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Evaluation of seasonal change in physico-chemical parameters of *Schizothoracinae* in Kashmir

Aijaz Ahmad Bhat
P.G. Department of Zoology, Cluster University, Srinagar, Jammu and Kashmir, India

Abstract
The current study was undertaken to assess the physio-chemical variation in various water bodies of Kashmir. Water quality has been measured in different seasons of the year to observe change over time. During 2011 to 2013 it has been seen that physico chemical parameters have direct relationship with the fish fauna. All the parameters like oxygen, carbon dioxide, Ph, alkalinity, depth, transparency varied with season as shown in the table below. Increase in temperature, vegetation, enrichment of the waste plays important role in shaping the environment.

Keywords: oxygen, carbon dioxide, Ph, temperature, depth, transparency, alkalinity

1. Introduction
The State of Jammu and Kashmir is rich in streams, lakes and water reservoirs. The Himalayas are the main watersheds in the Indo-Gangetic Region, having numerous rivers, lakes and reservoirs. Most fish species inhabiting the Himalayan region are of small size. Their distribution depends on the environmental conditions such as water current velocity, nature of substratum, and the availability of food. Schizothoracinae the cyprinids (also called snow trout's) are believed to have migrated into lakes and streams of Kashmir from central Asian watersheds (Sehgall, 1999), bordered by inner and southern slopes of Hindukush, Korakoram and inner ends of North Western Himalayas and Suleiman Ranges. These fishes got isolated in the Kashmir region by land upheavals and evolved into a large number of species now regarded as endemic in valley. (Raina and Peter, 1999). In most water bodies of Kashmir like Dal lake, River Jhelum, Manasbal, etc. Schizothoracinae are declining due to various reasons like pollution, habitat degradation, introduction of carp, removal of sand and gravel etc.

2. Material and Methods
Environmental parameters have a great role in effecting the physiology and growth of *S. niger* and *S. esocinus*. The major parameters are temperature, dissolved oxygen, pH, free carbon dioxide etc. The water quality parameters (Temperature, Dissolved oxygen, carbon dioxide and pH) monitored during the observation differ within various concentrations.
Total Hardness Total hardness in waters is the sum of the concentrations of metallic cations present in it. In most fresh waters nearly all of the hardness is imparted by the calcium and magnesium ions. According to the OECD, 1992 guidelines for fish toxicity tests, the test medium (water) with total hardness of between 10 mg and 250 mg CaCO3 per liter is preferred. The total hardness of the test medium used was determined by following method.
Hydrogen ion concentration (pH) Chemical properties of the water not only alter the physical properties of the medium but also have significant bearing on the distribution and metabolic activities of the life forms, these in turn tend change them in due course of time. pH is the measure of the relative acidity or alkalinity of water was measured by digital pH metre. Water Temperature The temperature of water was measured by a good grade mercury thermometer ranging from 0°C to 22°C
Dissolved oxygen was measured by modified Wrinkler's method. Oxygen combines with manga nous hydroxide to form higher hydroxide, which on acidification liberates iodine equivalent to that of oxygen fixed. This iodine is titrated by standard thiosulphate titrant using starch as indicator.

Air temperature
The atmospheric temperature depicted a definite seasonal trend during the entire period of study and changed with the change in the seasons. The highest value of air temperature (33.50C) was recorded at site II in the month of August against a lowest of 3.50C in the month of January at site I Further, on comparing the seasonal mean values of air temperature, a maximum of 32.5 ± 0.9 0C was observed in summer at site II and a minimum of 5.3 ± 1.8 0C at site I in winter.

3. Results

Table 1: Variations in air temperature (°C)

Seasons	Site I	Site II	Site III
Autumn	16.3±5.9	18.0±5.2	16.4±6.9
Winter	5.36±1.8	5.4±1.7	5.66±1.9
Spring	17±6.6	18.2±5.2	17.8±6.2
Summer	32.2±0.8	32.5±0.9	31.3±2.1

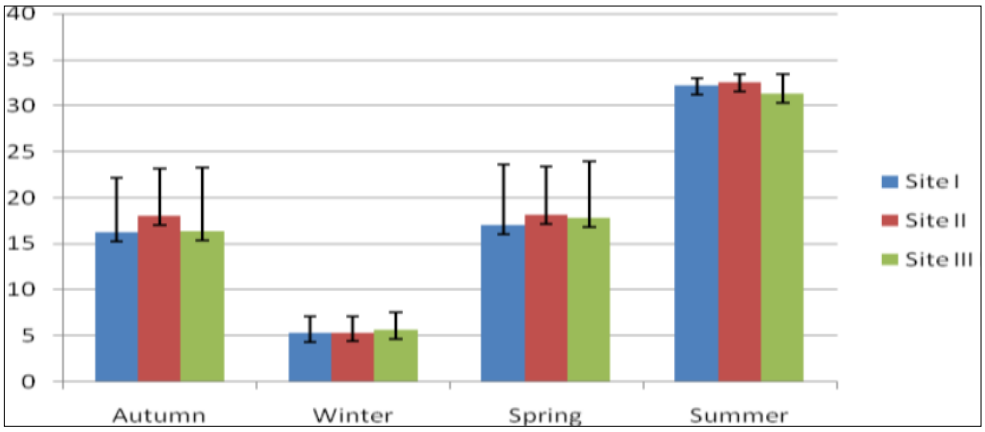

Fig 1

Water temperature

The sites depicted differential fluctuations in their water temperature with wide variations in some and narrow in others. In the present study, water temperature ranged between a minimum of 2.20C in the month of January at site I to a maximum of 20.40C in the month of August at site III. However, the highest (22.1 and lowest (1.0) seasonal mean values were recorded in summer at site II and in winter.

Table 2: Variations in water temperature (°C)

Seasons	Site 1	Site II	Site III
Autumn	13.9±5.8	14.9±6.3	14.6±7.1
Winter	13.9±1.7	14.9±1.7	14.6±1.8
Spring	14.3±4.5	15.0±4.7	15.1±5.9
Summer	28.1±2.2	29.1±2.6	28.4±3.0

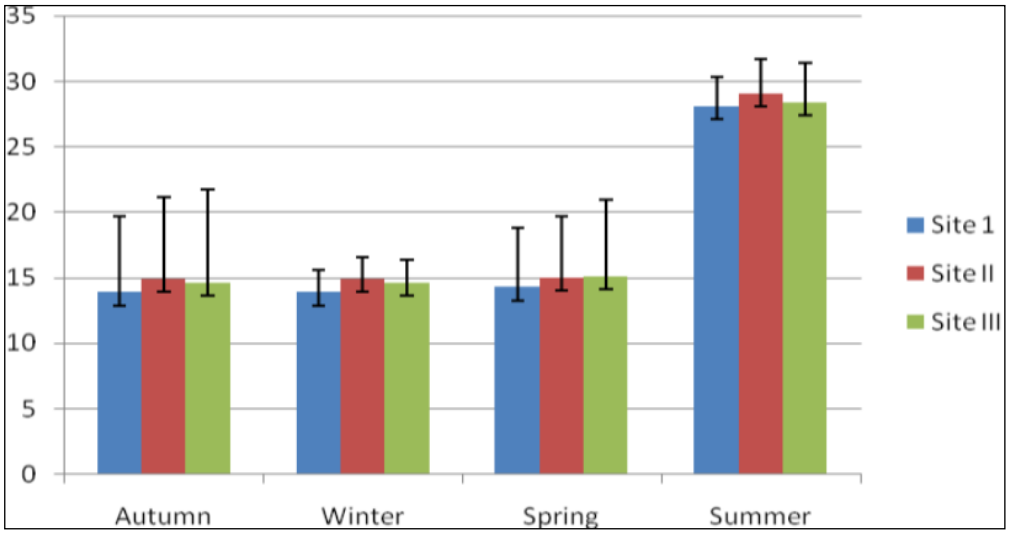

Fig 2

Depth

The depth of water at a particular site in a water body is one of the major physical factors which act as a controlling factor for determining the water quality as well as the wealth of flora and fauna. Among the different sites, a maximum depth of 1.5 m was observed in May at site III and a minimum of 0.3 m in January at site II.

Table 3: Variations in depth (m)

Seasons	Site I	Site II	Site III
Autumn	1.7±0.4	1.9±0.4	2.5±0.4
Winter	1.2±0.3	1.3±0.6	1.7±0.7
Spring	3.2±1.0	3.8±1.3	4.3±1.1
Mean± S.D	3.2±0.8	3.7±0.9	3.6±0.6

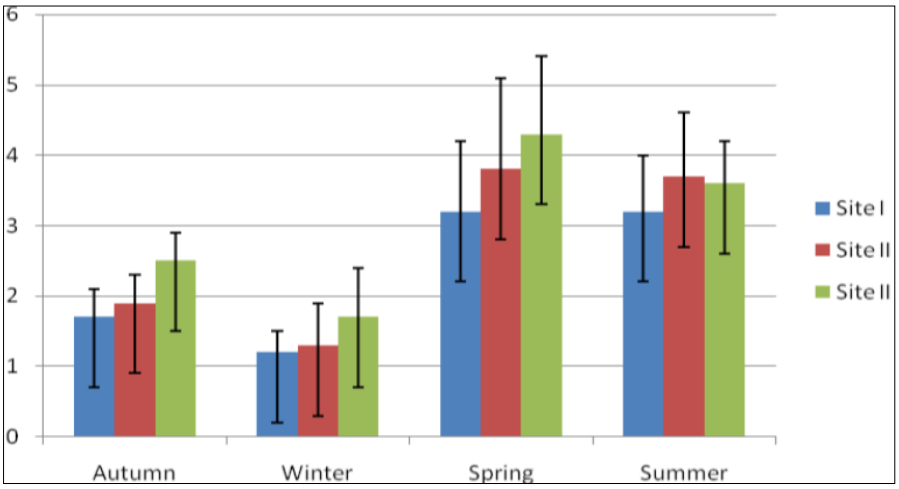

Fig 3

Transparency

The transparency of water fluctuated both spatially and temporally. In general, the highest transparency values were recorded in winter season and lowest in summer season. The seasonal mean values of transparency varied from a minimum of 0.6 m in summer at site II to a maximum of 1.7 ± 0.2 m at site III in winter.

Table 4: Variations in transparency (m)

Seasons	Site I	Site II	Site III
Autumn	1±0.2	1.1±0.2	1.2±0.1
Winter	1.2±0.1	1.3±0.2	1.7±0.2
Spring	0.7±0.3	0.6±0.4	0.9±0.4
Summer	0.8±0.4	0.7±0.3	1.0±0.3

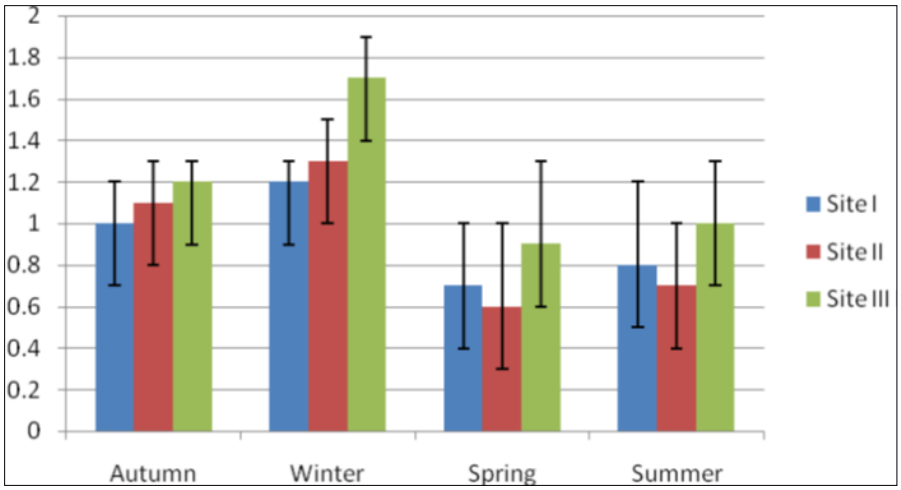

Fig 5

pH

The pH of any aquatic system is suggestive of the acid-base equilibrium maintained by various dissolved compounds. Further, pH is an important parameter which determines the suitability of water for various purposes. In the present study, the pH value was found to fluctuate from 7 to 9 at sites II and III in the months of December and May respectively, indicating that the waters were neutral to alkaline at various sites. The seasonal mean values of pH fluctuated between a minimum of 7.2 ± 0.1 in winter at site III and a maximum of 8.2 ± 0.5 in spring at site II. 76

Table 6: Variations in pH

Seasons	Site I	Site II	Site III
Autumn	7.8±0.5	7.8±0.5	7.8±0.4
Winter	7.2±0.2	7.4±0.1	7.2±0.1
Spring	7.9±0.5	8.2±0.5	8.1±0.3
Summer	7.9±0.1	7.8±0.3	7.9±0.2

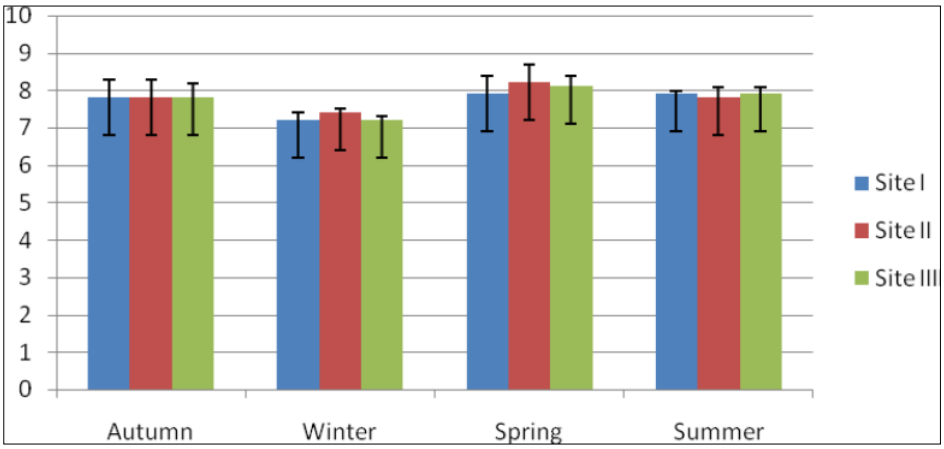

Fig 6

Dissolved oxygen

Dissolved oxygen concentrations in natural water depend on the physical, chemical and biochemical activities in the water body. In the present study, dissolved oxygen revealed a definite seasonal trend registering high values in winter and low in summer. The maximum seasonal mean value of 11.1 ± 0.4 mg/L was observed at site III in winter against a minimum of 8.0 ± 2.0 mg/L at site II in summer. The monthly dissolved oxygen concentrations revealed variations from a minimum of 3.4 mg/L for site II in July, followed by a gradual increase till the maximum values were attained in December (11.5 mg/L) for site III.

Table 7: Variations in dissolved oxygen (mg/L)

Seasons	Site I	Site II	Site III
Autumn	8.9±0.6	8.8±0.4	9.8±0.6
Winter	9.9±0.6	9.6±0.4	11.1±0.4
Spring	8.3±0.5	8.4±1.0	9.1±0.6
Summer	6.2±1.9	5±2. 0	6.4±1.3

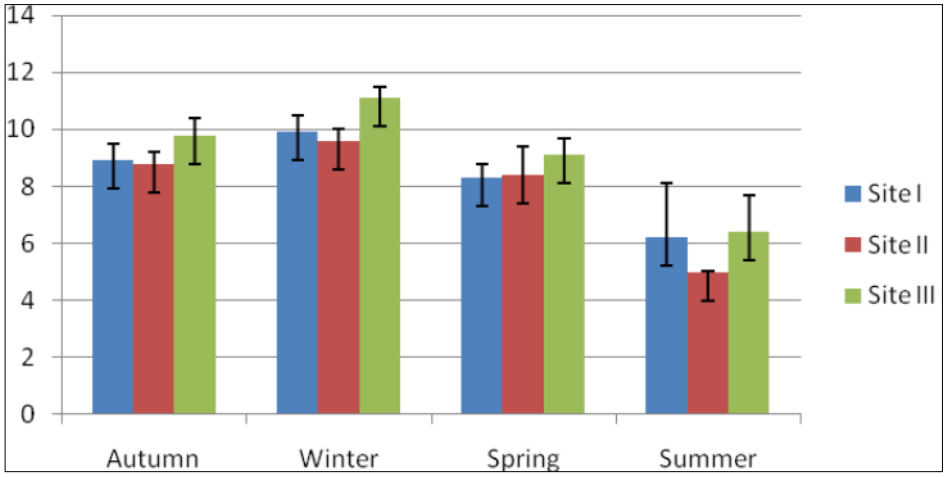

Fig 7

Free carbon dioxide

Free carbon dioxide was present in dateable concentration throughout year at all the sites and it ranged between 8 mg/L and 14 mg/L. The free CO2 depicted well marked seasonal fluctuations at all the sites, registering a minimum value of 11 ± 3.5 mg/L at site III in summer and a maximum of 15.3 ± 1.5 mg/L in winter at site I. The monthly values also showed fluctuations with a minimum of 8 mg/L in the month of July at site II and a maximum of 28 mg/L in January at site III.

Table 8: Variations in free carbon dioxide (mg/L)

Seasons	Site I	Site II	Site III
Autumn	17.3±4.2	16±1.0	16.3±2.5
Winter	23.3±1.5	21.7±3.1	22.7±4.7
Spring	13.7±3.5	10.7±4.0	11.3±2.9
Summer	13.3±1.2	12.3±4.5	11.0±3.5

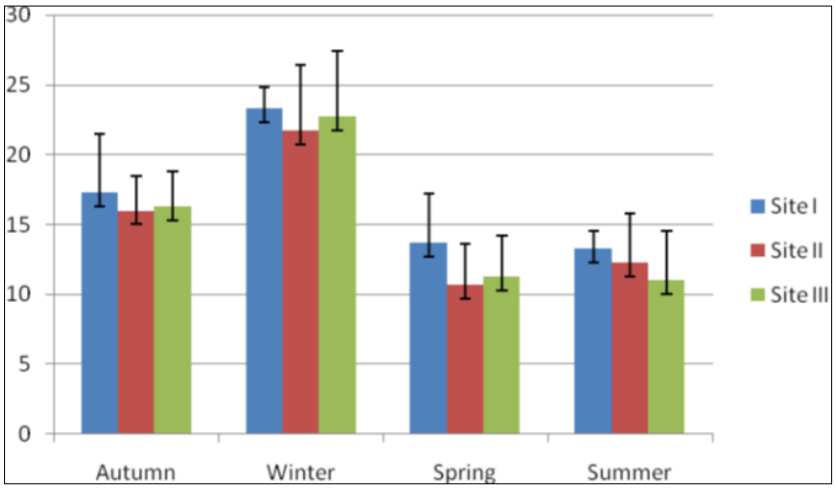

Fig 8

Total alkalinity

Total alkalinity followed a trend of decrease from winter to summer months. Significant spatial and temporal variations were observed for alkalinity. On comparing the seasonal mean values for total alkalinity, the values fluctuated from a low of 56.7 ± 6.8mg/L mean values to a high of 197.6 ±56.7 mg/L mean values in summer and winter seasons respectively.

Table 8: Variations in total alkalinity (mg/L)

Seasons	Site I	Site II	Site III
Autumn	118.3±20.0	124.7±32.6	110±40.3
Winter	150±20.7	126.3±28.0	165.6±31.3
Spring	120.3±15.0	84.7±22.0	126.7±44.0
Summer	76±5.6	56.7±6.8	60.3±14.0

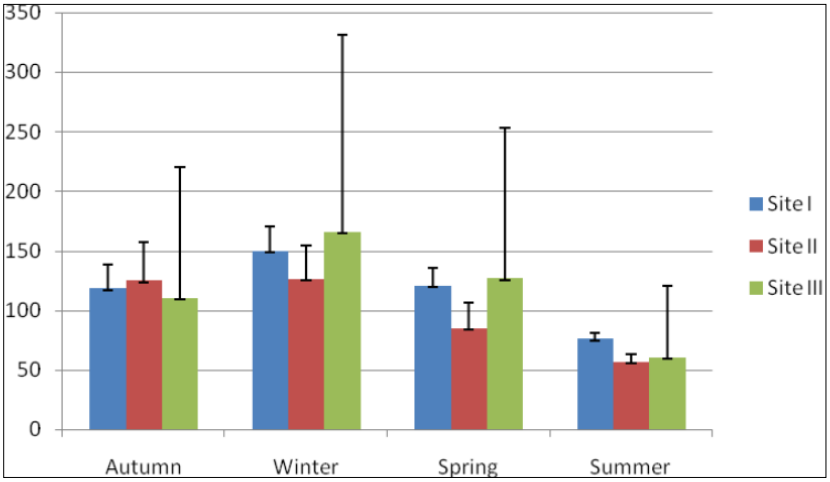

Fig 8

4. Discussion

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 condition of the water like pH, conductivity, saturation level of gases 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 organism's increases 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 2.2°C in the month of January at site I to a maximum value of 20.2.0C in the month of August at site III. The air temperature, on the other hand, revealed a maximum of 33.50C in August and a minimum of 3.50C in the month of January. In general, consideration the difference between air and water temperature at various sites was about 1-1.5°C. The term pH reflects the activity of the hydrogen ion. 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. Based on the affinity of the organisms towards a particular range of pH. The seasonal pH

values not significant as the waters were well buffered. This is in conformity with Kaul *et al.* and Zutshi *et al.* (1980) who attributed the alkaline nature of Kashmir water bodies to the presence of calcium rich rocks (lacustrine deposits) in the catchment areas. Dissolved oxygen is one of the essential immunological factors. In any aquatic ecosystem, dissolved oxygen is of paramount importance because it is critical to 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 concentrations in natural water depend 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 photosynthesis by phytoplankton and also oxygen dissolved from atmosphere. Serruya and Serruya (1972) held that under saturation of oxygen, low temperature and instability of water masses are much favorable for physical enrichment of oxygen. Similar results were made by the Hannan (1979), Badge and Verma (1985), Kaur *et al.* (2000), Rather *et al.* (2001) [20]. Alkalinity plays an important role in determining the ability of water to support algal growth and other aquatic life. Biologists use it as a measure of water fertility.

The increase in alkalinity during winter may be attributed to the accumulation of bicarbonate ions in these months as the rate of their uptake is declined. The decrease in the alkalinity in summer is due to the fact that there is decrease in bicarbonate ions in summer because of its use by luxuriant growth of phytoplankton. These findings are in agreement with Sahai and Shrivastava (1976) who observed low concentration of bicarbonates in summer owing to the increased use by phytoplankton and submerged macrophytes.

The importance of free carbon dioxide for autotrophic plants is very well known as they are the primary producers on which the biotic 108 components of aquatic ecosystem wholly depends. It is the basic raw material for the photosynthetic process. The two important sources of carbon dioxide in aquatic media are: (a) physiological process of photosynthesis, and (b) diffusion from atmosphere this gas alters the pH of water by forming carbonic acid, which further dissociates into carbonates and bicarbonates. Hence the estimation of free carbon dioxide in aquatic medium is of great importance. Temperature is undoubtedly a primary important factor in determining the solubility of dissolved gases and their concentration in water. The present data clearly shows that temperature of water is of prime importance in determining the solubility of free CO2. A perusal of data during the present study showed free carbon dioxide to range between 8mg/L and 28mg/L with maximum concentrations being obtained during colder months. With the onset of warmer months, the rate of photosynthesis increases and the free CO2 content gradually decreases.

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