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# THE INFLUENCE OF RAINBOW TROUT (ONCORHYNCHUS MYKISS) AQUACULTURE IN IZVORUL MUNTELUI – BICAZ RESERVOIR ON BENTHIC MACROINVERTEBRATE COMMUNITY STRUCTURE

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***Key words:*** *macrozoobenthos, aquaculture, reservoir*

## INTRODUCTION

The quantity of organic seston resulted from faeces and unconsumed nutriments from intensive fish farming, can often exceed the capacity of sediment assimilation, determining the intensification of anaerobic processes of bacterial decomposition, guiding to increased $H_2S$ and $NH_4$ concentrations with important perturbations in the benthic community structure (Growen et al. 1988); the amplitude of these modifications depends on lake limnological type and size (Koricka & Zdanowski 1981). In Izvorul Muntelui – Bicaz reservoir, the aquaculture of rainbow trout in floating cages experimentally began in 1972, arising nowadays at an industrial production of approximately 70 mt/year. Previous research on the reservoir was not orientated to illuminate the relation between aquaculture and biotic components of the ecosystem (Miron et al., 1983). Our investigation, run in 2004, identified some changes in the structure of benthic macroinvertebrate community, in the aquaculture area, compared to control situations. In this study we present a first synthesis of our observations, to serve like a reference for next research.

## STUDY AREA AND METHOD

Izvorul Muntelui–Bicaz reservoir is situated in the North–Eastern part of Carpathian Mountains, Romania being a relative young (built in 1961) dimictic, oligotrophic large man made lake: 26.5 km long, 0.7 km mean wide and 88.6 m maximum depth, with a surface area of 3109 ha, and 1230 mil. $m^3$ volume at maximum 526 m a.s.l. water level.

The aquaculture of rainbow trout in this lake is practiced in Potoci bay, situated in the lower part of the lake, in two floating farms (approx. 0.9 ha total surface area) producing together over 70 t commercial fish per year (Fig. 1).

This study was undertaken in four selected sampling sites (Fig. 1): 1. AmF – situated at 150 m upstream from the first trout farm (35 m max. water depth); 2. F – situated at 2 – 5 m downstream of the first farm (56.5 m max. water depth); 3. S – situated at 2 – 5 m downstream of the second farm (75 m max. water depth), 4. AvS – situated at 150 m downstream of the second farm (80 m max. water depth).

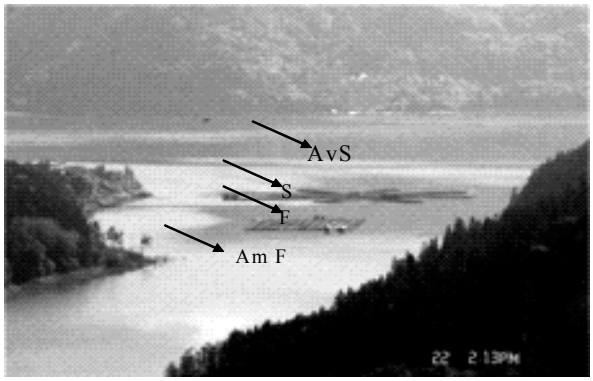


Fig. 1. Aquaculture cage floating-farms and sampling sites in Potoci bay – Izvorul Muntelui – Bicaz reservoir

The macrozoobenthos from these profound habitats was monthly sampled from May to October 2004. Nine randomly distributed samples were taken at each sampling sites using a modified Petersen grab (170.3 $cm^2$) surface area, washed through 0.25 mm sieve and preserved in 70% ethanol. The samples were sorted and the animals were determined to species level and counted. Biomass ($g/m^2$) was estimated as the wet weight of blot – drayed samples using an electronic microbalance (0.001 mg precision). Standard statistical methods were used to analyze the data (Elliott, 1977). The diversity was assessed using Shannon's index:

$$H = -\sum_{i=1}^{s} pi \ln pi$$; concentration of dominance was calculated by formula: $\sum_{i=1}^{s} (pi)^2$, where pi = proportion of abundance of species i, and S = number of species.

## RESULTS AND DISCUSSIONS

*Species composition and dominance.* The profoundal benthic fauna community in analyzed area consisted of 7 taxonomic groups comprising 15 species. From these, 4 are ubiquitous: *Tubifex tubifex, Limnodrilus hofffmeisteri, Procladius choreus* and *Polypedilum nubeculosum* and only 2 species *T. tubifex* and *L. hoffmeisteri* were dominant in all sites, being over 95 % of the total number

of individuals. The remained chironomidae larvae and other few species, excepting *Asselus aquaticus*, were present in small numbers only at 35 m depth, in AmF site (Table 1).

Table 1. Distribution and relative numerical species abundance at each sampling site expressed as a percentage of the annual means in Potoci bay: a (absent)=0%, R (rare)<0.5%, A (abundant): 2.1–30%, V (very abundant) >30%.

| Taxa | AmF | F | S | AvS |
|---|---|---|---|---|
| Nematomorpha | | | | |
| *Gordius aquaticus* | R | a | a | a |
| Oligochaeta | | | | |
| *Potamothrix hammoniensis* | R | a | a | a |
| *Limnodrilus hoffmeisteri* | V | A | A | R |
| *Psammorychtides barbatus* | R | a | a | a |
| *Tubifex tubifex* | A | V | V | V |
| *Lumbriculus variegatus* | R | a | a | a |
| Bivalvia | | | | |
| *Pisidium casertanum* | R | a | a | a |
| Hydrachnida | | | | |
| *Hydrachna* sp. *(crenta)* | R | a | a | a |
| Copepoda | | | | |
| *Cyclops vicinus* | A | R | V | R |
| Isopoda | | | | |
| *Asellus aquaticus* | A | A | R | a |
| Diptera | | | | |
| *Procladius choreus* | A | A | R | R |
| *Prodiamesa olivacea* | R | a | a | a |
| *Cryptochironomus defectus* | R | a | a | a |
| *Chironomus plumosus* | A | a | a | a |
| *Polypedilum nubeculosum* | A | R | R | R |

A particular position has *Cyclops vicinus* (Uljanin), found in variable numbers in all stations. In benthic spaces, neighboured with the fish cages with, it realized an impressive numerical development, arriving to over 2000 individuals/sample (station S, October). The massive presence of this pelagic cyclopid in the deep benthal is difficult to explain without information about micro- and meiobenthos. We can only suppose a reach and accessible food source for *C. vicinus* described as an omnivorous species, with important algal (Adrian, 1991) and bacterial (Damian – Georgescu, 1963) food components.

Two species, *Lumbriculus variegatus* (Müller) Grube (Oligochaeta) represented by few individuals in AmF station, and *Asellus aquaticus* (L.) Rakovitza (Isopoda) frequent and very well numerically represented (20 – 40 individuals/$m^2$), especially in F and S stations, can be considered new for the benthic fauna of the lake, while not cited in previous papers (Simalcsik 1973, Miron et al. 1983, Toderas et al. 1999).

*Species richness, diversity index and concentration of dominance.* These measures of the community structure are presented in figure 2. Species richness shows a clear decrease tendency by water depth increase, according to general tendency, characteristic to the lake (Miron et al. 1983, Toderaş et al. 1999). The diversity index has very low values ($H' < 1.0$) and decreased from AmF site to AvS site. The reverse was true for the concentration of dominance, which shows a single dominant population in the deepest AvS station.

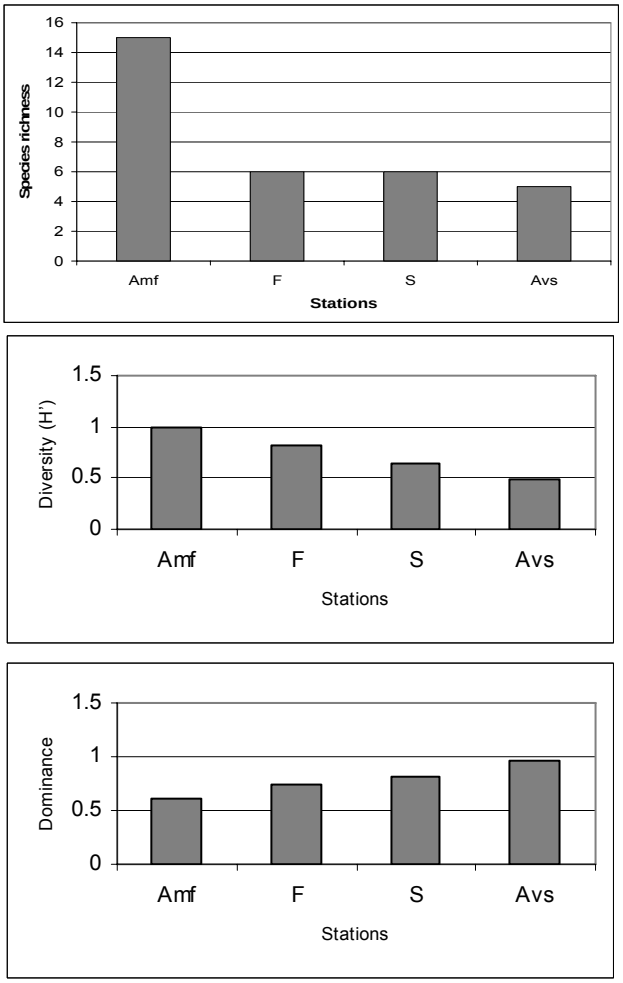


Fig. 2. Species richness, species diversity ($H'$) and concentration of dominance of macrozoobentos at sampling stations

*Density and biomass.* Numerical density (number of organisms/$m^2$) and biomass ($g/m^2$) were calculated for each station (Fig. 3).

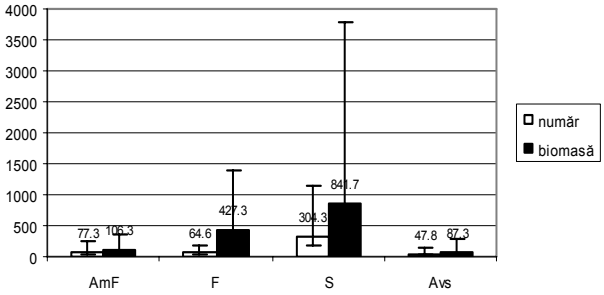


Fig. 3. Mean annual densities and biomasses of macrozoobenthos in Potoci bay. Vertical bars indicate the 95% confidence interval

We can observe that in control sites (AmF, AvS) the numerical density and biomass had values characteristic to the profound zone of the deep oligotrophic lakes (Adreani et al. 1981), compared to the values obtained in the upper part of the Bicaz Lake (Toderaş et al. 1999). Unlikely, in the sites situated in the neighbourhood of the fish floating cages, numerical density increased by 1.7 to 4.5 times, and

biomass by 4.1 to 9.6 times, compared to the control sites, having values characteristic to the littoral zone of the eutrophic lakes (Rasmussen 1988).

However, individual mean weight of the dominant tubificids (*T. tubifex*) is higher in the aquaculture area (stations S and F) compared to similar values observed in the control sites, showing good feeding conditions for these detritivorous worms (Fig. 4).

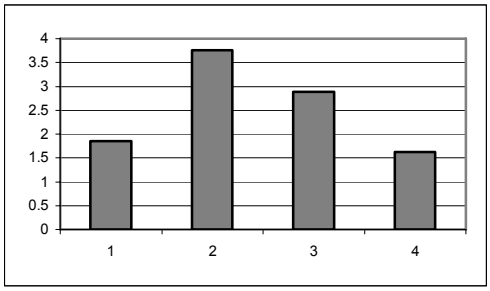


Fig. 4. Variation of individual wet weight mean of *T. tubifex* at sampling sites (mg/ individuals)

The analysis of variance shows, first of all, significance differences regarding numerical density and biomass average, between the control stations and those affected by aquaculture ($P<0.05$), and secondly insignificant differences between stations F and S and stations AmF and AvS.

Jaccard's similarity index shows maximum similarity (100 %) between stations F and S, very high (88.3 %) between stations F, S and AvS, and minimum (33.3 %) between AmF and the rest of the stations.

Referred to those shown above, we can promote next conclusive appreciations: aquaculture of salmonids in floating cage influence benthic macroinvertebrates community structure by an increased abundance of the detritivorous oligochaetae with an increased individual weight, as well as by attracting new species in the benthic macroinvertebrates associations. These effects appear in small areas situated in the neighborhood of the trout aquaculture floating cages, and can be interpreted like signs of limited eutrophication..

## REZUMAT

În urma analizei probelor cantitative prelevate lunar în intervalul mai – octombrie 2004 din zona profundală a lacului Bicaz, în două secțiuni situate în preajma platformelor de salmonicultură intensivă în cuşti flotabile şi două situate în zone neafectate, servind ca martor, au fost determinați câțiva parametri structurali ai comunităților de macronevertebrate bentonice. Pe fondul dominării a două specii, *T. tubifex* şi *L. hoffmeisteri* (Oligochaeta, Tubificidae) au fost identificate diferențe semnificative, în sensul creşterii abundenței numerice, a biomasei de 4,8 – 9,7 ori, a oligochetelor detritivore şi a greutății individuale a acestora în zona practicării acvaculturii, comparativ cu situațiile martor, şi apariția isopodului *Asellus aquaticus* în aria studiată, nesemnalat anterior în lacul Izvorul Muntelui Bicaz.

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