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Abiotic Status of River Jhelum with Special Reference to its Ichthyofaunal Diversity

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Abstract

During the course of present study, the abiotic factors investigated recorded remarkable variation at each of the three study sites. While pH, NO_3-N, Total Dissolved Solids, BOD and COD recorded increasing values towards the downstream sections of the river, DO, Ca and alkalinity recorded decreasing values towards the downstream areas of the river. A total of seven species belonging to two families Cyprinidae and Salmonidae were collected. While Cyprinidae is represented by five species viz., Schizothorax plagiostomus, S. curvifrons, S. esocinus, S. labiatus and Cyprinus carpio, the Salmonidae family is represented by only two species, Salmo trutta fario and Salmo gairdneri. While Schizothoracines dominated at sites II and III, Salmonids were found in abundance at site I. In this lotic system, the diversity and distribution of fishes were uneven. The un-even distribution and diversity may be due to changing water quality status.

Keywords: River Jhelum, physico-chemical parameters, fish fauna.

Introduction

Water, elixir of life, serves as a resource and a valuable habitat for varied groups of organisms[1]. Although water constitutes a greater bulk of the protoplasm, yet due to increasing anthropogenic intervention besides some natural processes, the water quality is deteriorating day by day, which has severely affected the indwelling aquatic fauna.

Kashmir in the North western Himalayas is blessed with a large number of natural inland water resources having good productivity status as they provide safe niches to various organisms like protozoans, macro- and micro- zoobenthos, invertebrates and vertebrates. Of all the aquatic ecosystems of the valley, River Jhelum is one of the major riverine systems which originate from a beautiful octagonal spring called Verinag situated in the foothills of mighty Pir-Panjal ranges. River Jhelum, the life line of Kashmir, traverses about 177kms in the valley during which it receives waters from an extensive network of canals and streams. On its way it receives enormous amounts of sewage, faecal matter, run off from the agricultural fields, effluents from the small scale industries, encroachment etc. which depletes its water quality status. The physico-chemical parameters of River Jhelum varies from one region to another which in turn affects the variety and distribution of Ichthyofauna present in it. The river Jhelum, under the conditions of encroachment, pollution and industrialization have reduced basin which subsequently influences the distribution and density of Ichthyofauna as well. So present study has been undertaken to monitor the water quality and ichthyofauna of River Jhelum.

Material and Methods

River Jhelum also known as Vyeth or Vitasta, originates from Verinag spring in the South-eastern part of the valley. The river Jhelum is considered as the life line of Kashmir as it flows from South to North and fulfills the requirements of about 25% of the population of the valley. River Jhelum is the second largest fisheries resource of the valley after Wullar Lake as it harbours a wide variety fish fauna. During the last few decades, dense human settlements, industries and other commercial establishments along the river banks and its surrounding areas have evolved, as a result of which large amounts of untreated sewage and effluents gets discharged into the river. The excessive encroachment has depleted the water quality which subsequently poses health hazards among its stakeholders.

In order to conduct the present study, three study sites were selected along the Jhelum namely Verinag, Sangam and Pantha Chowk. The site-I located in the foothills of Pir Panjal range about 26kms away from Anantnag town is famous for an octagonal verinag spring where water is very much pure and it appears blue in color. Site-II is located on Anantnag-Srinagar Highway about 50.8kms from Site–I. Most of the tributaries namely Lidder, Rambiara, Vaishav, Watlab and Arapal merge into the river Jhelum at this site hence the name Sangam. The merging of various tributaries of Jhelum at this site affects the abiotic parameters of water and also its aquatic fauna. Site-III is located in District Srinagar about 80kms from site-I and about 30kms from site-II. The velocity of water is comparatively slower and the bottom sediments include sand and silt only. At this site, River Jhelum experiences heavy domestic, industrial and commercial intervention. The entire population of the area

depends on it for irrigation, drinking and washing purposes but in turn dump heavy loads of sewage, run-off and effluent into the river.

The physico-chemical characters and ichthyofauna of the river Jhelum has been assessed by following standard methods

Physico-chemical analysis of Water: On monthly basis, water samples were collected from all the three sampling sites/ stations along the banks of river Jhelum. Sampling was done mostly in the first week of each month, from December 2014 to May 2015. While temperature was recorded on the spot at the time of sampling, other parameters such as pH, total alkalinity, BOD, COD, DO and total dissolved solids were estimated in the laboratory (PHE Techno-Lab Shopian) while following standard methodology[2] for which water samples were collected in polythene bottles between 8 am to 10 am from each sampling station.

Collection of Fishes (Ichthyofauna): Fish fauna of the River Jhelum was monthly collected from each of the three sampling stations. The fishes were collected with the help of local fisherman by using nets (Cast and Dip net) for fishing. Sampling was mostly done in morning hour. Fish samples were then preserved in a solution of formalin. Fishes less than 10 cm were immersed in a formalin solution without any incision, while fishes 10 - 30 cm in length were given a narrow cut one side of mid ventral line ventrally through abdominal wall. Fishes longer than 30 cm were injected with undiluted concentrated formalin in several places and the belly was incised at two or three places. Then the samples from each station were packed separately with appropriate labels indicating the date, time and locality. Finally the specimens were taxonomically identified on the basis of morphometric characters using the standard taxonomic keys[3].

Results and Discussion

The results obtained from the present study are discussed under following headings:

Physico-chemical analysis of water: The physico-chemical characteristics of River Jhelum record remarkable variations and the same is reflected by the tables 1-3. The air and water temperature recorded minor variations at each of the three study sites and that water temperature closely followed air temperature. pH a measure of the acidity of the water, recorded decreasing trend from Verinag to Pantha-chowk. At all the study stations the values of pH were higher in May due to an increase in ambient temperature and as a result of which rate of photosynthesis increases. pH recorded a tilt from alkaline to acidic side as the water flows from Verinag towards the Pantha Chowk. Alkalinity, a measure of weak acid present in water is usually due to the bicarbonate ion content of water[4,5]. At all the three sites, water has been observed to be alkaline, however the values of alkalinity recorded a decreasing trend from site-I (Verinag) to site-III (Pantha-chowk). Likewise the NO_3-N (Nitrate-nitrogen) content of river Jhelum shows an increasing trend in the downstream sections. Maximum values were observed at Pantha-chowk but with an increase in temperature, the concentration of NO_3-N also increased and the same has been observed in the month of May. Calcium an essential component for the structural and functional integrity of cell membrane[6,7], recorded a decrease in its concentration from site-I to site-III. During present study, the values of Total Dissolved Solids (TDS) show an increasing trend towards the downstream sections of river with maximum values at Pantha-chowk. At all sites the content of TDS increased from Dec. to May. The concentration of Dissolved oxygen (DO) recorded a decreasing trend from upstream towards the downstream sections of the river with maximum value at Verinag. However at all the sampling stations the amount of DO was observed to be higher in the month of January and the reason can be due to heavy snow and rainfall that the valley receives during winter. BOD is linked directly with the decomposition of dead organic matter, hence higher values of BOD can be directly related with the pollution status of the River[8]. Moreover, BOD has been considered as an important pollutant causing low dissolved oxygen concentrations[9]. During present investigation, the BOD concentration recorded increasing trend from site-I to site-III with minimum value at Verinag and maximum value at Pantha-chowk. Likewise a sharp increase has been observed in COD concentration also from Verinag to Pantha-chowk where it reached maximum. Present study also revealed that maxima of COD were observed in spring season and the same might be due to increased water temperature which enhances the rate of decomposition of organic matter.

Present investigation reveals that the water of River Jhelum at Verinag is alkaline but it turns acidic at Pantha-chowk and this can be attributed to the fact that as the water of the river runs downstream, it receives influx of untreated sewage and other organic and inorganic wastes. However in May, the pH of the water becomes alkaline in comparison to other months as with an increase in ambient temperature there is increase in the rate of photosynthesis and also the discharge of water from the spring. Likewise the values of alkalinity decreases in the downstream sections of River, which may be due to the increasing turbidity, which occurs because of influx of sewage and other suspended matter into the river. Hence the value of alkalinity is seen more at Verinag as that of Sangam and Pantha-Chowk because of less turbidity of water there. As per this investigation, the values of nitrate gets increased in the downstream portions of River Jhelum and the same could be due to allochthonous supply of nitrite rich materials and enhanced decomposition rate. The concentration of nitrate-nitrogen beyond 0.15 mg/l is an indicative of eutrophication[10]. And the same observation therefore places downstream portions of River Jhelum in eutrophic category. TDS values record increase in concentration towards the downstream portions of the river during present study and the same could be attributed to the heavy rains and floods of Kashmir that severely affect

these portions of the study sites (September, 2014) and also due to numerous anthropogenic activities because of heavy tourist inflow in the valley besides dumping of sewage into the river by human settlements and municipalities. The concentration of DO declines towards the downstream area and the same may be because of increasing amount of untreated sewage and overload of anthropogenic activities. Moreover the concentration of BOD increased towards the downstream sections of the river and the same may be attributed to the increased turbidity, nutrient load and sewage enrichment of rivers. Since Kashmir Valley is annually visited by large number of tourists due to its scenic beauty, especially in the spring and summer, there is greater generation of wastes which are directly or indirectly being dumped into the river hence the BOD values shows an increase in the downstream sections of the river. Likewise COD values increased from upstream portion towards the downstream sections and the same could be attributed to the fact that as the water flows downwards, it receives large amount of untreated sewage and effluents from domestic and commercial establishments. Hence down the river, the water quality gets deteriorated which greatly influences its aquatic biota. Similar increase in COD has also been recorded in the lotic systems of Kashmir[11].

From the above observations, it is clear that the physico-chemical characteristics of River Jhelum like pH, TDS, DO etc in the upstream portion of river were comparatively higher than that of lower stream sections of river which indicates that household wastes and garbage, untreated sewage, effluents from small scale industries and agricultural runoff add to the nutrient load of the river. All these activities lead to deterioration of water quality in the lower sections of river.

Ichthyofauna of River Jhelum: During the course of present study, a total of seven species, belonging to two families *Cyprinidae* and *Salmonidae* were encountered at three different sites from river Jhelum (table-4). Fish species abundance and distribution appear to be determined by water quality and food availability factors. In the present study, water parameters were found to greatly influence ichthyofaunal distribution at each of the three study sites. *S. plagiostomous, S. esocinus* and *S. curvifrons* were the main component of ichthyofauna of River Jhelum at Sites-II and III (Sangam and Pantha-Chowk) besides these, *S. labiatus* and *Cyprinus carpio* were also present at these sites. At Site-I (Verinag), *Salmo trutta fario* and S*almo gairdneri* were present in large proportion (Tables 5 and 6). At Site-II and Site-III, on the whole *Schizothoracinae* contributed about 95-96% of the total fish catch, while as at Site-I, *Trout* species (*Salmo trutta fario* and *Salmo gairdneri*) dominated the total fish catch at this site (93%). The present study reveals that the distribution of fishes is directly related to the physico-chemical conditions like pH, alkalinity, DO, TDS, BOD etc. Trout species (*Salmo trutta fario* and *Salmo gairdneri*) have been found to be present at Site-I where water is cold, well oxygenated and unpolluted. Areas (Site-II and Site-III) with more pollution load have communities dominated by tolerant species (*Schizothorax species*). Similar results on distribution pattern of ichthyofauna and their association with environmental factors in Mokau River[12].

Table-1
Monthly Variations of various abiotic parameters at Site-I of River Jhelum

Month	Temperature (˚C)		pH	Total Alkalinity (mg/l)	No_3-N (mg/l)	Calcium (mg/l)	TDS (mg/L)	DO (mg/l)	BOD (mg/l)	COD (mg/l)
	Air	Water								
December	6	8	7.2	200	0.01	35	120.10	12	3.08	23.30
January	5	8	7.3	220	0.01	39	123.70	12.5	3.11	23.50
February	3	9	7.5	230	0.03	47	127.30	12	3.40	23.75
March	5	8	7.3	255.20	0.03	40	127.90	11	3.67	24.10
April	11	7	7.3	278.30	0.05	47	129.60	10	3.81	24.33
May	15	10	7.7	310.10	0.06	52	130.45	10	3.83	24.90
Mean	7.5	8.34	7.39	248.94	0.031	43.34	126.50	11.25	3.49	23.98

Table-2
Monthly Variations of Various abiotic Parameters at Site-II of River Jhelum

Month	Temperature (˚C)		pH	Total Alkalinity (mg/l)	NO_3-N (mg/l)	Calcium (mg/l)	TDS (mg/l)	DO (mg/l)	BOD (mg/l)	COD (mg/l)
	Air	Water								
December	6	6	7.1	85.33	0.16	18	165.15	9.05	4.61	34.60
January	7	3	7.3	93.30	0.19	25	186.24	9.10	4.91	36.75
February	4	0	7.4	105.40	0.23	29	217.10	8.6	5.12	39.71
March	9	11	7.2	116.60	0.23	20	247.10	7.5	5.65	42.10
April	11	12.5	7.0	157.50	0.25	28	270.90	7.0	5.75	45.38
May	15.5	14.5	7.6	165.10	0.26	35	273.30	7.0	5.84	45.68
Mean	8.75	7.84	7.27	120.54	0.22	25.84	226.64	8.04	5.32	40.70

Table-3
Monthly variations of various abiotic parameters at Site-III of River Jhelum

Month	Temperature (˚C)		pH	Total Alkalinity (mg/l)	No_3-N (mg/l)	Calcium (mg/l)	TDS (mg/l)	DO (mg/l)	BOD (mg/l)	COD (mg/l)
	Air	Water								
December	8	6	7.0	82.75	0.21	14	172.00	7.8	4.65	35.80
January	7	3	7.3	87.40	0.23	27	197.45	7.12	4.74	37.80
February	3.5	0	7.2	104.00	0.25	32	220.25	7.7	5.40	40.65
March	9	9	7.5	120.45	0.29	20	272.58	7.01	5.75	45.40
April	13	10	7.3	153.20	0.29	18	290.00	6.30	5.82	46.70
May	16	15	8.2	161.30	0.31	23	290.30	6.1	5.97	46.90
Mean	9.41	7.16	7.25	118.19	0.26	22.34	240.43	7.005	5.39	42.21

Table-4
The fish species presently encountered from River Jhelum Kashmir

Fish species	Local name
Schizothorax plagiostomus Heckel 1838	*Khont*
Schizothorax curvifrons Heckel 1838	*Satter gad*
Schizothorax esocinus Heckel 1838	*Chhurru*
Schizothorax labiatus (McClelland 1842)	*Chush*
Cyprinus carpio Linnaeus 1758	*Panjabe gad*
Salmo trutta fario	*Trout*
Salmo gairdneri	*Rainbow trout*

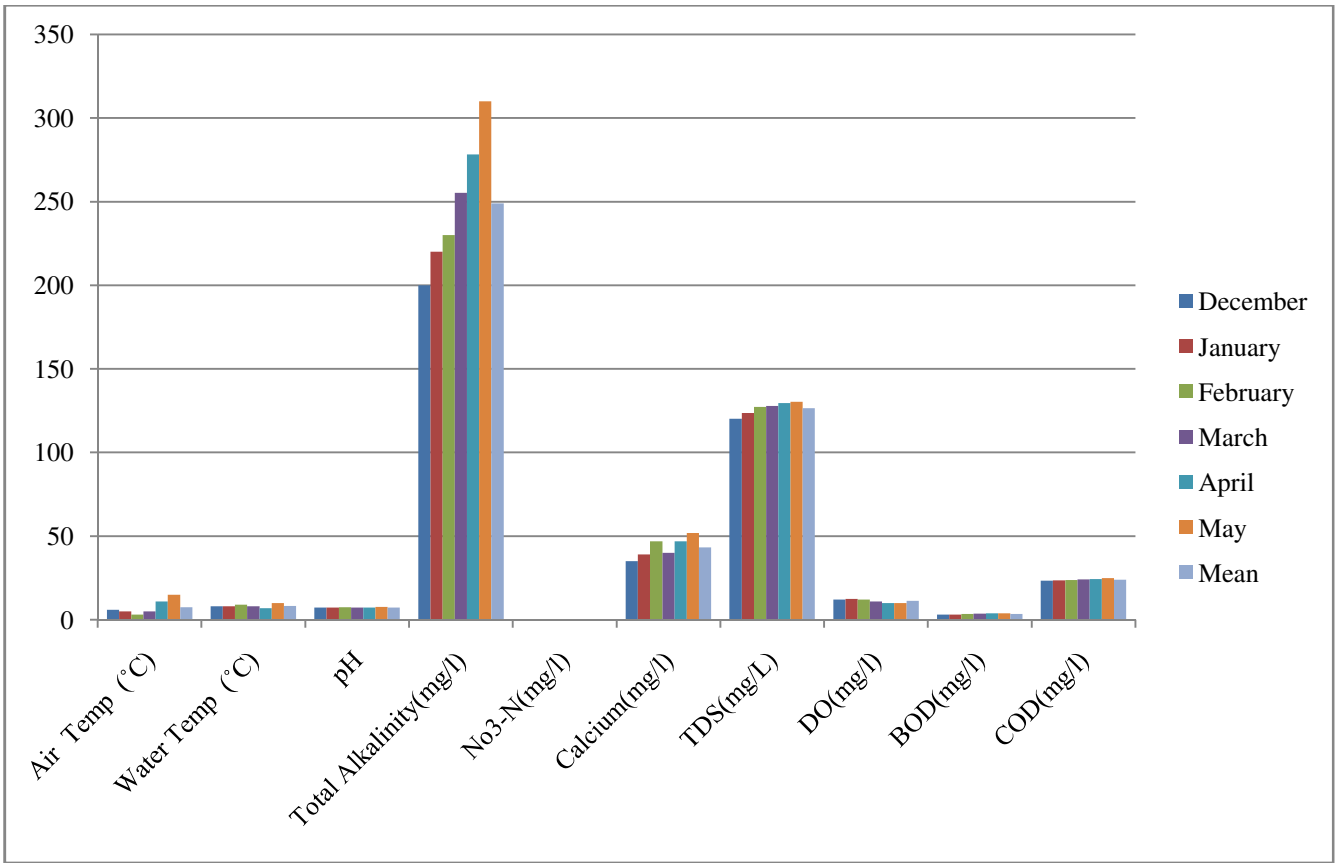

Figure-1
Monthly variation of various Physico- Chemical Parameters of River Jhelum At site I (Verinag)

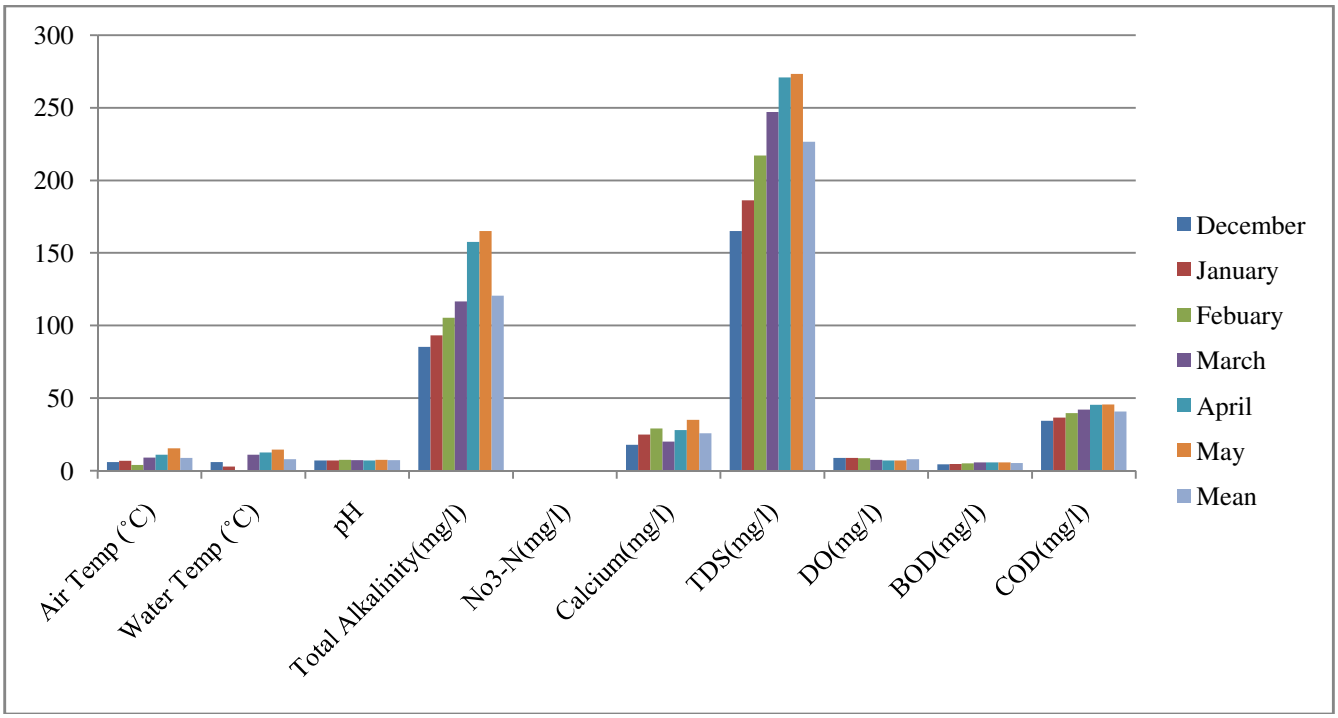

Figure-2
Monthly variation of various physico-Chemical Parameters of River Jhelum At site II (Sangam)

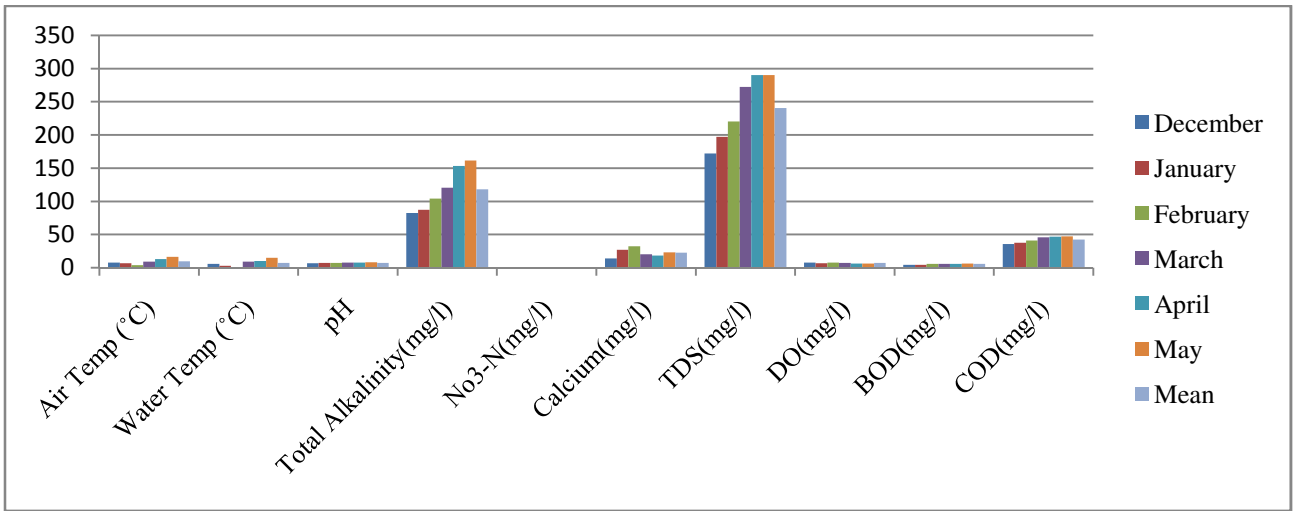

Figure-3
Monthly variation of various physico-Chemical Parameters of River Jhelum At site III (Pantha Chowk)

Table-5
Monthly Fish Catch from River Jhelum, December 2014 - May 2015

Fish Species	Dec.	Jan.	Feb.	Mar.	April	May
Schizothorax plagiostomus	2	4	5	3	5	3
Schizothorax curvifrons	5	2	4	2	1	2
Schizothorax esocinus	4	3	1	3	2	6
Schizothorax labiatus	3	1	2	0	1	2
Cyprinus carpio	1	0	1	0	0	1
Salmo trutta fario	14	9	7	4	6	6
Salmo gairdneri	11	8	6	6	3	4
Total	40	27	26	18	18	24

Table-6
Contribution of fish by number at different study sites, December 2014-May 2015

Fish species	Site-I	Site-II	Site-III
Schizothorax plagiostomus	2	14	6
Schizothorax curvifrons	0	10	6
Schizothorax esocinus	3	9	7
Schizothorax labiatus	0	8	1
Cyprinus carpio	0	2	1
Salmo trutta fario	45	1	0
Salmo gairdneri	38	0	0
Total	88	44	21

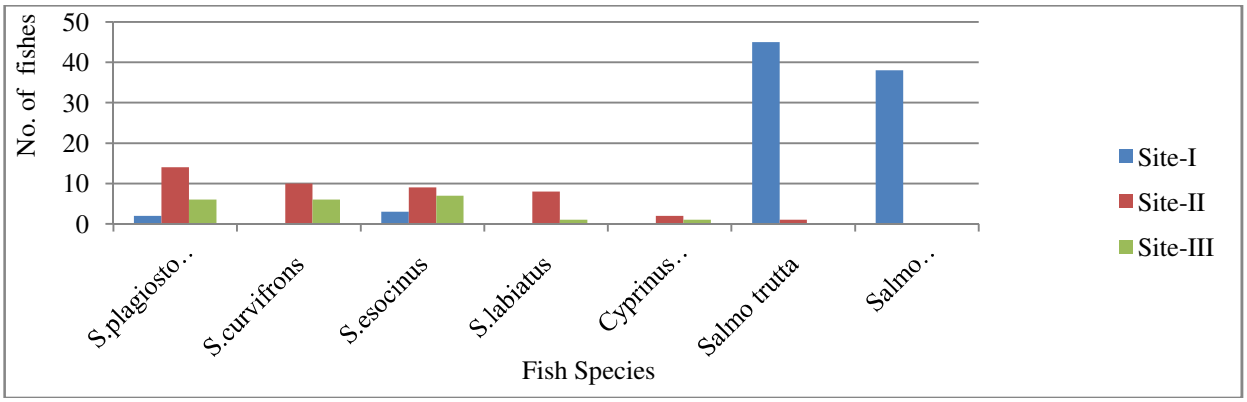

Figure-4
Showing Distribution Pattern of Fishes of River Jhelum

Conclusion

On the basis of the present investigations, it can be conveniently concluded that different physico-chemical parameters of River Jhelum usually recorded increasing trend with an increase in distance from the source indicating the deterioration of water characteristics due to untreated sewage, effluents and surface run-off, anthropogenic activities in the catchment areas etc. Variation in water quality status and the food availability factors of the river also influences the abundance and distribution of fish fauna. During present survey, ichthyofauna of River Jhelum were observed to be comprised of seven species, out of which four belong to *Schizothorax* species (*S. plagiostomus, S. curvifrons*, *S. esocinus* and *S. labiatus*), one *Cyprinus* species (*Cyprinus carpio*) and two *Trout* species (*Salmo trutta fario* and *Salmo gairdneri*). On the basis of the above mentioned distribution of ichthyofauna, it may be concluded that at Site-I, Trout species were found in large proportion in relation to that of Sites II and III, as these species preferred the cold, well oxygenated and pollution free habitat while as at Sites II and III, *Schizothoracinaes* were dominant, as these are tolerant to polluted water. From this very survey, it may also be concluded that the water quality status of the river should be monitored regularly in order to preserve this important lotic fish habitat.

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