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Copepod plankton of Lake Manasbal, Kashmir

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Abstract

Nine species of copepods were recorded from Lake Manasbal, Kashmir, during a two-year limnological study. *Mesocyclops leuckarti* Claus, *Cyclops vicinus* Uljanin and Cyclops sp. were the dominant forms. *M. leuckarti*, *C. vicinus* and *Acanthodiaptomus denticornis* Wierz. constituted the true planktonic forms, being more abundant in the limnetic zone. Others were more abundant in the littoral zone. Quantitatively copepoda constituted generally more than 50% of the total zooplankton in the lake.

Key words: Copepoda, littoral, limnetic, population density.

1. Introduction

Lake Manasbal, Kashmir, is located at an altitude of 1584 m A.S.L. at 34°, 15′ N latitude and 74°, 80′ E longitude. The lake has an area of 280 ha with a maximum depth of 12.5 m and remains stratified for eight to nine months from March/April to November[1]. About a dozen species of fish occur in the lake. Of these *Schizothoraichthys esocinus* (Héckel), *S. niger* (Heckel), *Cyprinus carpio* Linn., *Labeo diplostomus* Day and *Crossocheilus latius* Ham. are commercially important. In order to have an insight into the ecology of fish inhabiting this water-body, a detailed limnological investigation was undertaken for a period of two years. Some of the data collected during the study have already been published[1–9]. The present contribution discusses the seasonal changes in the copepod community structure in the lake.

2. Methods

Sampling was done once every month from May, 1976 to April, 1978, except for July, 1976 and January, 1977. Five study sites were selected in the lake, three (St. 1, 2 and 5) in the peripheral shallow and macrophyte-infested area (littoral zone) and two (St. 3 & 4) in the deep-central area which is free of macrophytes (limnetic zone). The location of the different study sites is given elsewhere[4,9]. In both the zones water samples for zooplankton analysis were procured with the help of a two-litre water sampler. The sampling was done at a depth of 0.5 m in the littoral zone, and at 0.5 m, 3 m, 6 m and 9 m in the

limnetic zone. From each depth, ten litres of water were collected and sieved through a standard net having 60 meshes per linear centimetre. The plankton thus collected was fixed and preserved in 5% formalin. Identification of crustaceans present in the samples was done with the aid of standard taxonomic works in the field[10–12]. Counting of the plankters was done in a Sedgwick rafter cell under a binocular Meopta research microscope at a magnification of × 100.

3. Results and discussion

During the present study a total of nine species of copepods were recorded from the lake. Of these, one each belonged to Calanoida and Harpacticoida and the remaining seven to Cyclopoida. The list of species recorded during the present study together with the lists of copepods recorded from the lake by Kiefer[10] and Akhtar[13] are presented in Table I. Comparison of the lists reveals that both the species reported by Kiefer[10] are still present. Of the nine species recorded by Akhtar[13], the presence of five species could not be confirmed. It is most likely that the two unidentified *Cyclops* spp. of the present study are the ones which have been identified by Akhtar[13] as *Microcyclops bicolor* Kiefer and *Megacyclops viridis* Jurine. However, the diagrams drawn by her for these species do not correspond well with the characters of the species which we found in the lake. *Eucyclops serrulatus* Koch and *E. speratus* Lillj. have been synonymised by some workers. Therefore, the only change in the specific composition of Copepoda in the lake is the disappearance of two calanoids — *Allodiaptomus mirabilipes* Kiefer and *Pseudodiaptomus lobipes* Gurney. Their absence seems to be related to the gradual eutrophication of the lake.

Population density of total Copepoda in the lake was very high as compared to that of Rotifera and Cladocera. Although qualitatively Rotifera with 38 species formed the

Table I
Comparison of the list of copepods recorded during the present study with the lists of Kiefer (1939) and Akhtar (1972)

Present study	Akhtar (1972)	Kiefer (1939)
Calanoida	Calanoida	Calanoida
Acanthodiaptomus denticornis Wierz.	*A. denticornis* Wierz.	*A. denticornis* Wierz.
Harpacticoida	*Allodiaptomus mirabilipes* Kiefer	Cyclopoida
Canthocamptus sp.	*Pseudodiaptomus lobipes* Gurney	*C. vicinus* Ulj.
Cyclopoida	Harpacticoida	
Mesocyclops leuckarti Claus	*Canthocamptus robertcokeri*	
Cyclops vicinus Ulj.	Cyclopoida	
C. scuifer Sars	*C. scuifer* Sars	
Cyclops sp. a	*Microcyclops bicolor* Kiefer	
Cyclops sp. b	*Megacyclops viridis* Jurine	
Eucyclops speratus Lillj.	*E. serrulatus* Koch	
Macrocyclops albidus Jurine	*M. albidus* Jurine	

largest group of zooplankton in the lake followed by Cladocera with 20[8], quantitatively Copepoda, with an average contribution of more than 50%, dominated the total zooplankton population (fig. 1). Since the earlier reports on Copepoda from the lake[10,13] are only of qualitative nature, comparisons are limited to the species composition and changes in the relative abundance of total Copepoda as also various species with time cannot be compared.

Zooplankton has often been shown to take the form of a bimodal curve presenting two maxima, one each during spring and autumn[14]. In the present lake also the population density of Copepoda, which was the main contributor of total zooplankton population, depicted two well-defined peaks, one in May–June and the second in September, the first one being more pronounced than the second. When the copepod density at different

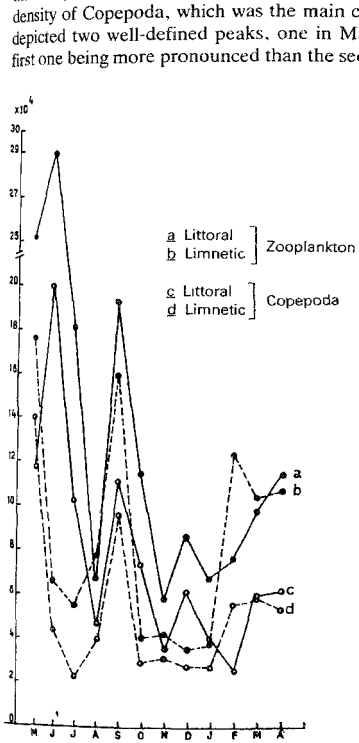

FIG. 1. Monthly changes in the population density of total zooplankton and its copepod component in Lake Manasbal.

study sites in the lake was compared, it was noticed that the littoral zone had generally relatively higher density than the limnetic zone. This is because the macrophytic associations, which are the characteristic feature of this zone, provide-shelter and hence help the copepods to escape the fish predation[15].

A perusal of the data reveals that the main contributors of the copepod population were the nauplii and copepodite stages. Whereas the nauplii were dominant during spring, the copepodites made higher contribution during autumn (fig. 2). Among the adults, main contributors of the copepod biomass included *Acanthodiaptomus denticornis*, *Canthocamptus* sp., *Mesocyclops leuckarti*, *Cyclops* sp. and *C. vicinus*. Fluctuations in the population density of these species are shown in Table II.

Calanoids are essentially planktonic forms[16]. The single calanoid recorded in the lake, *A. denticornis*, also conformed to euplanktonic group, being mainly present in the open water area, where its peak population was observed during spring. The species was completely absent during July–August and occurred in only small numbers from

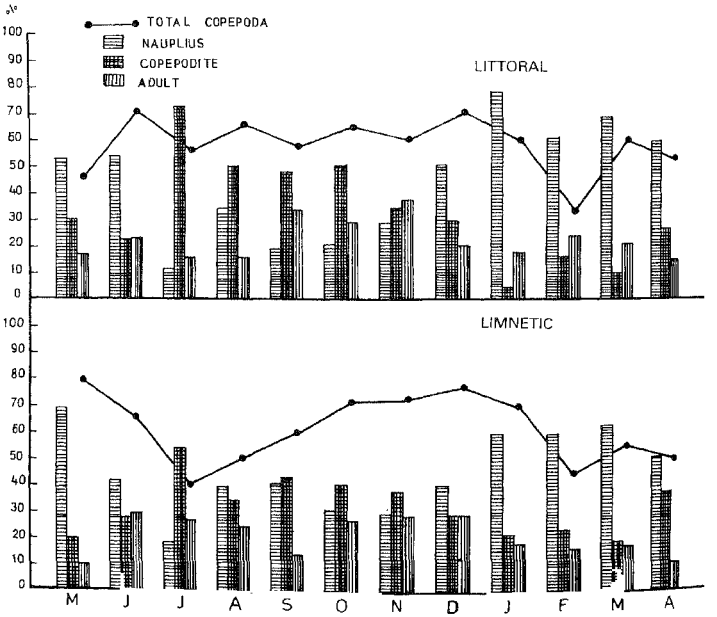

FIG. 2. Relative contribution of different life stages to the total copepod population density in Lake Manasbal.

Table II
Seasonal changes in the population density of some common copepod species in Lake Manasbal, Kashmir (individuals/m^3)

Species	Zone	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan	Feb.	Mar	Apr.
Cyclops vicinus	a	93	—	—	93	111	370	324	2000	722	1890	949	241
	b	382	—	—	—	1174	1171	3708	3164	2063	5169	3417	355
Cyclops sp.	a	5375	28727	14444	5410	30105	15936	4789	861	55	278	615	908
	b	370	261	167	1598	4316	3666	2022	932	83	63	813	77
M. leuckarti	a	9262	6718	1778	741	519	454	741	788	–	509	2778	46
	b	5672	11485	2188	7905	8552	1826	1409	3176	—	528	1542	226
A. denticornis	a	880	46	—	—	93	185	93	—	—	204	–	889
	b	3388	365	—	—	—	—	41	63	188	83	354	3192
Canthocamptus sp.	a	—	—	—	—	—	1760	4725	3751	2944	2778	2167	407
	b	—	—	21	—	—	775	906	438	146	3274	1042	42

a = littoral zone, b = limnetic zone.

September to December (Table II). *Canthocamptus* sp., although found in both the zones, recorded higher density in the littoral zone thereby revealing its affinity for the vegetated area. The species occurred in both the zones from October to April, thus qualifying to be categorised as cold-stenotherm species.

According to Hutchinson[16] *Cyclops* spp. appear generally in cooler season in the north temperate zone, whereas *Mesocyclops* spp. are more abundant during summer. Kowalczyik[17] found adult *M. leuckarti* from March to October (Spring and Summer) and adult *C. vicinus* during autumn and winter. A similar phenomenon was observed in Lake Manasbal. *M. leuckarti*, although a perennial plankter in the lake, was more abundant during the warmer months of May to September. Higher density of this species was recorded in the limnetic zone. *C. vicinus* recorded higher density during the cooler months of November to March, being totally absent in the adult stage during June and July in the littoral zone and during June–August in the limnetic zone. Both *M. leuckarti* and *C. vicinus* recorded higher population in the limnetic zone, thereby revealing that they are planktonic in nature.

One of the two unidentified *Cyclops* sp. was an eurythermal form in the lake being present in the adult stage throughout the year. Relatively larger population of this species (Table II) was recorded generally in the littoral zone, thereby indicating its affinity for the vegetated areas. The second unidentified *Cyclops* sp. was recorded only in small numbers during May to October, mainly in the littoral zone. *C. scutifer* was recorded only once in March at a depth of 9 m at St. 4. When the seasonal occurrence of the above mentioned four species of *Cyclops* is compared, it appears that Hutchinson's[16] statement applies only to those species which come under sub-genus *Cyclops* of genus *Cyclops*. The two unidentified *Cyclops* sp. in the present study therefore seem not to belong to this sub-genus.

Table III
Depth distribution of copepod plankton in Lake Manasbal ($\times 10^3$ individuals/m^3)

Depth	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Surface	321	55	17	21	226	35	20	27	28	30	27	38
3 m	104	49	29	13	31	6	55	33	24	63	87	50
6 m	53	54	20	84	97	27	29	35	36	76	68	85
9 m	31	20	22	42	33	31	22	20	10	59	52	37

E. speratus was present only in small numbers and was restricted in its distribution to the littoral zone during autumn and winter. *Macrocyclops albidus* was recorded in small numbers in both the zones and attained peak density in spring season.

All the planktonic forms generally occurred in higher densities in the thermocline region of the water column during stratification (Table III). This seems to be related to the fact that during stratification abrupt changes in the density of water in thermocline slow down the sinking velocity of seston in this layer. As the seston takes longer time to sink in thermocline it remains available for a longer period and this attracts the filter-feeding rotifers and crustaceans which in turn attract the carnivorous plankton. This results in the concentration of copepods (some of which are filter feeders and others are predators) in this layer.

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