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# MACROFAUNAL BIOMASS IN THE SUBMERGED VEGETATION STANDS OF LAKE VELENCE

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## INTRODUCTION

Lake Velence is one of the most interesting European representatives of large, shallow lakes. It is the third largest lake in Hungary, lying 106 m above sea level, extending some 10.5 km NE to SW, with an average width of 2.5 km; its average depth is between 1 and 2 m. The surface area is 26 $km^2$, of which 64 per cent is reedy, while a further 29 per cent of the open water is covered with hair-weeds (Kiss 1972).

Only a few small streams and brooks empty into the lake. The pollution of Lake Velence today is yet but slight, though the natural state of the lake has often been disturbed (dredging, mechanical weeding, water-level regulation).

Since Rezső Maucha's fundamental paper published in 1931, European limnology has shown growing interest in Lake Velence. Many papers discussing the lake have so far raised certain problems regarding hydro- (Donászy 1953) and sediment chemistry (Csajághy 1953), bacteriology (Oláh and Vásárhelyi 1970, Vásárhelyi and Felföldy 1970), public hygiene (Schiefner and Gregács 1964), botany (Borhidi and Balogh 1969, Kiss 1972) and zoology (Berczik 1961, P.-Zánkai 1959), some other papers even ventured as far as to offer solutions. In spite of the great number of data accumulated so far on these topics, the professional opinion of international hydrobiologists is that Hungarian hydrobiology ought to pay a great deal more attention to Lake Velence.

Recently, complex hydrobiological researches on the whole lake have been carried out by a team of workers of the Research Institute for Water Resources Development (VITUKI) headed by Lajos Felföldy. One of the most important accomplishments of these researches was the mapping of the macrovegetation of the lake (Kiss 1972) which revealed extensive stretches of *Vaucheria dichotoma*.

The submerged vegetation playing a significant part in the life of the lake has undergone thorough hydroecological and zoological examination in the past years conducted by the Department of Systematic Zoology and Ecology of the Eötvös Loránd University, Budapest, headed by Árpád Berczik. Here the results of the zoocenological study of some characteristic reed-grass stands are discussed with the principal aim of discovering the differences in the macrofaunal biomass of the water plant population situated next to each other.

The zoocenological observations were carried out in a hydrochemically characteristic area of Lake Velence, close to the Bird Observatory near Agárd, at 16 collecting sites (Fig. 1).

The research area is situated in the south-western third of the lake. This particular area belongs to the moderately saline parts of the lake. Examinations heretofore have shown a gradual alkalization in a SW–NE direction ascribed to climatic causes (Borhidi and Balogh 1969).

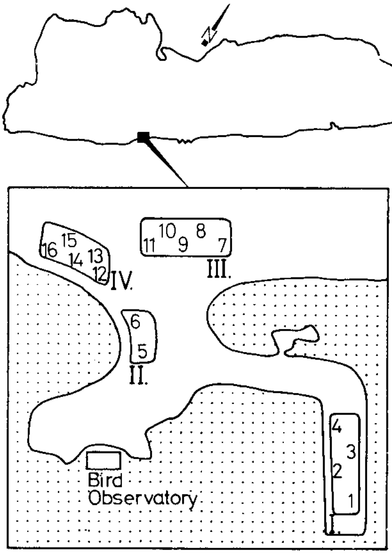


Fig. 1. The lay-out of the collecting sites in the lake

In the various shallow waters the quasi-quantitative examinations indicate a spring and late summer as well as an autumn maximum in the individual numbers of most macrofaunal groups (Berczik 1970).

Considering these results the collecting time was chosen between the 20th and 22nd of August in 1972 hoping that it would coincide with the period of the second population-dynamic maximum. It was assumed, therefore, that the data received on the biomass would show the maximal or near maximal macrofaunal zoomass living in different vegetation stands.

Two different kinds of collecting methods were applied. On various sampling sites composed of *Myriophyllum spicatum*, *Utricularia vulgaris*, *Potamogeton pectinatus*, *Najas marina*, a prism with 50 × 50 cm basic area and 120 cm height covered by close-meshed net was used. The appliance was lowered on the vegetation stand at a spot of characteristic density. Then, the entire mass of vegetation was carefully removed from the sediment by divers. Subsequently, the lower opening of the prism was closed and the biomass of the macrofauna was determined. For this purpose the plants were washed and the entire water volume was filtered, using a net of 0.5 mm mesh (Fig. 2).

In the case of *Vaucheria dichotoma* covering large stretches of Lake Velence, a 15 × 15 cm, sharp-edged, metal frame covered at the top was used being in turn pressed through the *Vaucheria* stand well into the sediment, then the entire plant material was lifted from the water. In both cases special attention was paid to the careful approach of the collecting sites.

The material was preserved in 4 per cent formalin, sorted out to order and after identification the dry weight of the species was recorded. The specimens were dried at 60 °C. The collected and carefully washed plants were weighed at air-dry state.

Throughout the examinations special attention was devoted to determining the biomass of the faunal fractions of Ephemeroptera, Odonata and Trichoptera which subsequently were compared to the quantitative data

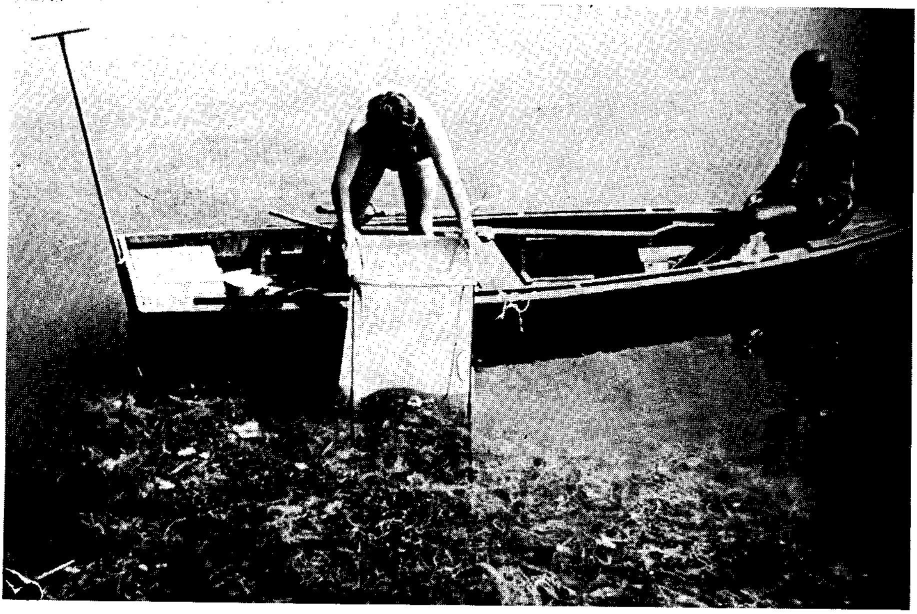

Fig. 2. The first phase of sampling

obtained for other macrofaunal categories. The number of individuals and values of weight were correlated to 1 $m^2$ of surface and 1 kg air-dry vegetation mass, respectively.

## RESULTS AND DISCUSSION

According to the results, four types of collecting sites clearly differing from one another can be distinguished on the basis of dominant plant species, position of the site and the total biomass of the macrovegetation and macrofauna.

I. The first group of collecting sites includes a vegetation stand of about 20 $m^2$ east to the Bird Observatory, composed of *Myriophyllum spicatum* and a lesser cover of *Potamogeton pectinatus* (depth: 70 cm; Fig. 1). The environments of the artificial inlet serving bathing purposes have entirely been cleared of reeds. The total average biomass of the macrovegetation in air-dry state was 162 g per $m^2$. The total average biomass of the macrofauna was 0.109,0 g per $m^2$. Detailed zoocenological data are given in Table 1.

II. The second group includes the *Myrophyllum spicatum* stand of about 10 $m^2$ surface area, lying N to the Bird Observatory (depth: 1 m; Fig. 1). The total average biomass of the macrovegetation was 325 g per $m^2$. The total average biomass of the macrofauna was 1.195,6 g per $m^2$. Detailed zoocenological data are given in Table 2.

III. The third group comprises the *Vaucheria dichotoma* stand situated N to the Bird Observatory (depth: 125 cm). The total average biomass of the

TABLE 1

*Average biomass of macroorganisms at station group No. I*

| Taxa | A | B | C | D |
|---|---|---|---|---|
| Ephemeroptera | | | | |
| *Cloeon dipterum* (L.) | 28 | 0.003,2 | 170.8 | 0.019,5 |
| *Caenis horaria* (L.) | 20 | 0.002,4 | 122.0 | 0.014,6 |
| Odonata | | | | |
| *Ischnura pumilio* (Charp.) | 8 | 0.021,6 | 48.8 | 0.131,7 |
| *Agrionidae* (juv.) | 64 | 0.006,4 | 390.4 | 0.039,0 |
| *Sympetrum* sp. (juv.) | — | — | — | — |
| Trichoptera | | | | |
| *Echnomus tenellus* (Klap.) | — | — | — | — |
| *Cyrnus* (*flavidus* MacLach ?) | 8 | 0.001,6 | 48.8 | 0.009,7 |
| Hirudinoidea | — | — | — | — |
| Mollusca | 4 | 0.001,2 | 24.4 | 0.007,3 |
| Isopoda | — | — | — | — |
| Coleoptera | 4 | 0.002,4 | 24.4 | 0.014,6 |
| Heteroptera | 8 | 0.001,6 | 48.8 | 0.001,6 |
| Lepidoptera | 8 | 0.004,6 | 48.8 | 0.028,1 |
| Diptera | | | | |
| Chaoboridae | — | — | — | — |
| Chironomidae (larvae) | 728 | 0.059,2 | 4,440.8 | 0.361,1 |
| Chironomidae (pupae) | 44 | 0.004,8 | 268.4 | 0.029,2 |
| Hydracarina | — | — | — | — |
| Total | 924 | 0.019,0 | 5,636.4 | 0.656,4 |

A = average No. per m²; B = average dry weight per m²; C = average No. per kg dry plant weight; D = average dry weight per kg dry plant weight.

algal stand was 165.5 g per m². The total average biomass of the macrofauna was 3.981,5 g per m². Detailed zoocenological data are given in Table 3.

IV. The fourth group comprises mainly *Utricularia vulgaris* and a smaller cover of *Potamogeton pectinatus* and *Najas marina*; it is situated NW from the Observatory. The total average biomass of the macrovegetation was 158.4 g per m². The total average biomass of the macrofauna was 1.092,5 g per m². Detailed zoocenological data are given in Table 4.

It is a clearly seen from the tables that 3.4–15.7 per cent of the macrofauna biomass is made up of Ephemeroptera, while Odonata and Trichoptera are represented by 0.0–25.6 and 0.3–9.1 per cent, respectively.

The biomass formation of the mud inhabiting *Caenis horaria* larvae may be a good indicator as regards sedimentation at the area covered with macrovegetation. The most intensive sedimentation occurs in those vegetation

TABLE 2

*Average biomass of macroorganisms at station group No. II*

| Taxa | A | B | C | D |
|---|---|---|---|---|
| Ephemeroptera | | | | |
| *Cloeon dipterum* (L.) | 228 | 0.171,2 | 864 | 0.513,6 |
| *Caenis horaria* (L.) | 44 | 0.016,8 | 132 | 0.050,4 |
| Odonata | | | | |
| *Ischnura pumilio* (Charp.) | 12 | 0.030,4 | 36 | 0.091,2 |
| *Agrionidae* (juv.) | — | — | — | — |
| *Sympetrum* sp. (juv.) | — | — | — | — |
| Trichoptera | | | | |
| *Echnomus tenellus* (Klap.) | 16 | 0.019,2 | 48 | 0.074,4 |
| *Cyrnus* (*flavidus* MacLach?) | — | 0.024,8 | 12 | 0.057,6 |
| Hirudinoidea | — | — | — | — |
| Mollusca | 32 | 0.001,6 | 96 | 0.004,8 |
| Isopoda | — | — | — | — |
| Coleoptera | — | — | — | — |
| Heteroptera | — | — | — | — |
| Lepidoptera | — | — | — | — |
| Diptera | | | | |
| Chaoboridae | 8 | 0.025,2 | 24 | 0.075,6 |
| Chironomidae (larvae) | 1,692 | 0.892,8 | 5,076 | 2.678,4 |
| Chironomidae (pupae) | 40 | 0.008,8 | 120 | 0.026,4 |
| Hydracarina | 24 | 0.004,8 | 72 | 0.014,4 |
| Total | 2,160 | 1.195,6 | 6,480 | 3.586,8 |

A = average No. per m²; B = average dry weight per m²; C = average No. per kg dry plant weight; D = average dry weight per kg dry plant weight.

stands (e.g. *Vaucheria dichotoma, Utricularia vulgaris*) in which the number of *Caenis horaria* larvae is very high; in other biotopes the process is comparatively slower.

The extensive *Vaucheria dichotoma* stands of Lake Velence proved to be the richest in macrofauna, where, let alone a few taxa or species, the molluscans appeared in a strikingly high percentage. Their quantity outstripped even that of the Chironomidae larvae, whereas the average macrofaunal biomass in the *Myriophyllum spicatum* stand found in the artificial inlet was markedly low.

The detailed taxonomic elaboration of the three macrofaunal orders has shown that within a small area no qualitative difference may be ascertained in the zoocenosis of the hair-weed population of different species. This finding was confirmed by previous detailed taxonomic researches, too (Andrikovics 1973), which had been carried out on other orders of the macrofauna. The tables do not comprise other species of the macrofauna except

TABLE 3

*Average biomass of macroorganisms at station group No. III*

| Taxa | A | B | C | D |
|---|---|---|---|---|
| Ephemeroptera | | | | |
| *Cloeon dipterum* (L.) | — | — | — | — |
| *Caenis horaria* (L.) | 44 | 0.137,6 | 264 | 0.825,6 |
| Odonata | | | | |
| *Ischnura pumilio* (Charp.) | — | — | — | — |
| *Agrionidae* (juv.) | — | — | — | — |
| *Sympetrum* sp. (juv.) | — | — | — | — |
| Trichoptera | | | | |
| *Echnomus tenellus* (Klap.) | 44 | 0.363,1 | 264 | 2.178,6 |
| *Cyrnus* (*flavidus* MacLach. ?) | — | — | — | — |
| Hirudinoidea | — | — | — | — |
| Mollusca | 3,774 | 1.252,0 | 22,644 | 7.512,0 |
| Isopoda | 355 | 0.612,7 | 2,130 | 3.676,2 |
| Coleoptera | — | — | — | — |
| Heteroptera | — | — | — | — |
| Lepidoptera | — | — | — | — |
| Diptera | | | | |
| Chaoboridae | — | — | — | — |
| Chironomidae (larvae) | 1,198 | 1.451,8 | 7,192 | 8.710,8 |
| Chironomidae (pupae) | 44 | 0.164,3 | 264 | 0.985,8 |
| Hydracarina | — | — | — | — |
| Total | 5,459 | 3.981,5 | 32,758 | 23.889,0 |

A = average No. per m²; B = average dry weight per m²; C = average No. per kg dry plant weight; D = average dry weight per kg dry plant weight.

those of the orders Ephemeroptera, Odonata and Trichoptera. The following list shows the most characteristic and commonest species:

Mollusca: *Armiger crista, Planorbis spirorbis*; Hirudinoidea: *Piscicola geometra; Diptera larvae; Chaoborus crystallinus* and the species of the subfamily of Orthocladiinae in Chironomidae; Lepidoptera: *Paraponyx stratiotata, Nymphula nympheata*; Heteroptera: *Micronecta pusilla, Cymatia coleoptrata, Naucoris cimicoides*; Isopoda: *Asellus aquaticus*; Hydracarinae: *Hydrodroma despiciens* and the species of *Arrenurus* and *Piona*. All of them are common eurytrophic species.

As a result of these researches, concrete quantitative data on the zoocenoses of the hair-weed stands in Lake Velence were obtained. A comparison of the macrofaunal biomass of the different plant stands shows that zoocenosis limited primarily by extreme water climatic conditions will respond

TABLE 4

*Average biomass of macroorganisms at station group No. IV*

| Taxa | A | B | C | D |
|---|---|---|---|---|
| Ephemeroptera | | | | |
| *Cloeon dipterum* (L.) | 120 | 0.029,2 | 756 | 0.183,9 |
| *Caenis horaria* (L.) | 36 | 0.076,0 | 226.8 | 0.478,8 |
| Odonata | | | | |
| *Ischnura pumilio* (Charp.) | — | — | — | — |
| *Agrionidae* (juv.) | — | — | — | — |
| *Sympetrum* sp. (juv.) | 4 | 0.011,2 | 25.2 | 0.070,5 |
| Trichoptera | | | | |
| *Echnomus tenellus* (Klap.) | — | — | — | — |
| *Cyrnus* (*flavidus* MacLach.?) | 4 | 0.003,6 | 25.2 | 0.022,6 |
| Hirudinoidea | 4 | 0.002,2 | 25.2 | 0.138,6 |
| Mollusca | 308 | 0.014,0 | 1,940.4 | 0.088,2 |
| Isopoda | 4 | 0.001,8 | 25.2 | 0.011,3 |
| Coleoptera | — | — | — | — |
| Heteroptera | 12 | 0.000,7 | 75.6 | 0.004,4 |
| Lepidoptera | — | — | — | — |
| Diptera | | | | |
| Chaoboridae | 4 | 0.004,8 | 25.2 | 0.030,2 |
| Chironomidae (larvae) | 3,424 | 0.819,6 | 21,571 | 5.163,4 |
| Chironomidae (pupae) | 64 | 0.025,2 | 403.2 | 0.158,7 |
| Hydracarina | 16 | 0.004,2 | 100.8 | 0.026,4 |
| Total | 4,000 | 1.092,5 | 25,299.8 | 6.377,0 |

A = average No. per m²; B = average dry weight per m²; C = average No. per kg dry plant weight; D = average dry weight per kg dry plant weight.

in variously situated stands of different sedimentary processes to diverse population and food supply conditions by changing the quantitative composition of the macrofauna.

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