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# Observations on Seasonal Variations of Benthic Organisms in Two Trout Streams of Kashmir

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The paper embodies information on the seasonal variation of benthic fauna in two trout streams (viz. the Sind and the Lidder) of Kashmir. In both, the bulk of benthic life was contributed by insects. The average number of organisms recorded were 63 units $m^{-2}$ in Sind and 116 units $m^{-2}$ in Lidder. The insect community comprised nymphs of Ephemeroptera and Plecoptera; larvae of Trichoptera, Diptera; and larvae and adults of Coleoptera. *Mystacides* sp. and *Baetis* sp. were the most dominant forms. The other forms which co-dominated include *Ephemerella* sp., *Hydropsyche* sp., *Rhyacophila* sp., *Leptids* sp. and *Nemoura* sp. in order of abundance. The relative abundance of the major order of class Insecta has been correlated with the physico-chemical factors of the streams.

**Key Words: Seasonal variations, Benthic organisms, Nymphs**

## Introduction

The functional role of benthic fauna in an upland stream is well realised. Mainly composed of secondary producers like small crustaceans, molluscans and nymphal, larval and adult forms of insects the benthic fauna is directly preyed upon by the ultimate consumers (fishes) and as such offers the very subsistence to them. Trout streams display considerable ecological solidarity in their fauna and their abundance in a unit space is generally used as an index for grading the streams (Jhingran & Sehgal 1978). The present communication embodies the observations made on the seasonal variations in the benthic fauna of the Sind and the Lidder trout streams of Kashmir during the two years.

## Material and Methods

The analysis for physico-chemical factors is based on APHA manual. Benthic fauna was collected from preselected beats of each stream, by enclosing one sq.m of stream bed with square-meshed cloth. The bottom stones, gravel and sand on the upstream of the cloth were hurriedly scuffed to dislodge the aquatic life. The organisms were hand-picked and preserved in 5% formalin.

## Topography

From the high snow mountains in Kashmir region many perennial streams carrying the ice cold water take their origin. The principal streams among them are the Sind and the Lidder. The Sind takes its origin in the Panchtarni range and after flowing toward southward it joins Jhelum at Shadipur. Out of its total, streams-length of 184 km, a stretch of 84 km between Sonamarg and Woyil is the trout stream which is divided into 12 beats including Kangan and Wusan beats. The main Lidder is formed by the confluence of East and West Lidder which take their origin from east

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Tarsar and Seshnag respectively. The Lidder has a combined length of 142 km divided into 14 beats including the Wadhan and Yanyar beats.

## Results

### *Environmental Factors*

The physico-chemical parameters comprised water temperature, *p*H, turbidity, dissolved oxygen, total alkalinity and silicates. The average values as well as ranges of these parameters are shown in table 1.

### *Benthic fauna*

In both the streams, bulk of bottom fauna comprised nymphs, larvae and adults of selected orders of class insecta. The average number of benthic organisms was 63 $m^{-2}$ in Sind and 116 $m^{-2}$ in Lidder. Insects contributed 94.2% and 99.51% respectively in Sind and Lidder streams, the rest being contributed by Turbellarians and Malacostracan. The fluctuation of total benthic fauna in the two streams during different months of the year is shown in figure 1.

The insects comprised nymphs of Ephemeroptera and Plecoptera; larvae of Trichoptera, Diptera and larvae and adults of Coleoptera with respective percentage of 39.39, 6.55, 37.34, 5.13 and 5.84 in Sind and 26.14, 11.56, 41.98, 3.09 and 6.74 in Lidder stream. The remaining percentages were contributed by Turbellarians and Malacostracan. May-flies were available throughout the year in the collections represented by almost a dozen forms and in combination with caddis flies accounted as much as 75.13% and 78.86% of total benthic life in Sind and Lidder streams respectively. The important genera in order of abundance were *Baetis, Ephemerella, Heptagenia, Iron, Caenis, Epeorus, Rhithrogena, Stenomera, Ecdyonurus, Calibaetis* and *Isonychia.*

**Table 1** *Physico-chemical characteristics of the Sind and the Lidder streams during the two years (pooled)*

| Factors | Sind | Lidder |
|---|---|---|
| Water temperature (C°) (Average) | 3.2–129.0 (19.0) | 3.1–29.0 (19.1) |
| Transparency (cm) (Average) | Nil–28.0 (7.4) | Nil–22.0 (8.2) |
| *p*H (Average) | 7.2–7.8 (7.5) | 7.1–7.6 (7.4) |
| Dissolved oxygen (ppm) (Average) | 9.4–11.4 (10.3) | 9.8–11.4 (10.4) |
| Total alkalinity (ppm) (Average) | 35–95 65.0 | 35–105 78.0 |
| Silicates (ppm) (Average) | 0.540–1.380 (1.013) | 0.700–1.90 (1.000) |

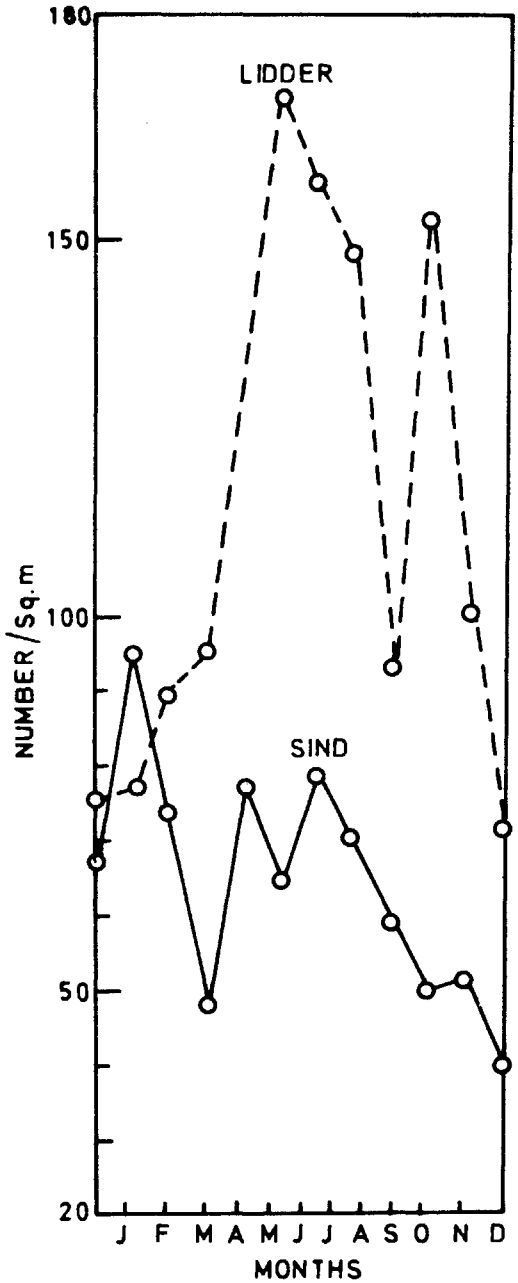


**Figure 1** Fluctuations of total benthic fauna in two streams during different months

The average number of their abudance was 24.8 U $m^{-2}$ in Sind and 30.1 U $m^{-2}$ in Lidder. Their minimum ... maximum number were recorded during December

(8 U $m^{-2}$) and August (52 U $m^{-2}$) in Sind against November (16 U $m^{-2}$) and August (37 U $m^{-2}$) in Lidder.

The plecopterans were represented in the samples by six genera viz. *Nemoura, Nemurella, Perla, Amphinemura, Chlroperla* and *Leuctra*. Their availability was comparatively poor in both the streams and were completely absent from the collections during certain months of the year. The average number of their availability was 2.6 U $m^{-2}$ in Sind and 13.5 U $m^{-2}$ in Lidder. Their minima and maxima were encountered in May (1 U $m^{-2}$), September (10.2 U $m^{-2}$) in Sind and February (0.5 U $m^{-2}$), October (43 U $m^{-2}$) in Lidder respectively.

Both the cased and caseless caddis larvae (Trichoptera) were encountered in plenty in both the streams. *Rhyacophila* were found hiding beneath gravel while *Setodes* constructing cases and a few even ballasting their houses by cementing large pebbles along each side. The important genera in the order of their abundance were: *Mystacides, Hydropsyche, Rhyacophila, Brachycentridae* and *Setodes*. The average number of Trichopteran encountered in the two streams was 25.2 U $m^{-2}$ in Sind and 62.7 U $m^{-2}$ in Lidder. September (9 U $m^{-2}$), May (39 U $m^{-2}$) and February (30 U $m^{-2}$) June (123 U $m^{-2}$) were the months of their minimum and maximum availability.

The order Coleoptera was moderately represented in the collections and comprised mainly beetles and bugs. The common representative in both the streams were *Hyarogobus, Hydrophilus, Elmis* and *Dytiscus*. Their average number of availability, was 2.6 U $m^{-2}$ in Sind against 3.2 U $m^{-2}$ in Lidder. The minima of their number were recorded in February (1 U $m^{-2}$) in Sind and April (1.1 U $m^{-2}$) in Lidder while their maxima was recorded during October in both the streams.

The Dipteran larvae were represented by *Atherix, Chironomus, Simulium, Blepharocera, Tabanus, Pedicia* and Antocha. Among all these forms Blepharocerids reportedly show (Usinger 1967) considerable skill to live under water falls and thrive in torrents, where they defy the current by clininging to rocks with suction discs. The average number of dipterans was 5.3 U $m^{-2}$ and 8.6 $m^{-2}$ in the Sind and the Lidder stream respectively. The maxima of their number were recorded in April (11 U $m^{-2}$) in the Lidder while minima were recorded during October (2 U $m^{-2}$) in the Sind and December (3.2 U $m^{-2}$) in the Lidder.

Barring insects the only invertebrates encountered in the two streams were Malacostracan represented by *Gammarus pulex* and turbellarians represented by *Planaria* sp. The former were dominant in Sind while the latter in Lidder stream. *G. pulex* were found usually associated with stones having excessive periphytic and moss growth while plannarians were encountered in free-swimming state.

*Dominant Forms*

Throughout the sampling year, the bulk of fauna was formed by *Mystacides* but at times it was superseded by *Baetis*. The other two genera *Ephemerella* and *Hydropsyche* also co-dominated in the collections. The subordinate species belonged mainly to the groups Diptera, Coleoptera and Plecoptera. Many of their representative namely *Rhyacophila, Leptids* and *Simulium* exhibited seasonal dominance while *Nemoura* and *Hydrophilus* occurred only sporadically and in considerably small numbers. The fluctuations of dominant forms in the collections of four centres during different months is given in figure 2.

*Mystacides*

The larvae of *Mystacides* were found to spend their growing period in cylindrical or conical cases in sand grains until pupation. Later they cement cylindrical case on to the surface of the rock and close the opening with flat pebbles. At some places, clusters of cases presenting the appearance of a wooden pile were seen.

In both the streams, *Mystacides* were considerably dominant in number during major part of the year. From mid-April, they showed a sharp increase in their number and this trend continued till mid September. The trend of their availability was almost identical in both the streams. Their average number of availability was 22.5 U $m^{-2}$ in Sind and 36.7 U $m^{-2}$ in Lidder. Highest number were recorded during June in both the streams (39.0 U $m^{-2}$) in Sind and (94.0 U $m^{-2}$) in Lidder while lowest number were recorded in April in Sind (8.0 U $m^{-2}$) and February (7.5 U $m^{-2}$) in Lidder.

*Baetis*

These are typical streams adapted mayflies, whose thin flat bodies and limbs are closely pressed against the underside of the stones. Though they are known to be excellent swimmers yet they were found more in caddis. Their average number of availability was 17.4 U $m^{-2}$ in Sind and 18.2 U $m^{-2}$ in Lidder. The minimum and maximum number of *Baetis* recorded during two years were 1 U $m^{-2}$ and 22 U $m^{-2}$ in the months of January and September in Sind and 6.5 U $m^{-2}$ and 31 U $m^{-2}$ in the months of February and October in Lidder respectively.

*Ephemerella*

The average number of availability of these stifflegged mayflies was 5.3 U $m^{-2}$ in Sind and 31.2 U $m^{-2}$ in Lidder. The minimum and maximum number available during the year were in the month of September (3 U $m^{-2}$) and February (12 U $m^{-2}$) in Sind while January (5 U $m^{-2}$) and May (44 U $m^{-2}$) in Lidder respectively.

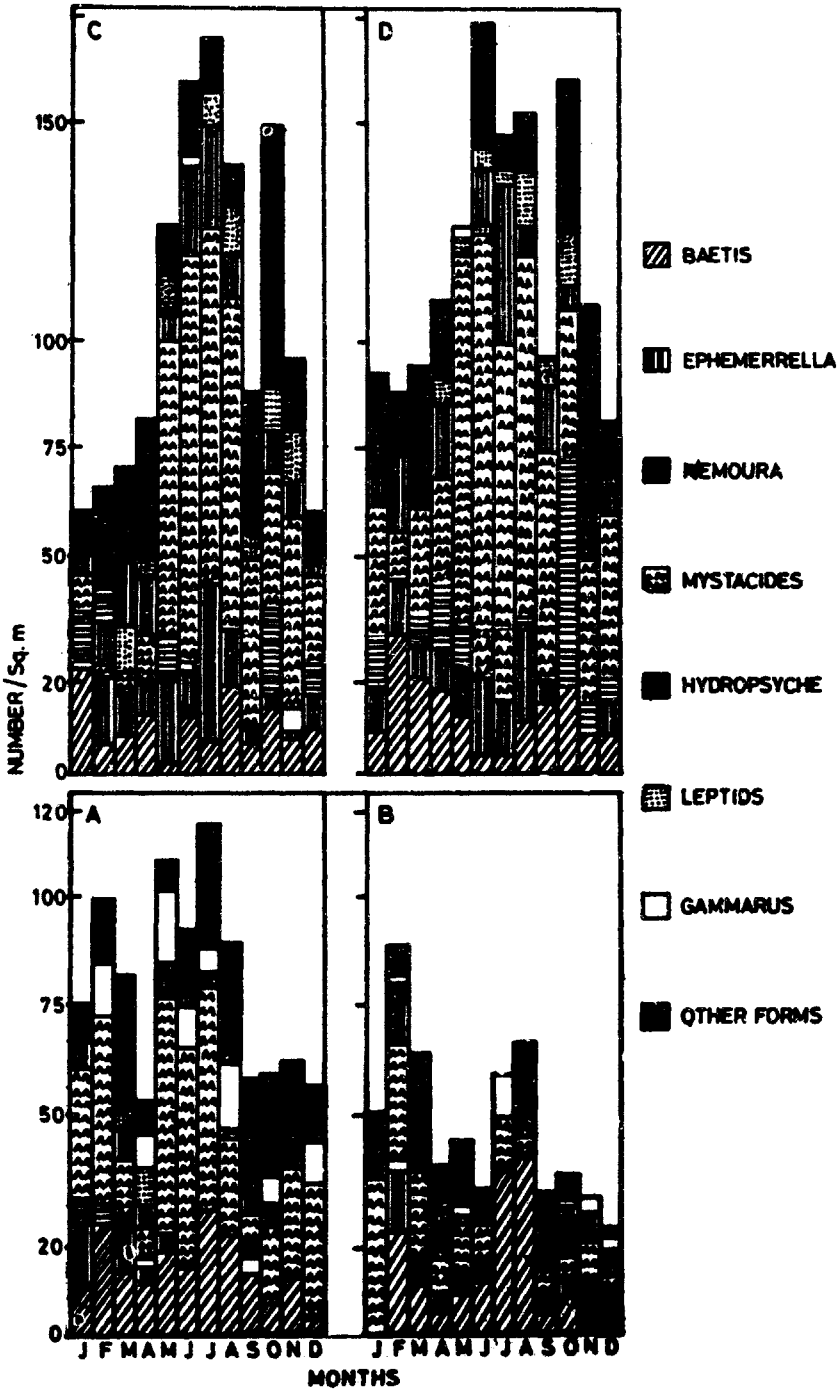


**Figure 2** Fluctuations of dominant forms during different months

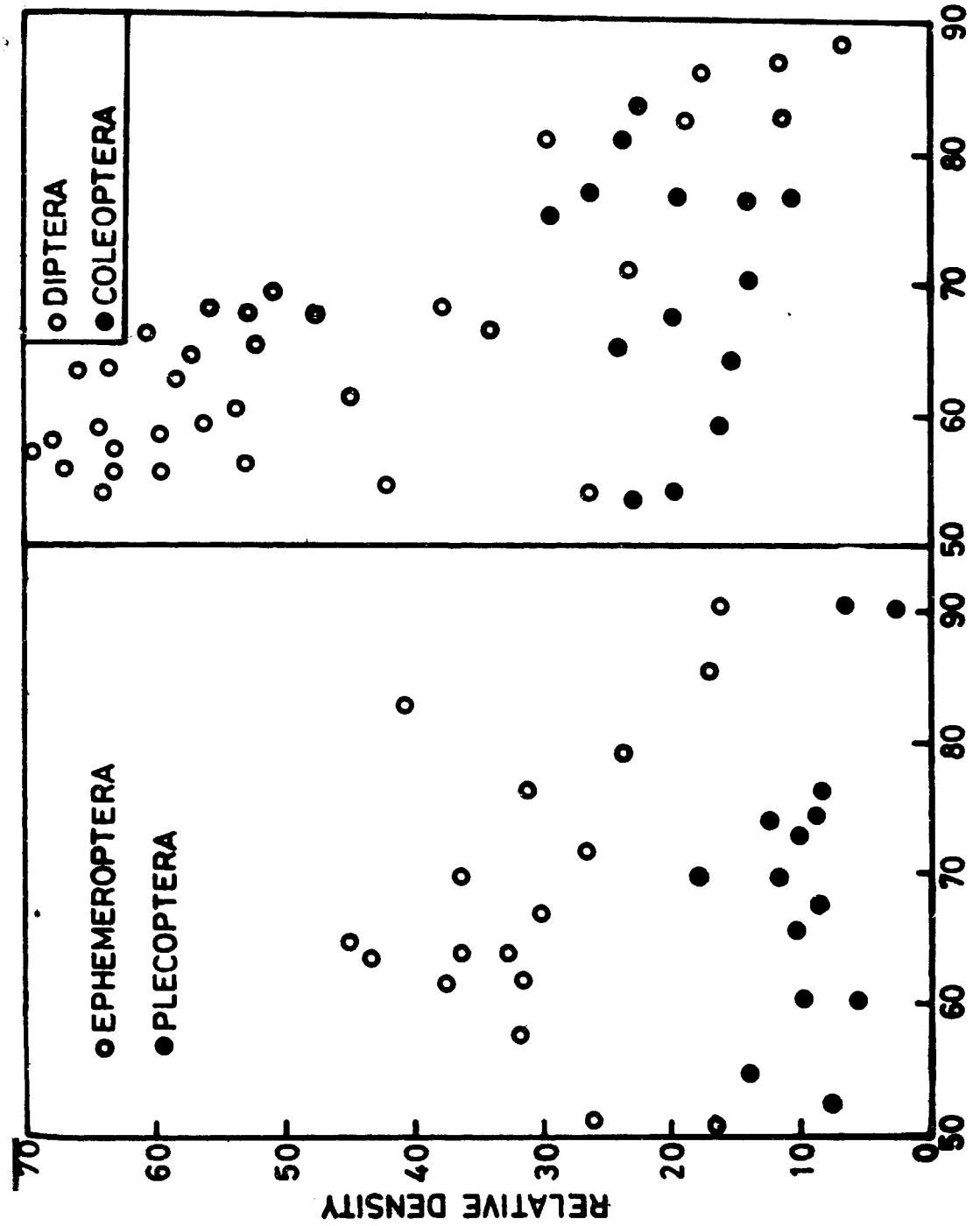


Figure 3 Relative densities of major insect orders against total alkalinity in the stream

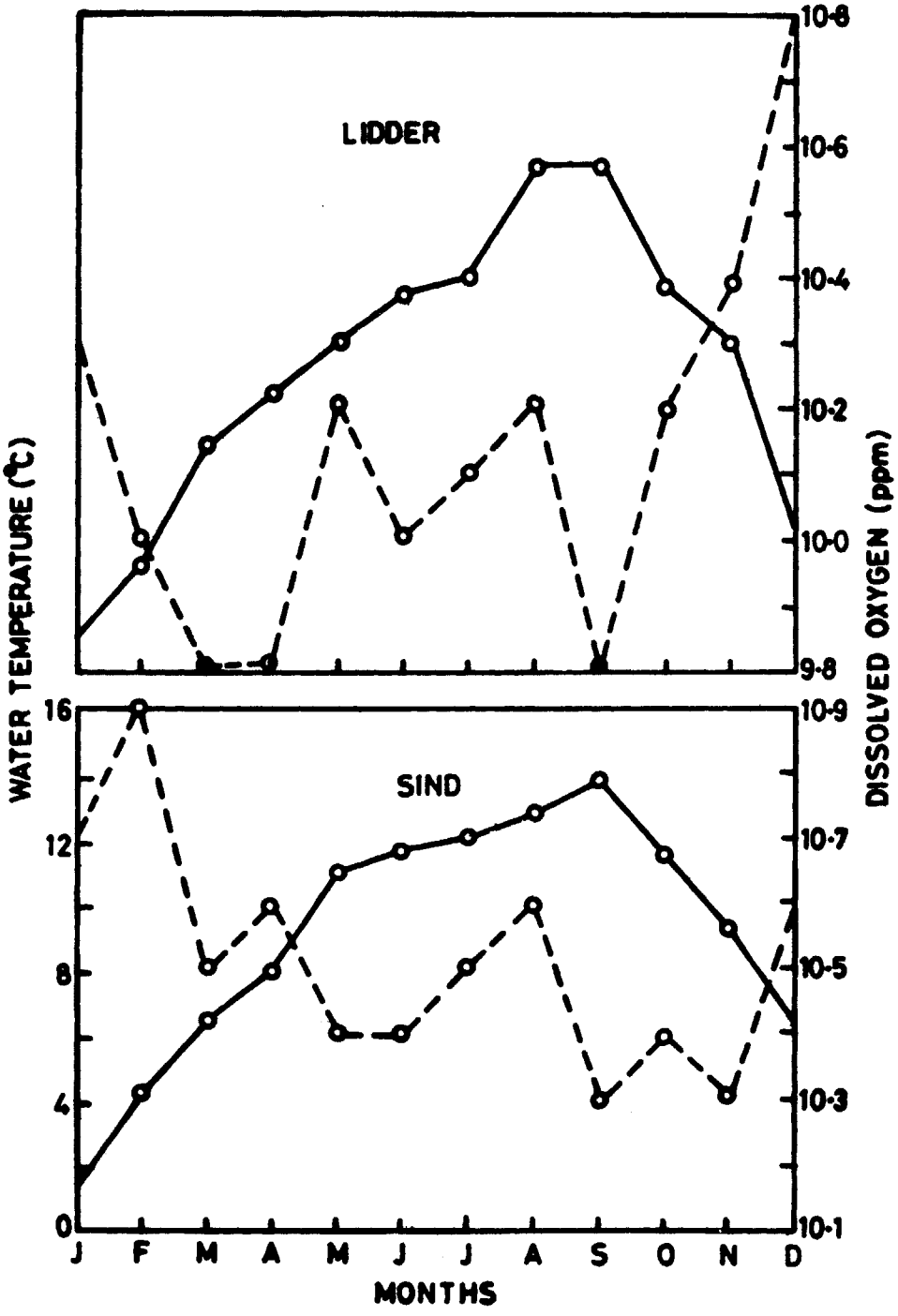


**Figure 4** Seasonal variations in two major parameters in Sind & Lidder streams

*Hydropsysche*

These were found in riffles and near waterfalls. The larvae creeps out periodically to harvest the feast snared in their nets and then retreat to crevices into the rocks. In Sind, they were numerically more in summer months while reverse was in the case of Lidder where they were more dominant during winter months. The average number of *Hydropsyche* available in the two streams were 4.8 U $m^{-2}$ in Sind against 10.7 U $m^{-2}$ in Lidder. The minimum and maximum number encountered in the two streams were 2 U $m^{-2}$ (September) and 10 U $m^{-2}$ (February) in Sind against 3.5 $m^{-2}$ (October) and 23 U $m^{-2}$ (July) in Lidder respectively.

**Discussion**

The hillstreams generally comprise of many sub-habitats, from rapids and water falls to sluggish stretches and placid 'backwaters'. According to Usinger (1967) though the upland streams maintain a characteristic individuality, under similar habitat a fair degree of oneness is found in terms of their benthic life. Sehgal (1977) surveyed the various coldwater streams lying in the northern and southern regions of the country and concluded that qualitatively the benthic fauna of all these geographically separate streams is almost the same. In the present study also, an ecological solidarity in terms of benthic fauna was observed in both the streams.

According to Sehgal (1977) the seasonal variation in the quantum of benthic fuana in streams depends upon the interplay of various environmental factors. Armitage (1958) highlighted the role played by stream-flow in the composition of ecological life. While a sudden increase in volume might create a surge sufficient to dislodge the bottom life, the decrease on the other hand might expose sessile organisms to dryness leading to their death. However, neither of these extremes was observed in the Sind and Lidder streams. The increase of flow from May onwards was gradual and in a same fashion it receded during the winter months.

Numerous attempts have been made to evaluate the relative importance of the various environmental factors in determining the quantity and quality of organisms. Linduska (1942) considered the nature of bottom as a very important factor. Gaufin (1949) chose the most variable factors, volume, velocity, alkalinity and bottom composition responsible for difference in the Provo river. Needham (1934) considered depth, bottom and current as most important. Sprules (1947) picked temperature, nature and configuration of bottom particles and rate of flow to be the chief determinants. Ricker (1934) utilised speed of current, type of bottom temperature, width and depth, flora, fauna and chemical characteristics in making classification of Ontario streams. In his classification of streams, Ricker (1934) used volume of flow and temperature as primary characters, current speed and bottom texture as secondary characters and dissolved solids as tertiary characters. These seem to form rather natural groupings, especially if qualitative faunal differences are considered but do not carry any implication concerning the quantum of bottom organisms.

Further, there are a number of generalised statements in the literature concerning the factors affecting the standing crop of insects. Needham (1934) states that warm streams are richer in food than colder ones. Taft and Shapovalor (1935) state, in general, high alkalinity readings are indicative of streams rich in bottom fish foods. Although some authors have established the positive correlation between benthic life with temperature (Allen 1951, Ekman 1911) the bicarbonate alkalinity is considered more important than temperature in influencing the density of bottom fauna (Gaufin 1949, Armitage 1958, Needham & Usinger 1956).

The relative abundance of major insect orders also changes with alterations in average alkalinity. Figure 4 shows the results of plotting relative density of the four orders from the Sind and Lidder streams against total alkalinity. The correlation coefficient of these plots were determined with the following values.

| | |
|---|---|
| Ephemeroptera | .65 (Significant at 1% level) |
| Plecoptera | .23 (Non-significant at 5% level) |
| Trichoptera | .751 (Significant at 1% level) |
| Diptera | .314 (Non-significant at 5% level) |

Though a number of distinct aberrations were observed from the general distribution, these may be explained as arising out of interplay of other environmental factors.

To sum up, in both the Sind as well as the Lidder streams of Kashmir, bicarbonate alkalinity appears to be the prime factor in determining total quantity of benthic organisms. Other factors such as volume of flow, temperature, current speed and bottom texture may modify the effect of the bicarbonates. The variations in turbidity and silicates were not consistant. These factors changed with the seasons of the year and could not be correlated with any benthic assemblage of organisms.

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