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Short Communication

Limnology of two trout streams of Kashmir

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Abstract

The paper describes the results of investigations carried out during the year 1980 on physico-chemica factors of two trout streams, the Erin and the Madhumati, of Kashmir. The Madhumati is a soft water type throughout the year while the Erin is so only during spring and summer. Both the streams are alkaline (pH 7·28–8·52), mainly due to bicarbonates of Ca^{++} and Mg^{++}. The low temperature (4·2–19·5°C) and high oxygen concentration (8·0–12·4 mg/l) and the low concentration of various nutrients are the special features of these streams.

Key words: Trout streams, Erin, Madhumati, steep gradient, alkaline, oxygen-supersaturation, low nutrients.

1. Introduction

The mountainous tarns, glacial lakes and the numerous snow and spring-fed streams of Kashmir Valley are best suited for the cold water fisheries. Except for Seghal *et al*[1] and Kumar and Bhagat[2], who studied the ecological aspects of some of the streams, no serious attention has been paid to their limnological characteristics. The present contribution describes the seasoual fluctuations of the physical and chemical characteristics of two streams, the Erin and the Madhumati (fig. 1), which are famous for the trout, particularly the former where a hatchery has also been established.

The Erin stream rises from the western flanks of the Harmukh, persues a course of about 24 km through cascaded valley, and ultimately falls into the Wular Lake, south of Bandipur. Further north, the Madhumati drains the northern slopes of Harmukh precipice with its feeder streams spread over a vast area between Nagmarg in the west and Sarbal Nag in the East. The stream joins the Wular near Bandipur after traversing

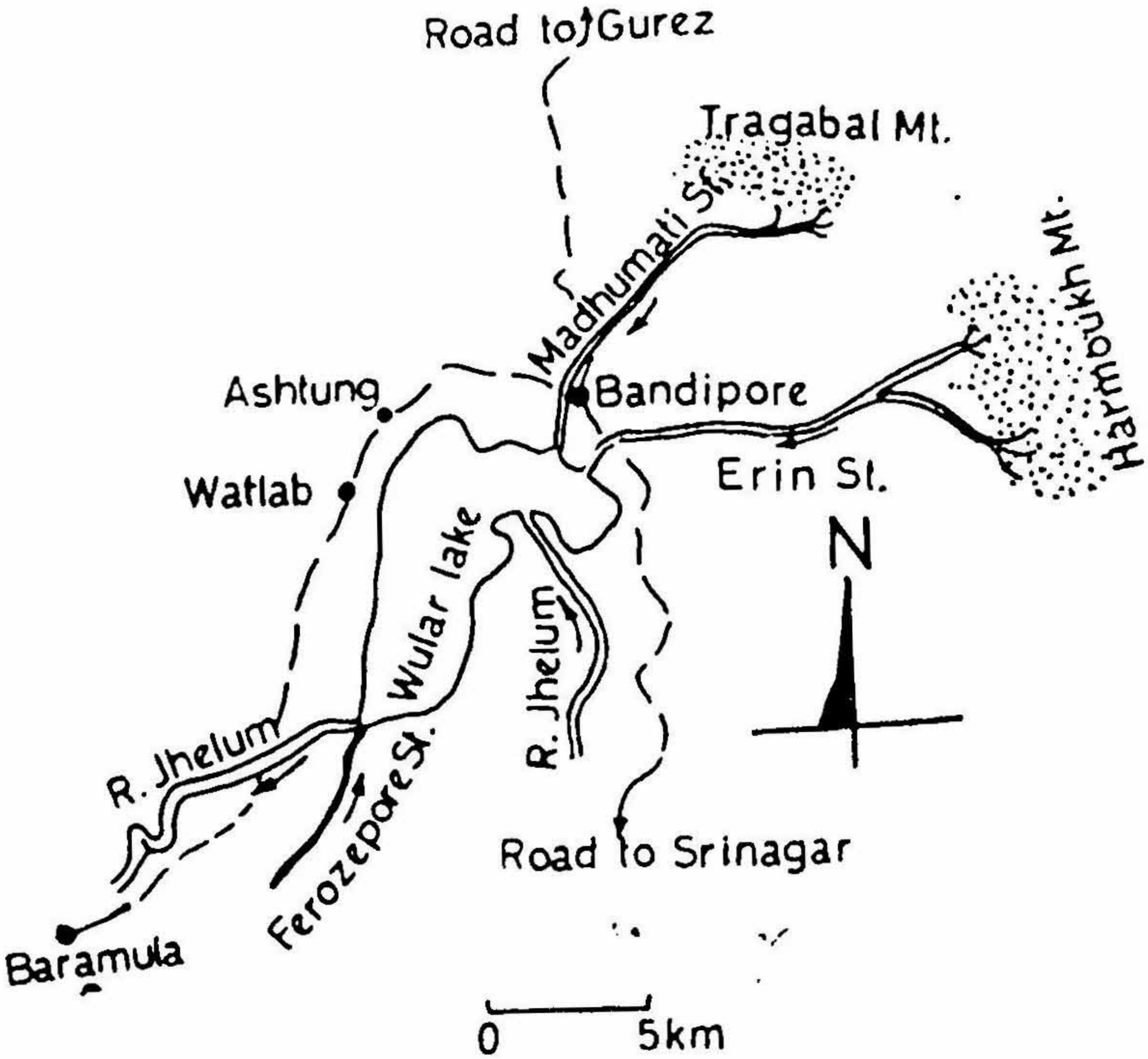

FIG. 1. Map showing the location of the streams.

a distance of 39 km. Both the streams are characterised by steep gradients, the Erin falls 88 m in one km, whereas Madhumati falls 103 m in one km[3].

2. Material and methods

Water samples were collected once every month from January 1980 to December 1980 about 3 km away from the mouth of the streams. Water was sampled between 1000 and 1200 hours IST and transported to the laboratory in polyethylene bottles, and analysed according to standard methods followed by Yousuf and Qadri[4]. Saturation values of dissolved oxygen were calculated by Truesdale *et al*'s[5] table, incorporating the correction factor for altitude. The data thus obtained are given in fig. 2 for the Erin and in fig. 3 for the Madhumati.

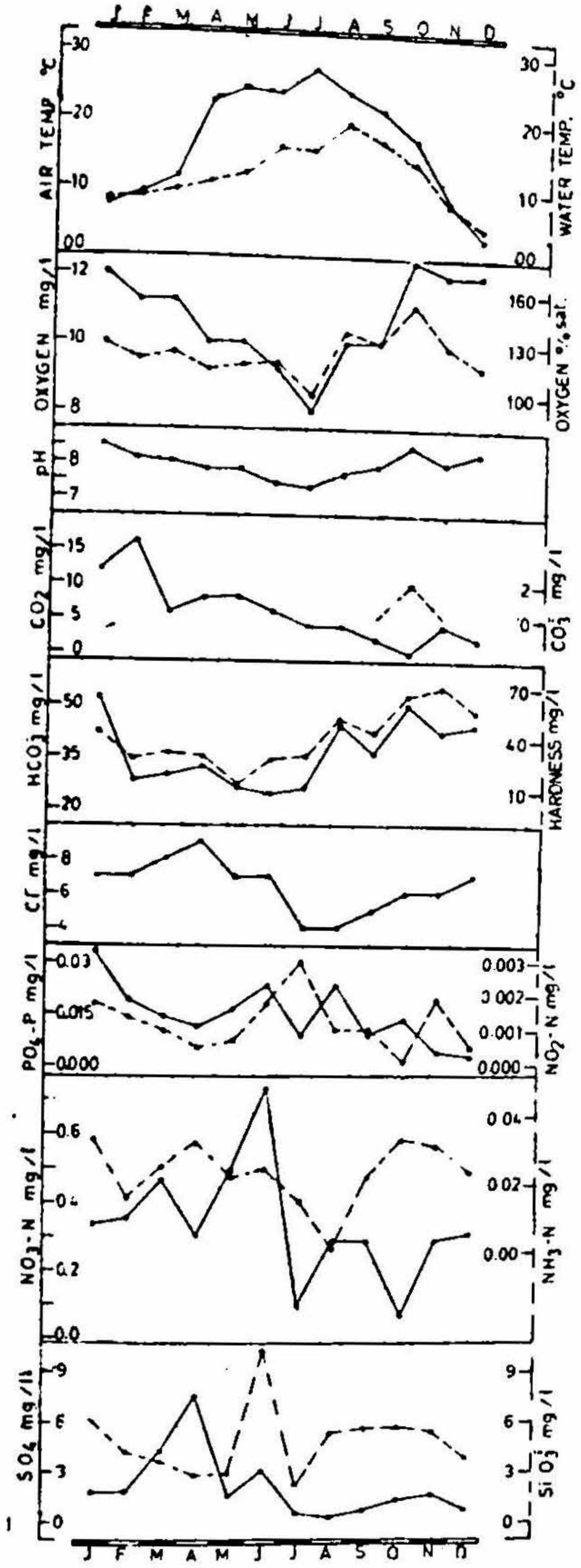

FIG. 2. Physical and chemical variables of Erin stream.

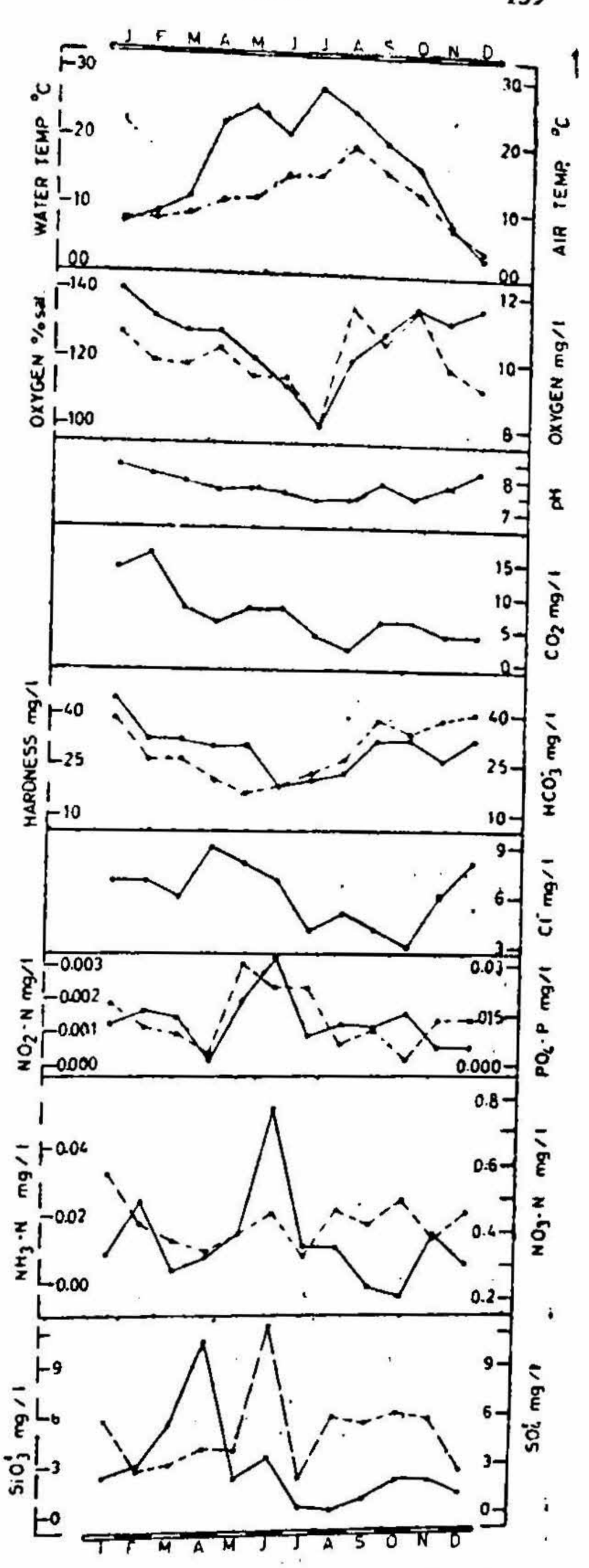

FIG. 3. Physical and chemical variables of Madhumati stream.

3. Results and discussion

Streams characterised by V-shaped valley, high gradient, clear water, rocky to gravelly bottom, high dissolved oxygen and low-free carbon dioxide content and absence of pollutants are termed trout streams[6]. The Erin and the Madhumati have a steep gradient (88 m/km and 103 m/km for the two streams respectively) and are, therefore, torrential in nature. The rapid flow of water of these streams through deep valleys plays an important role in their thermal structure and prevents the extreme heating and cooling of water. This is exhibited by a distinct amplitude of variations between the water and atmospheric temperature, which reaches up to a maximum of 12·5° C [for Erin and 13·5° C for Madhumati in May. Such a phenomenon has also been reported by Sehgal *et al*[1] and Kumar and Bhagat[2].

Under natural conditions, the running waters typically contain a relatively high concentration of dissolved oxygen tending towards saturation[7]. In the present streams, the oxygen remains in a supersaturated condition throughout the year. The minimum values (8 mg/l; 100·6% Sat. in Erin and 8 mg/l ; 100% in Madhumati) were recorded in July. The annual cycle of dissolved oxygen of these streams is inversely correlated with temperature condition, the concentration of dissolved oxygen decreasing with an increase in the temperature.

The seasonal variation of the buffer system and other dissolved solids represents a measure of actions and interactions of chemial and biological processes of waters. No regular relationship between dissolved CO_2 and oxygen is established in the two streams. However, in the Erin peak concentration period of oxygen in October is marked by the complete absence of free CO_2 and presence of carbonates, which are otherwise characteristically absent. In lentic waters the CO_2 depletion has been attributed to increased photosynthetic activity of phytoplankton[8]. The present streams were characteristically poor in the phytoplankton. However, a rich growth of sessile algae was noticed on the submerged rocks and boulders. It seems possible that the photosynthetic activity of these algae use free CO_2 and release large quantities of O_2. This is substantiated by the values of O_2 and CO_2 of October in Erin stream. After the removal of CO_2 the bicarbonates are used as carbon source for photosynthesis and carbonates are liberated as by-product[9].

The water in both the streams was always alkaline with a pH range of 7·28–8·52 in Erin and 7·32–8·35 in Madhumati stream. Bicarbonates were present throughout the year and the maximum and minimum concentrations were recorded in January and June respectively in both the streams. The Erin was slightly richer in this anion (24–52 mg/l) than the Madhumati (18–44 mg/l). Carbonates were conspicuously absent except for the month of October when a low concentration of 2·0 mg/l was observed in the Erin.

Both the streams are of soft water type during February–July with the total hardness values below 40 mg/l (14–32 mg/l in Erin and 16–26 mg/l in Madhumati). But

from August to January the Erin becomes medium hard type, while there is very little or no change in the hardness of the Madhumati. This is possibly due to the fact that from February onwards the ice starts melting and both the streams receive a large quantity of water which is very low in the ionic concentration. This process continues throughout the summer till most of the ice has melted. From August to January the ground water seems to be contributing the major portion to the streams, particularly to Erin and this increases the hardness of water.

The concentration of chlorides (6·4 mg/l and 6·2 mg/l), silicates (4·7 mg/l), sulphates (1·15 mg/l and 2·6 mg/l) phosphates (0·0146 mg/l and 0·0125 mg/l) and inorganic nitrogen compounds (NO_2-N, 0·0012 mg/l and 0·0013 mg/l: NO_3-N, 0·331 mg/l and 0·352 mg/l: NH_3-N, 0·023 mg/l and 0·017 mg/l respectively for Erin and Madhumati) is fairly low and does not follow any regular seasonal pattern. However, chlorides, silicates and sulphates show a marked increase during the wet months of March and April, while during the dry months of late summer and autumn their values are relatively low. This is suggestive of flushing of these ions into the streams from surface run-off during the spring rains and decrease during the dry period, as has also been reported by Feller and Kimmins[10].

It may be concluded that the physical and chemical characteristics of both the streams seem to be conducive to the cold water fishery. The data regarding the plankton and the benthos of these streams are being processed and it is hoped that these will throw more light on the limnological conditions of the two streams.

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