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DATA ON THE VERTICAL DISTRIBUTION OF ZOOBENTHOS IN SALINE "LAKES" AND RIVERS

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Abstract

In the course of investigating the vertical distribution of the zoobenthos and comparing the cases of the small, astatic saline lakes to the river Tisza, we obtained the following results:

a) There could be observed a vertical distribution (with special respect for the maximum values and varying in the single collections), mainly in cases of Oligochaeta, Ephemeroptera, as well as Ceratopogonida and Chironomida.

b) In both water-types, about half of the zoobenthos lives in the upper 10 cm layer. The vertical distribution of the taxons occur equally in both watertypes (Chironomida, Ceratopogonida) is similar.

c) The change in the water-level and drying up governs the vertical distribution of zoobenthos. The groups Chironomida and Coleoptera are respond in a similar way. Chironomida and Ceratopogonida, however, respond oppositely.

Introduction

The qualitative and quantitative, space and time distribution of the zoobenthos of waters is influenced by abiotic and biotic factors. The knowledge of the structure, and the material-energy circulation of ecosystems is increased by revealing the causal relations of population dynamics.

It is only justified from special points of view to compare the zoobenthos of rivers and standing waters with each other. The vertical guantitative distribution and the horizontal quantitative distribution of the zoobenthos taxons in the sediment may be considered such.

The zoobenthos density — according to my investigations — diminishes in horizontal and vertical directions — from the river — and lakeside towards the middle of watercourse, and from the surface towards the deeper layers of the sediment in the river and standing waters of this country.

The life of sediment-dweller organisms at the bottom surface and their vertical movement are determined by several factors, of course, but the single populations react to these factors in different ways. In the course of my perliminary investigations I could establish mainly the vertical distribution and only the quantitative conditions of that. It is a task of further investigations, to reveal the causative relations.

Materials and Methods

In order to get realiable results from the investigation of the vertical distribution, the methods have to be improved to eliminate or at least minimize the loss of animals during sampling. It is a problem to separate the bottom samples into layers, and to stabilize in original situ the bottom fauna (EFFORD, 1960; COLEMAN—HYNES, 1970; BRINKHURST—BATOOSINGH, 1969; FERENCZ, 1968).

To remove the deposit, a 425 mm long cylindrical corer of 84 mm diameter was used (FERENCZ, 1968). The samples were cut into 5, or 10 cm parts in the field. Then in the laboratory, eluting them through a 0.28 mm mesh metal sieve, we selected the animals, fixed in 6 per cent formalin according to taxon-groups and evaluated them quantitatively. The Mollusca group was omitted, because those living there and the empty shells carried along by water are confusable, that is to say, the subfossil and recent ones are undistinguishable, and our results would have been unreal with respect to a vertical distribution of Molluscs.

Because of the sampling-technical conditions, the bottom samples of the saline waters were separated and examined in 5 cm, and those of the river Tisza in 10 cm layers. It is to be noted that we don't regard the investigation of bottom layers thicker than 5 cm, fine enough although it is true that, on the other hand, the error, as a possible result of removing the animals after taking them out, is smaller in a thicker sample.

Sampling sites

The investigated material was sampled from two different water-types: from the shallow, astatic saline „lakes" and the river Tisza.

a) Saline lakes. Small stagnant waters in the region of Fülöpháza, with sandy-muddy bottom, bordered by macrovegetation, or partly covered:

Lake Hattyúszék: the open water of the lake is of 1.5 ha surface, maximum water depth is 1 m, astatic water. Its predominant group is: Ceratopogonidae.

Lake Zsírosszék: 20.9 ha surface. A lake of astatic type. Predominant group: Ceratopogonidae.

Lake Szappanszék: elongated, 1.5 km long, about 200 m broad, of 10.4 ha surface, astatic. Predominant group: Ceratopogonidae.

Lake Kondor: the lake is of 34.2 ha surface, of 1.5—2 m maximum water-depth, of non-astatic type. Its predominant group is: Chironomidae.

The collections were carried out in spring 1972 (May) and summer 1974 (July) (MEGYERI, 1975).

b) In the Szeged stretch of the river Tisza, between the river kilometer numbers of 166—176, the bottom samples were generally taken from the biotopes close to the riverside. Water-depth: between 0.5—6 m. Time of collection: 1967—1975, on a spring (May) and five autumn (September, Oktober, November) occasions. On the autumn, the water-level was receding or stagnantly low (FERENCZ—CSOKNYA, 1973; FERENCZ, 1974a). The predominant group of the zoobenthos in the river-reaches investigated was: Oligochaeta.

Results

The taxon-groups, in the sequence of the decrease in their individual number, are:

Saline lakes: Ceratopogonida (2210)
Chironomida (79)
Coleoptera (28)
Diptera: Brachycera (8)

Tisza: Oligochaeta (1410)
Ephemeroptera: *Palingenia longicauda* (293)
Amphipoda (185)

Chironomida (96)
Trichoptera (54)
Diptera: Brachycera (49)
Ceratopogonida (16)
Polychaeta: *Hypania invalida* (14)

Oligochaeta. This is the predominant group of the river. The depth-distribution varied with the single collections. Their maximum generally falls into upper 10 cm, but it also occurs between 10 to 20 cm. Surface-dominance is about 50 per cent (Fig. 3) This datum differs from the results of other investigations of similar character (BRINKHURST, 1969), according to which more than 99 per cent of the worms were found in the 10 cm layer below the surface. With respect to the modifying effect of the life stage (differences in size, period of reproduction), we have no data concerning vertical distribution. According to BRINKHURST, the vertical distribution is not specific in Annelids. The maximum richness of the upper 2 cm layer (water -mud

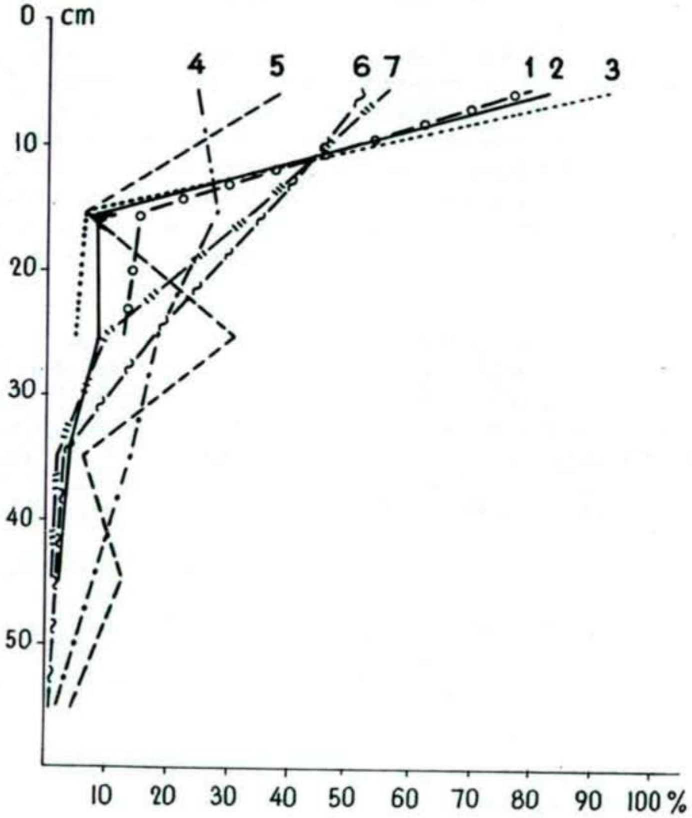

Fig. 1. Vertical distribution of zoobenthos in the Tisza, 1.: Polychaeta (Hypania invalida). 2.: Chironomida, 3.: Trichoptera, 4.: Ephemeroptera (Palingenia longicauda), 5.: Ceratopogonida 6.: Oligochaeta, 7.: Amphipoda.

interface) in individuals is explained by the above author as due to the respiratory mechanism of the animals, and the density of population of the 6 cm thick silt layer is also due to the large amount of heterotrophic bactera living there, which serve as food. It is beyond question that, apart from some exceptions, the alimentary homogeneity of the fresh-water Oligochaeta species (detritophagous or bacteriophagous) can be established. In the four saline lakes investigated there were no Annelids.

Ceratopogonidae. The predominant group of the great majority of saline waters is formed by these detritophagous or predatory larvae. These thin-bodied, rapidly moving animals can exist even in the deepest layers of the bottom. Leaving the quantitative fluctuations at the beginning of collections out of consideration, their predominance in the upper layers can be established, and their percentage is fairly high at a 15—20 cm depth in natron lakes, as well as 20—30 cm deep in the river. (Figs. 2., 4). In this respect they differ from the behaviour of the other taxon-groups. Their larvae that tolerate even the extreme conditions well, putting up a stout resistance to the unfavourable effects, do not achive high individual number in the river. Their vertical distribution takes, nonetheless, a similar from in both biotope-types.

Chironomidae. Their larvae showed a similar individual number and vertical distribution both in the river investigated and in stagnant waters. Their surface predominance is 80—85 per cent (Fig. 1). Most of them are detritophagous, and respond the quickest to the food-supply coming from the water (LELLÁK, 1965). The individual density of this group, — known as an important component of the zoobenthos, — is generally in inverse ratio to that of the Oligochaeta (LELLÁK, 1965; FERENCZ, 1974b). Many species of these make loose or rather stable dwelling-tubes. And those of them not having such tubes, can bore themselves into even greater depths in the bottom (50 cm).

Ephemeroptera. In the material investigated there was only a single mayfly species, Palingenia longicauda. The maximum individual number of its larvae, living in self-made ducts in the calyey riverside sectors was found at a 10 to 20 cm depth, although there was some fluctuation to be observed in the single collections in their vertical distribution (0 to 10, resp. 10 to 20 cm). It is an unequivocally detritophagous species, with a characteristic special biotope (CSOKNYA—FERENCZ, 1972). Its vertical distribution is influenced by its ontogeny and the change in the water-level.

Amphipoda. This is an essential group of the river zoobenthos from the point of view of both their individual number and their decomposing activity. They are detrito-, and necrophagous animals. Their vertical distribution is very similar to that of other Diptera taxon-groups. Their surface dominance is between 50—60 per cent. Their individual number decreases uniformly to the 50 cm depth.

Trichoptera. These species live dwelling tubes in the upper layers of the bottom. In the Tisza, their surface dominance is over 90 per cent. They can be characterized, therefore, as a typical surface group. Their depth-record is also the smallest, similar to the Polychaeta: Hypania invalida.

Polychaeta. This is a group represented by only,

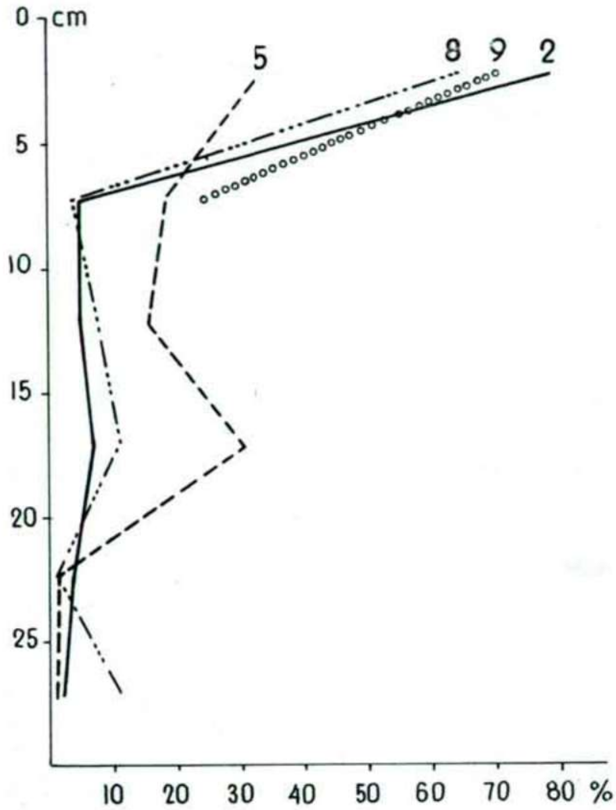

Fig. 2. Vertical distribution of zoobenthos in saline waters, 2.: Chironomida, 5.: Ceratopogonida, 8.: Coleoptera, 9.: Diptera (Branchycera).

Hypania invalida, a species immigrated from the Black Sea and living in the Tisza. It can probably even leave its loose mud dwelling-tube, much longer than its body. It can swim and dig itself into the bottom. It prepares its new dwelling-tube at the surface of the sediment. This is the taxon with the lowest individual number in the material investigated. Its vertical distribution is similar to that of the former group, being thus a typlically surface member of the zoobenthos (FERENCZ, 1969).

Coleoptera. This is a group characteristic of some saline waters and achieving higher individual numbers from time to time. With respect to its vertical distribution, it could not be observed if the larvae or imagos were closer to the surface, or in the deeper parts of bottom. The group takes a place in the sediment similar to that of the Chironomidae.

Diptera: (other). This group, achieving no individual number in any of the water-types, was represented by the Brachycera larvae.

The effect of the extreme water-level fluctuation, and drying on the vertical

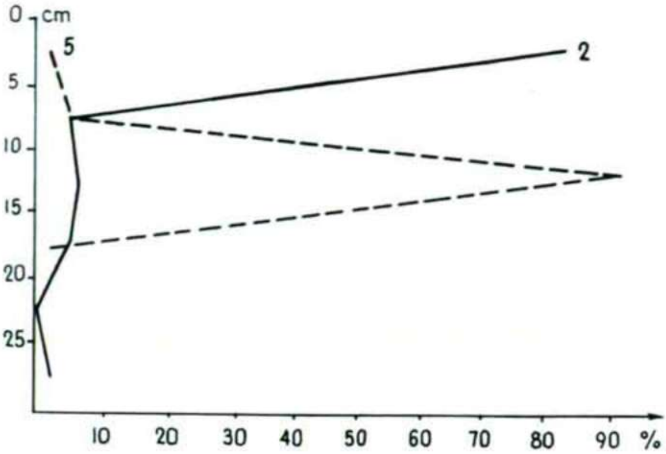

Fig. 3. Vertical distribution of zoobenthos in non-dried saline waters, 2.: Chironomida, 5.: Ceratopogonida.

distribution of the zoobenthos was studied in astatic saline lakes. While the Ceratopogonida-Chironomida group responded differently to the drying up of water, the Chironomida-Coleoptera groups showed certain similarity.

In water-covered places, the Ceratopogonida larvae tended to concentrate deeper in the bottom. On a wet, not completely dried out lake-bottom their individual number decreases in the deeper bottom layers and increases in the surface ones. On a dried up bottom, most larvae are in the upper 5 cm (Fig. 7).

The Chironomida larvae live in the upper layer of the water-covered bottom — and that is, of course, the typical case at the river, as well. They do not bear drying up well (their absolute individual number decreases). They withdraw into the deeper layers.

This antagonism between the Ceratopogonida-Chironomida groups has manifested itself in various ways in the course of my investigations.

That these caracteristics of the vertical distribution, as a result of the extreme changes in the water-level, are not connected with the swarming of the two insect-groups, is proved by sampling at the same time but from different places.

If we are comparing the single groups on the basis of the surface dominance, of the maximum occurrence in depth — avoiding typization or categorization (we have too few data for these) — then it can be established that

a) those living at the surface of the bottom are: Trichoptera, Polychaeta, Chironomida,

b) those not living at the surface of the bottom are: Palingenia longicauda, Ceratopogonida.

About the half of the zoobenthos organisms live in the upper layer of the sediment-according to the data of our investigation. This seems to be but few as, from the point of view of food-supply and O_2-content, the optimum situation exsists in the upper layer. In waters with fish, however, fishes mean selection, consuming

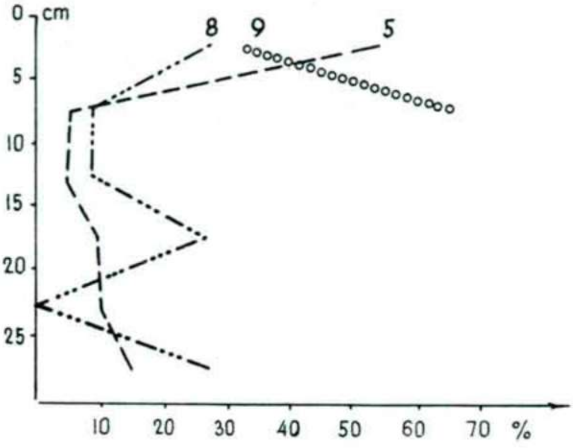

Fig. 4. Vertical distribution of the zoobenthos in dried saline waters, 5.: Ceratopogonida, 8.: Coleoptera, 9.: Diptera (Brachycera).

about half of the zoobenthos (LELLÁK, 1965). Nevertheless, on the basis of comparing the saline waters and the river Tisza from this point of view, the two water-types show no essential difference, although in the natron lakes there are no fish. The picture of the vertical distribution of the zoobenthos in case both water-types is probably so similar because of the greater individual density of the Ceratopogonida larvae a predominant group, as observed in the deeper bottom layers.

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