sp.*	4576	381.3	90.6
	Plecoptera	1408	117.3	39.0
1.	*Perlidae sp.*	1408	117.3	39.0
	Amphipoda	6820	568.3	80.60
1.	*Gammarus pulex*	6820	568.3	80.60
	Oligochaeta	616	51.3	52.51
1.	*Tubifex sp.*	264	22	19.67
2.	*Limnodrillus sp.*	352	29.3	24.09
	Hirudinea	3388	282.3	68.8
1.	*Erpobdella*	3388	282.3	68.8
	Gastropoda	2024	168.6	141.4
1.	*Lymnaea sp.*	2024	168.6	141.4
	Pelecypoda	3476	289.6	34.89
1.	*Corbicula sp.*	1496	124.6	31.5
2.	*Promenetus sp.*	1980	165	42.47

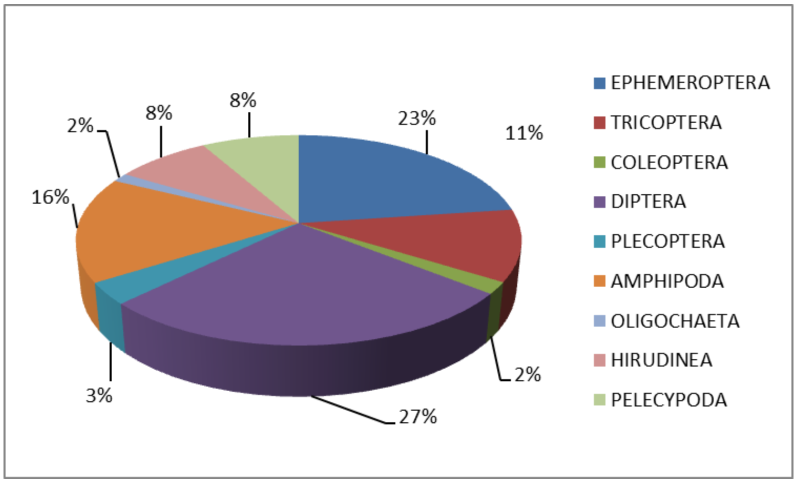

Fig 2: Percentage composition of different classes of macroinvertebrates in Verinag spring.

Macrozoobenthos represents one of the most important groups of animals particularly with respect to food of fishes and also plays an important role in Cycling of the organic material. Macrozoobenthos contributed a total of 19 texa of which 12 belonged to Insecta, 1 to Crustacea, 3 to Annelida, and 3 to Mollusca. Insecta, represented by Ephemeroptera (May flies), Coleoptera (beetles), Tricoptera (Caddis flies), Diptera (mosquitoes, flies and midges) and plecoptera (Stone flies). It was represented by a total no. of 12 texa. The Dipterans contributed the highest mean density 946±376.87 (ind/m^2). Dipterans in the Verinag spring included *Simlium sp., Limnonlli sp., Tiploidy sp., Bezzia sp.,* and *Diamessa sp*. Presence of these bioindicators indicates the pollution status of spring. The dominant genera of the order diptera were *diamessa* which indicates that the spring is free from pollution. Some dipteran genera which only occur in small number are associated with nutrient poor water (Cairns and Dickson, 1971; Learner *et al*, 1971)). Ephemeroptera ranked second as per mean population density 799.3±121.34 (ind/m^2). Hawkes (1979) reported that Ephemeroptera do not tolerate organic enrichment. *Baetis sp.* are an exception in being quite tolerant of appreciable organic enrichment. In the present study it is clearly indicates that the spring water is still clean. In the present study mean population density of Tricoptera and Coleoptera was 385±70.51 (ind/m^2) and 63.3±109.5 (ind/m^2). This is confirmed by the present data as the Ephemeroptera and Tricoptera was comparatively higher in the verinag spring. This also indicates that the spring water is free from pollution. This is also elucidated by Gaufin (1957) and Reddy and Rao (2001), who inferred that an association of May fly, Stone fly and Caddis fly in a water body is indicative of clean water condition and their absence often denotes a super abundance of organic wastes and low oxygen supply.

Gammarus being a fresh water species, the mean population density of *Gammarus* was 568.3±80.60 ind/m^2. It is found in the edges and evenly distributed in areas where it can take shelter under stones (Hynes, 1979). Annelida was represented by *Tuifex, Limnodrillus* (Class Oligochaeta) and *Erpobdella* (Class Hirudinea). The mean population density of *Hirudinea* was 282.3±68.8 ind/m^2. The leech was recorded only in those water bodies with some organic enrichment (Wetzel 1983., Edward et al., 1972). In the present study mean population density *Oligochaeta* was 51.3 ±52.51 ind/m^2. Hawkes (1979) has reported that the members of *Oligochaeta* are usually favoured by the organic environment and remain dominant in severally polluted conditions with special emphasis on *Tubifex sp*. which inhabit areas with strong sewage pollution and anoxic waters. Takeda (1999), Nocentini et al. (2001), Callisto et al. (2005), Chakraborty and Das (2006), Manoharan (2006) and Gasim, et al. (2006) observed that presence of good organic detritus content contributed the maximum quantity of Oligochaetes. In the present study it may be conclude that the population density of oligochaeta was found only in summer season with low density, it may be due to some human interference in the catchment of the concerned water bodies. Mollusca was represented by *lymnae* (class Gastropoda) and *Corbicula*, *Promenetus* (Class Pelecypoda). The mean population density of Gastropoda and Pelecypoda was 168.6±141.4 ind/m^2 and 289.6±34.89 ind/m^2 which may be due to soft and organically rich bottom, alkaline nature of water and higher concentration of calcium as has been reported by earlier workers Manoharan et al. (2006), Aldridge et al. (2007) and Garg et al. (2009).

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