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Short Communication

Distribution of *Polyarthra vulgaris* Carlin (Rotifera: Monogonota) in a warm monomictic lake of Kashmir, India

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Abstract

The paper describes seasonal changes in the abundance of *Polyarthra vulgaris* Carlin (Rotifera: Monogonota) in a warm monomictic water body of Kashmir — Lake Manasbal. The lake is alkaline, generally with low nutrient content.

P. vulgaris is a perennial rotifer in the lake and shows higher population density in the open water area. It prefers a temperature range of 9–18°C and avoids warmer waters with pH >8.5. Besides the abiotic factors, its population appears to be influenced by the abundance of other zooplankters, especially that of *Diaphanosoma brachyurum* Lieven (Cladocera).

Key words: Warm monomictic lake, rotifer ecology, food competition, perennial behaviour.

1. Introduction

Lake Manasbal (34° 15′ N and 74° 40′ E) is situated at an altitude of 1584 m A.S.L. to the north-northwest of Srinagar, Kashmir. A detailed limnological study of the lake was made from May 1976 to April 1978. Many of the hydrobiological features recorded during this study have already been reported[1–6]. The present paper describes the seasonal fluctuations in the population density of *Polyarthra vulgaris* Carlin in this warm monomictic water body.

2. Materials and methods

Lake Manasbal covers an area of 2.8 km^2 with a maximum depth of 12.5 m. The lake finds its source of water through a large number of springs spread over its basin. On its eastern side a branch of an irrigational channel drains into it from March to October. Excess water from the lake is drained out into river Jhelum by a channel on its western side. The littoral zone of the lake supports a luxuriant growth of macrophytes, including *Myriophyllum*, *Ceratophyllum*, *Nelumbium*, *Typha* and *Potamogeton*.

On the basis of morphometry, five representative stations were selected for the collection of limnological data (fig. 1). Water samples were collected for various

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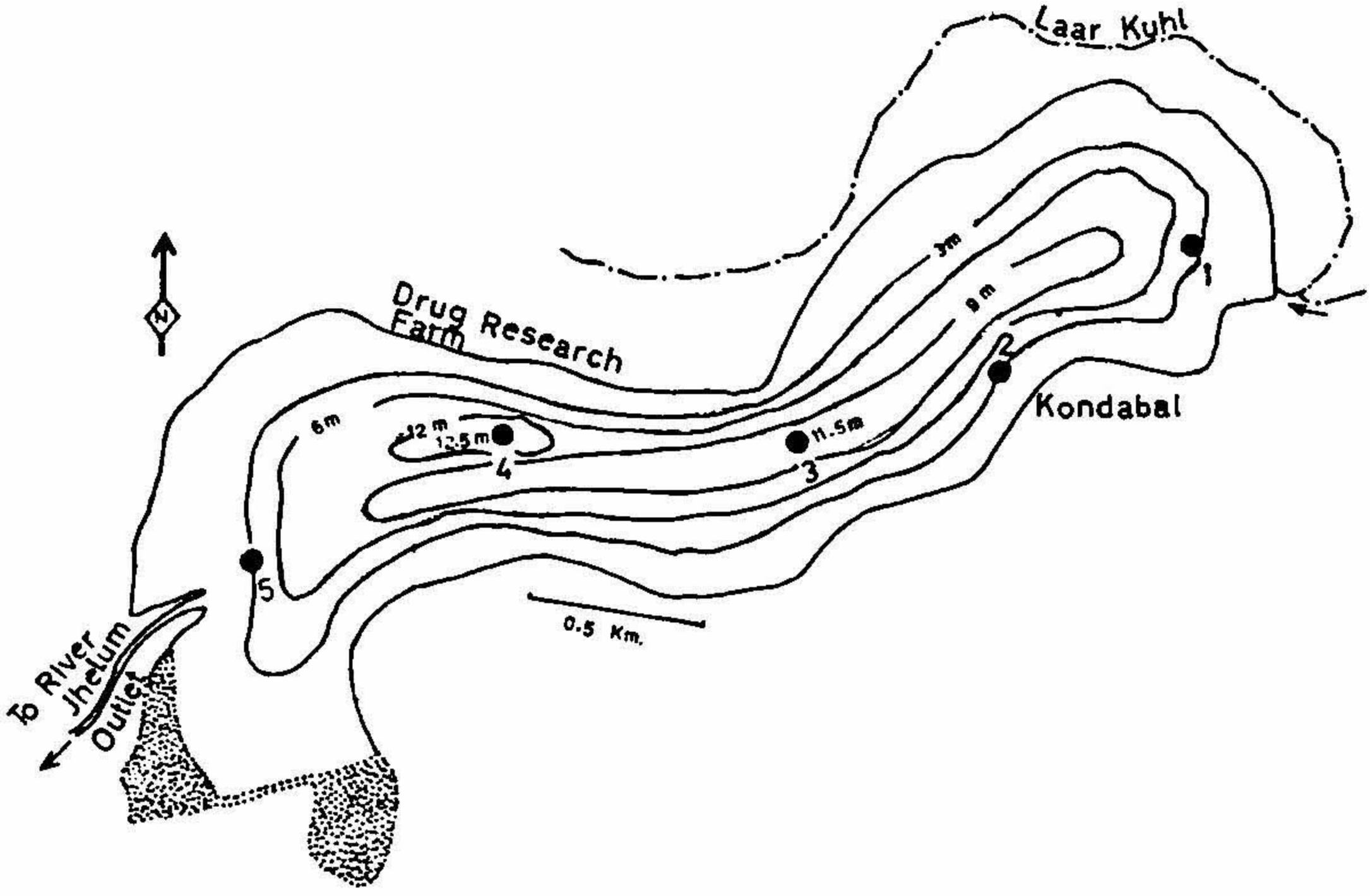

FIG 1. Bathymetric map of Lake Manasbal, showing different stations (● 1–5) of collection.

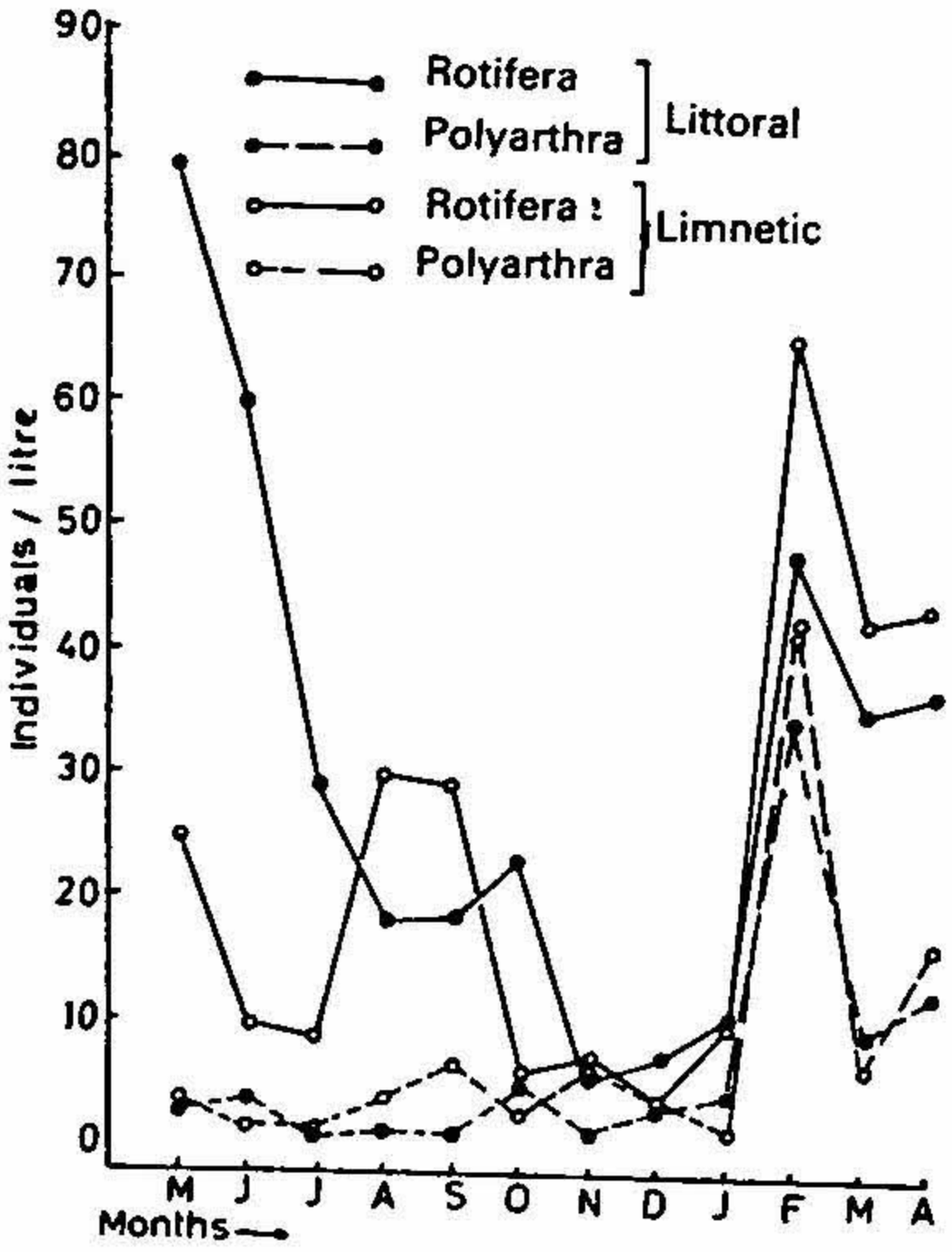

FIG 2. Monthly changes in the abundance of *Polyarthra vulgaris* and total rotifera in Lake Manasbal. Values are the averages of two years.

Table 1
Mean values of the abiotic features of Lake Manasbal, Kashmir during 1976–78.

Parameter	Littoral zone	Limnetic zone			
	Surface	Surface	3 m	6 m	9 m
Temperature of air °C	20·4 (7·07)	20·5 (7·14)			
Temperature of water °C	18·4 (7·02)	18·5 (6·9)	17·5 (6·6)	15·4 (5·4)	12·0 (3·0)
pH	8·59 (0·57)	8·31 (0·47)	8·19 (0·33)	7·81 (0·14)	7·52 (0·16)
Free CO_2 mg/l	8·4 (10·23)	11·4 (10·84)	13·1 (10·40)	18·6 (9·24)	25·9 (11·80)
Carbonates mg/l	11·5 (13·43)	5·0 (9·17)	1·4 (3·57)	– –	– –
Bicarbonates mg/l	88·4 (31·65)	101·7 (24·80)	109·8 (17·66)	128·4 (12·32)	148·7 (16·10)
Hardness mg/l	115·3 (28·20)	121·8 (25·94)	126·9 (21·77)	142·5 (13·40)	157·9 (11·20)
Diss. O_2 mg/l	10·3 (1·82)	8·0 (2·40)	7·2 (2·13)	4·9 (1·93)	3·3 (1·74)
Chloride mg/l	5·6 (0·78)	5·2 (0·80)	4·8 (0·73)	4·8 (0·71)	4·7 (0·79)
Silicates mg/l	4·4 (2·96)	4·9 (3·35)	5·4 (3·27)	6·7 (2·94)	8·3 (3·26)
NO_3 –N mg/l	0·435 (0·191)	0·396 (0·191)	0·409 (0·241)	0·427 (0·213)	0·438 (0·217)
NO_2 –N µg/l	3·6 (3·13)	2·7 (2·40)	2·4 (2·10)	3·6 (2·75)	5·1 (3·55)
NH_3 –N µg/l	52·7 (29·4)	38·1 (37·0)	39·1 (37·3)	31·8 (31·1)	70·4 (43·8)
PO_4 –P µg/l	7·9 (6·0)	7·2 (6·9)	7·4 (6·8)	7·2 (7·3)	6·5 (6·3)
Sulphates mg/l	4·21 (1·29)	3·85 (1·04)	3·5 (0·85)	3·7 (1·02)	3·13 (0·89)

Figures in parentheses are standard deviations.

physical, chemical and biological parameters using a Van-Dorn type sampler from a depth of 0·5 m in the littoral (stations 1, 2 and 5) and from 0·5, 3·0, 6·0 and 9·0 m depths in the limnetic zone. Methods used for analysis of physico-chemical features are the same as described by Yousuf and Qadri[5]. Population density of the zooplankters was calculated by counting the samples in a Sedgwick rafter cell under a magnification of × 100 as per the method of Welch[7].

3. Results

The lake has a clear differentiation of littoral and limnetic zones and appreciable differences were noticed in the various limnological features of the two regions of the

lake. The mean values of the abiotic factors for the littoral and limnetic regions are given in Table I. The lake was always alkaline (mean pH = 7·5 to 8·6). Alkalinity was largely due to the presence of bicarbonates of calcium and magnesium. Dissolved oxygen exhibited a typical clinograde curve during thermal stratification and the hypolimnion (from 9 m downwards) became completely anoxic towards later stages of stagnation. Nutrients were generally present in small quantities but NO_3–N, NH_3–N, NO_2–N and Sio_3^{2-} appeared in higher concentrations in the deeper strata, especially during stagnation.

Polyarthra vulgaris Carlin (Rotifera: Monogonota) was one of the dominant perennial rotifers of the lake. Except in station 2, it was recorded at all other stations throughout the year: at station 2 it was present only from December to April. Its population density and the pattern of distribution varied in the littoral and limnetic zones. In the former it constituted on an average 20·16% of the total rotifer population, whereas in the latter zone it formed 33·18% (fig. 2). In its vertical distribution the species appeared to prefer middle layers of the water column (fig. 3).

In spite of its perennial occurrence in the lake, *P. vulgaris* population was much higher at temperatures <25°C. During June–August, when the water temperature exceeded 25°C its population decreased greatly. Compared to this the average population during February–April was high. In both the regions and at all the depths peak density of this rotifer was recorded in February (figs. 2 and 3), when on an average 35 and 42 individuals/litre were recorded in the littoral and limnetic zones respectively.

4. Discussion

Distribution of aquatic organisms is controlled by several environmental factors such as temperature, ionic composition of water and the food availability. *P. vulgaris*, being a perennial species in the present lake, tolerates a wide range of temperature fluctuations (5·6–28·9°C) and thus belongs to the eurythermal category. However, considering its seasonal abundance it appears to prefer a temperature range of 6–18°C, being most abundant at 6·7–9·8°C. During the summer stratification, when the surface layers experience an increase in temperature, pH and carbonates and a decrease in bicarbonates, carbon dioxide, total hardness and transparency, the species record only low population density and majority of the individuals remain in the deeper layers even though there is deficiency of dissolved oxygen in such strata.

In dimictic lakes, two well established population peaks, one in late spring-summer and the other in autumn, have been recorded for *P. vulgaris* (see for example Sebestyen[8]).In the present lake, which falls under the warm monomictic category, only one conspicuous peak is recorded in late winter (February) at a time when the lake is about to stratify. The peak population remains till mid-spring (April) with a temporary decrease in March. This decrease seems to be related to the shortage of suitable food as a result of utilization during the late winter peak.

Carlin (c.f. Hutchinson[9]) opines that the abundance of *P. vulgaris* is influenced by factors other than temperature. In the present lake, its population density seems to be

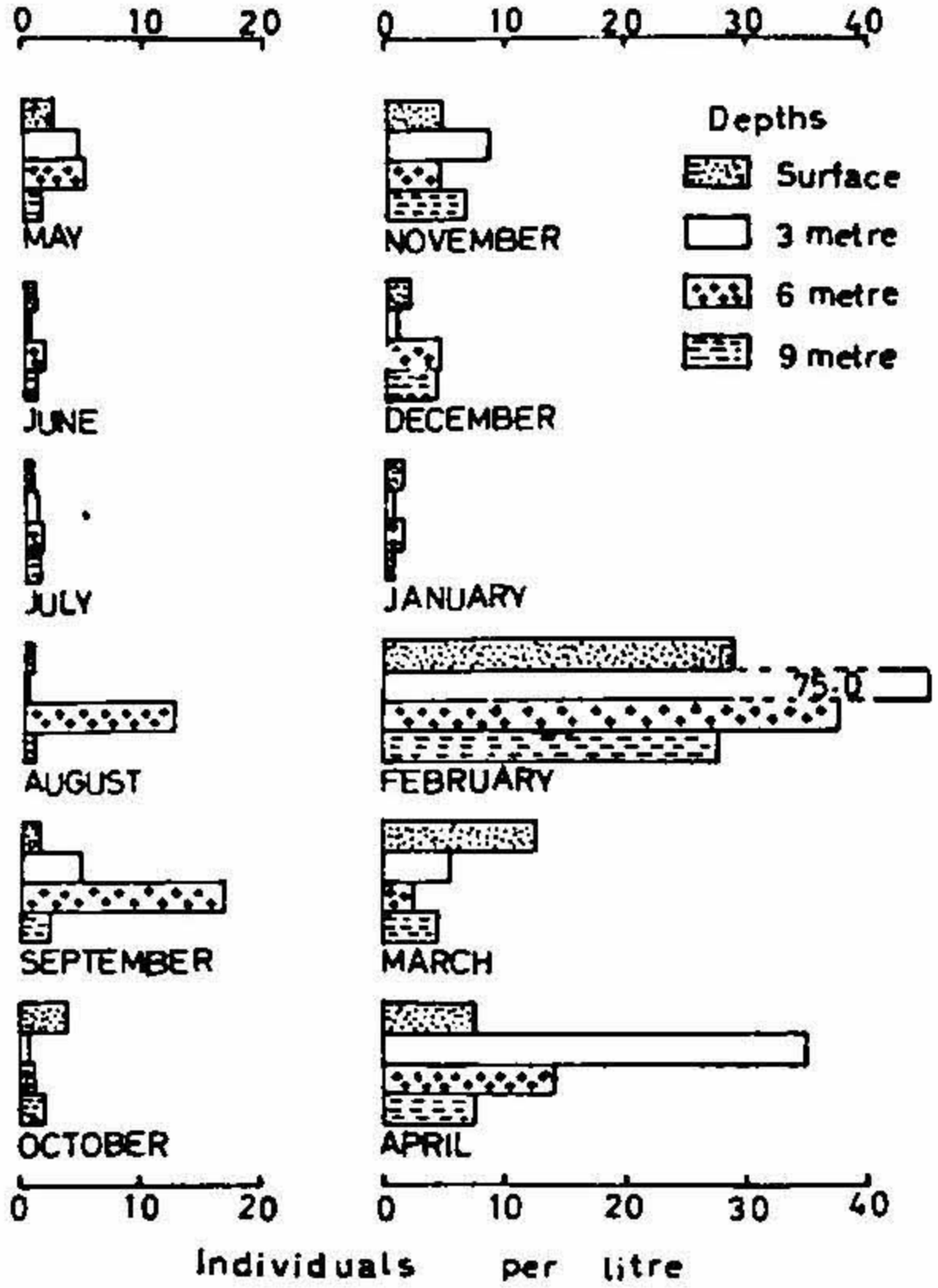

FIG 3. Vertical distribution of *Polyarthra vulgaris* in Manasbal. Values are the averages of two years.

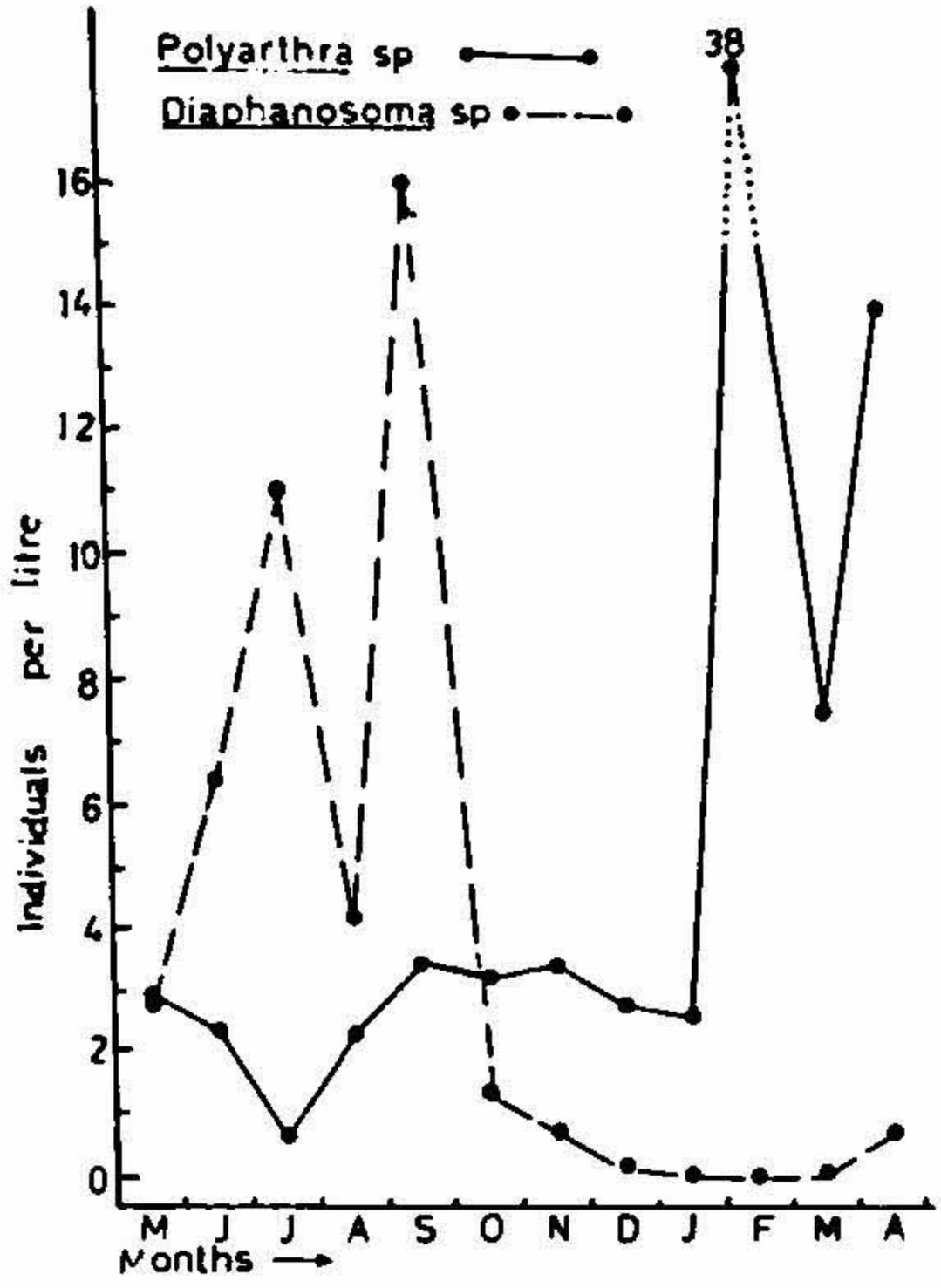

FIG 4. Seasonal abundance of *P. vulgaris* and *Diaphanosoma brachyurum* in Lake Manasbal. Values are averages of two years.

influenced not only by the abiotic factors, but also by other zooplankters. During summer and early autumn such opportunistic forms as *Brachionus quadridentata* and *Anuraeopsis fissa* find environmental factors suitable and hence dominate the rotifer community in the lake[5,10]. Perennial species like *P. vulgaris* increase their population only after these forms have disappeared. The abundance of *P. vulgaris* is also affected by a cladoceran, *Diaphanosoma brachyurum* Lieven. *D. brachyurum* constitutes an aestival form in Lake Manasbal, preferring warm water (>20°C) with pH>8·0, low carbon dioxide and bicarbonate content[6]. Comparison of the seasonal abundance of *P. vulgaris* and *D. brachyurum* reveals a negative relationship between these two plankters (fig 4). Since both of them are filter feeders, they may be competing for the same food. The cladoceran species predominates under favourable conditions because of its greater capability to utilize the available food. As soon as environmental conditions become unfavourable for its existence and it disappears, the rotifer species with a short life span and rapid egg production reacts instantaneously so as to have several quick successive generations and builds up large populations.

From the foregoing discussion, it may be concluded that the occurrence, abundance and vertical distribution of *P. vulgaris* is influenced not only by the physical and chemical factors of the water, but also by the presence of other plankters, especially *D. brachyurum*, with which it probably competes for its food.

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