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THE ZOOPLANKTONIC COMMUNITIES OF THE CÂRJA AND MĂLINA FARMS (ROMANIA)

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Abstract

Zooplankton communities represent an important link in the aquatic food web with an important role in the transmission of matter and energy from producers to consumers. Also, they are excellent indicators of water quality and their functioning through the central position they occupy in the food web. This study presents the taxonomic composition, abundance, and spatio-temporal distribution of zooplankton communities in two pond ecosystems with different water supply sources, in two seasons (spring and autumn). Diversity and similarity for the three zooplankton groups between the two fish farms were also calculated. The study was conducted in 2020.
The zooplankton taxonomic groups identified in the samples taken were: Rotifers, Cladocera and Copepods. In the Mălina aquatic ecosystem, species from the Cladocera taxonomic group dominate, with the species *Daphnia cristata*, *Daphnia longispina* and *Daphnia cuculata* while in the Cârja aquatic ecosystem, species from the Rotifera taxonomic group dominate, namely *Brachionus angularis*, *Brachionus rubens*, *Brachionus urceolaris* and *Trichocerca tigris*.
Comparing the diversity of the two aquatic ecosystems (which are water supplied by distinct rivers), we conclude that the Mălina farm has the greater diversity for all three groups of zooplankton.
Using the Sorenson Diversity Index (IS) to see the degree of similarity of the taxonomic composition between the two aquatic ecosystems studied, it was observed that for the Rotifera group, the similarity is 56%, for the Cladocera group 50% and for the Copepoda group 80%.

Keywords: zooplankton, communities, rotifers, copepods

1. Introduction

Freshwater is essential to humanity as it provides us with drinking water and nourishment, but also many other ecosystem services that we depend upon. [Paquette C., et. al, 2022].
Due to the multiple services that fresh waters provide (in agriculture, fishing, tourism and other economic and social activities), ecosystems have become very vulnerable. These pressures lead to changes in component aquatic biodiversity and ecological functions.

The zooplankton community is an important link in the aquatic food web and shows important ecological roles, including the transfer of matter and energy between primary producers and consumers at higher trophic levels [Lampert W., Sommer U., 1997].

The structure of zooplankton communities depends on a complex of factors. These include morphometric and regional climatic conditions, which govern important physical characteristics of water bodies, and chemical characteristics of the water, which are generally determined by edaphic features and vegetation cover [Sioli, H., 1975; Margalef, R., 1983]; biogeographical factors, which control species colonization [Dumont, H. J., 1999; Rocha O., et

al., 1999]; and biotic interactions, principally competition for resources and prey [DeMott, W. R., 1989; Gliwicz Z. M., and Pijanowska J., 1989].

Zooplankton are of particular importance to fish farms because they are an essential food resource for larval and juvenile fish, as well as for some adult species.

Zooplankton is a very good source of protein and lipids for fish. The percentage of proteins and lipids is different from one species to another, but also according to the season or development stage. [Kibria et al., 1999]

Zooplankton can enter the pond with supply water (allochthonous populations) or from internal sources (autochthonous), as they are zooplankton species able to survive periods of drought or other adverse conditions by forming resistant stages that can remain in diapause in the sediment for long periods, hatching when favourable conditions return [Hairston et al., 1995].

Many studies have established the importance of zooplankton as an excellent indicator of the health of an aquatic ecosystem and its important role in the rearing process of fish.

The object of this work was to study zooplankton communities in two pond ecosystems with different water supply sources, in two seasons (spring and autumn), analysing the taxonomic composition and abundance of the populations, so as to contribute to the knowledge of their biodiversity.

2. Methodology

Study area

The analysis of zooplankton communities was carried out on two bodies of water belonging to two hydrographic basins located in the E - SE part of Romania (figure 1). The two bodies of water represent cyprinid growth pools.

The Mălina fish farm is located in the village of Movileni, Galați County. The Mălina fish farm is part of the hydrographic basin of the Siret River. The total area of the farm is S = 127 ha and the pond from which the zooplankton samples were taken has an area of S = 30 ha. Water supply and drainage are done through distinct channels.

The Cârja farm is in the village of Cârja, Vaslui County and is part of the hydrographic basin of the Prut River. The samples were taken from Balta Mare of the Carja 1 fish farm which has an area S= 297 ha. Water supply and drainage are done through the same channel.

Sampling stations were established to capture the variability of the entire aquatic ecosystem.

The stations were established both on the surface of the pond and on the respective supply channels and the discharged channel. For the Mălina farm, they were marked with M1÷M5 the stations inside the pond and with MA - the station in the channel through which water is supplied to the farm from the Siret River and MEv - the station through which water is discharged from the pond. The same was done for the Cârja farm, where with C1 ÷ C5 the stations inside the studied body of water and with C6 – the channel through which the water is supplied and discharged.

Sampling and preservation procedures of zooplankton

The zooplankton samples were collected in the spring and autumn of 2020 from the established stations. The samples were taken from a depth of 0.5 m of water and a quantity of 10 l was

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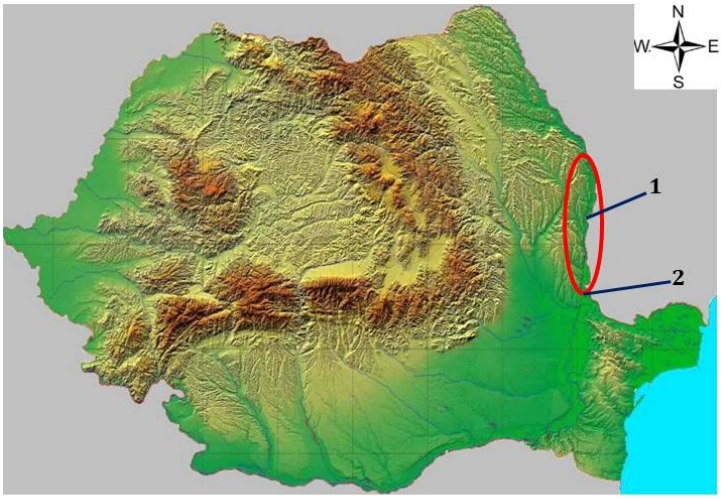
filtered through the planktonic net. The concentrate was immediately fixed with Lugol's solution in a ratio of 1:100 (1 ml of solution for 100 ml sample) and transported to the laboratory. In the laboratory, the samples were centrifuged at 1200 rotations/per minute.

The zooplankton was analysed from a qualitative (the number of individuals and species) and quantitative (the density and the numerical abundance) point of view.

Zooplankton diversity was calculated using the Shannon-Wiener Index H' (the natural logarithm was used) for all three groups (Rotifera, Cladocera and Copepoda) [Shannon, C.E. 1948] and the Evenness Index J [Pielou, E.C, 1966].

To see the degree of similarity of the zooplankton taxonomic composition between the two water bodies studied, we used the Sørensen Similarity Index (SI) [SorensenT.A, 1948; Wolda H., 1981].



1 - Cârja fish farm; ***2 - Mălina fish farm***

Figure 1 Area study

3. Results and discussion

Mălina fish farm

The sampling stations from the Mălina fish farm can be seen in Figure 2.

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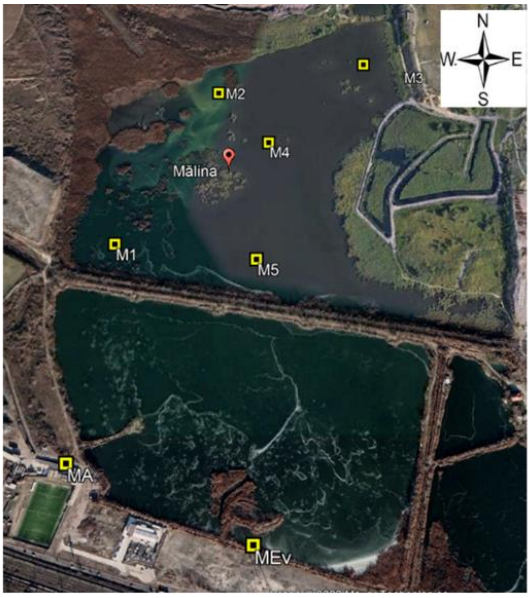

M1÷M5 Mălina, sampling station 1÷5
MA -Mălina, sampling station on the water supply channel
MEv - Mălina, sampling station on the water discharge channel

Figure 2 Sampling stations – Mălina fish farm

Taxonomic composition, abundance and density of zooplankton

The zooplankton taxonomic composition of the Mălina pond is represented by a total number of 39 species belonging to three taxonomic groups: Rotifera, Cladocera, Copepoda.

25 taxa belong to the Rotifera group, 11 taxa belong to the Cladocera group and 3 taxa belong to the Copepods group

The numerical density varied between 333 - 9235 specimens/l in the spring samples and 48 - 627 specimens /l in the autumn samples.

Temporal distribution

In the Mălina farm, the highest absolute abundance is observed in the spring season when the Cladocera and Copepoda taxonomic groups predominate and in autumn season species from the Rotifera group predominate (figure 3).

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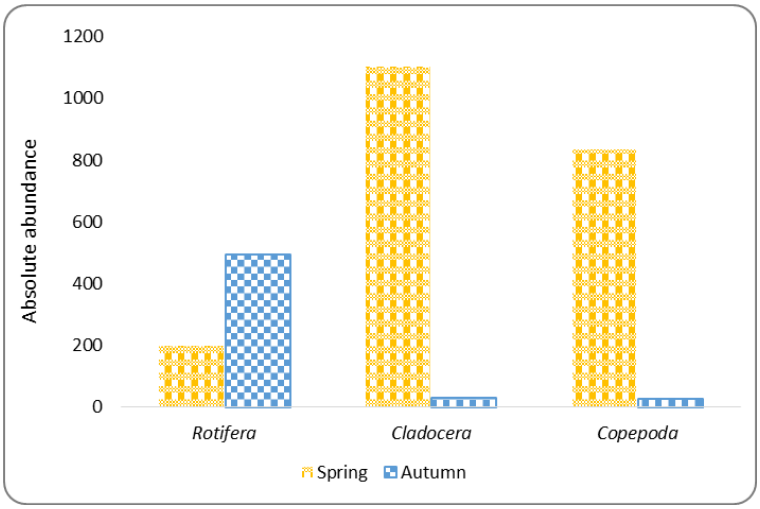

Figure 3 Temporal distribution of zooplankton in the Mălina fish farm

In the spring samples, the group of Cladocera is dominant and constant, being represented by the species: *Daphnia cristata, Daphnia longispina, Daphnia cuculata, Daphnia magna, Daphnia pulex*. From the group of Copepods, the species *Cyclops strenus* is dominant in the spring samples. From the group of Rotifers, *Trichocerca brachiura, Filinia longiseta, Keratella cochlearis, Brachionus angularis* dominate in the autumn samples.

Comparing the relative abundance of the zooplankton communities in the 2 seasons on the Mălina farm, the relative abundance of Rotifera varies between 9% (spring) and 89% (autumn). Also, the relative abundance of Cladocera varies between 6 - 52% and of Copepods between 5 - 39% as can be seen in Figure 4.

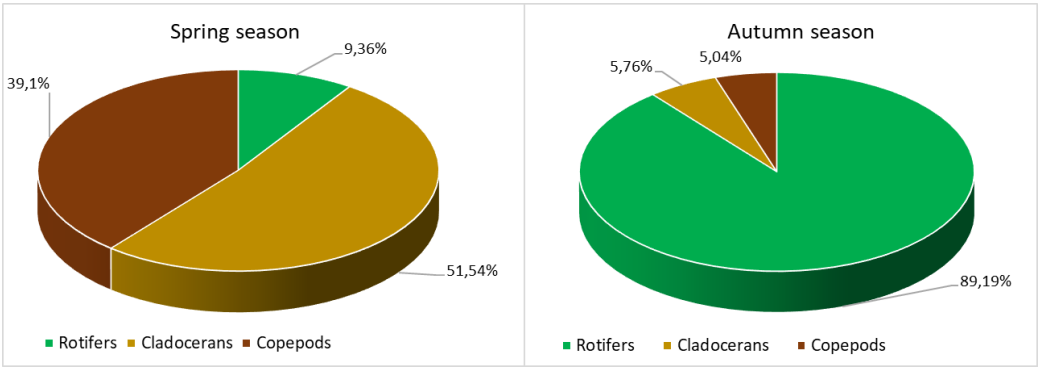

Figura 4 Relative abundance of Rotifera, Cladocera and Copepoda in the zooplankton community
of Mălina farm

Cârja fish farm

Balta Cârja is part of the hydrographic basin of the Prut. The map with the sampling points can be seen in Figure 5.

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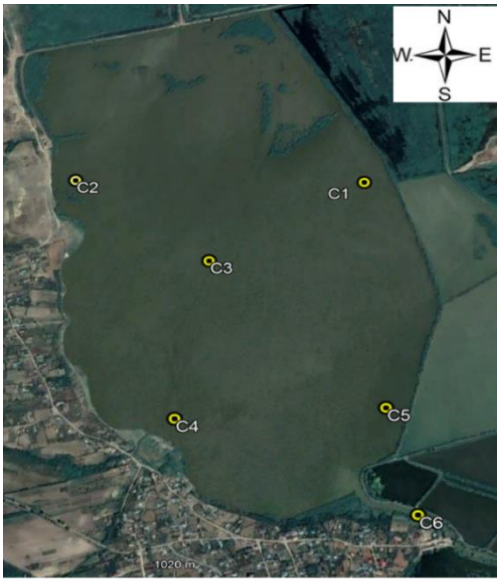

C1 –C5 Cârja, sampling station 1÷5
C6 - Cârja, sampling station on the water supply - drainage channel

Figure 5 Sampling stations – Cârja fish farm

The taxonomic composition is represented by a total number of 29 species, consisting of 18 taxa belonging to the Rotifera group, 9 taxa belonging to the Cladocera group and 2 taxa belonging to Copepods.
The numerical density varied between 582 - 1635 specimens/l in the spring samples and 415 - 1737 specimens/l in the autumn samples.

Temporal distribution
Rotifers and Copepods were dominant both in the spring and autumn seasons, as can be seen in Figure 6.

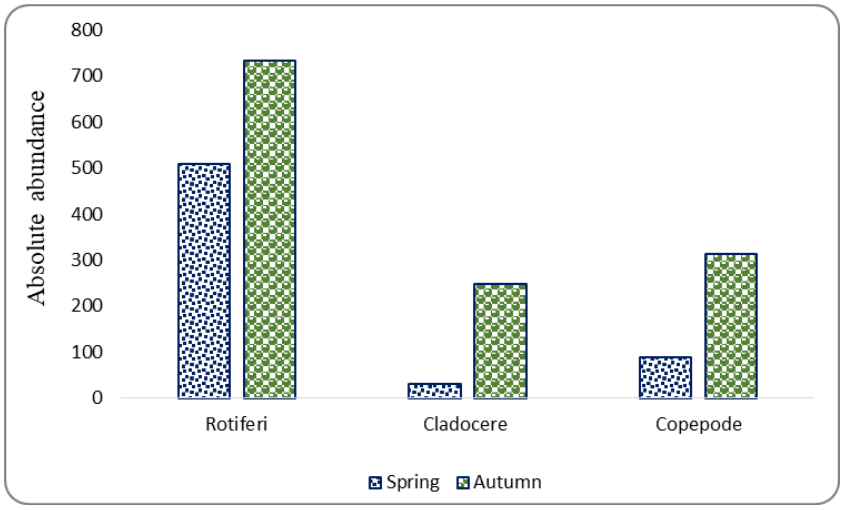

Figure 6 Temporal distribution of zooplankton in the Cârja fish farm

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The most abundant species from the group of Rotifers were: *Brachionus angularis, Brachionus rubens, Brachionus urceolaris, Trichocerca tigris, Notholca foliacea.*
Among the Copepoda, the *Cyclops strenuus* species appears in all samples analyzed both in the nauplii and adult stages.

Comparing the relative abundance of zooplankton communities in the 2 seasons, the relative abundance of Rotifers varies between 81% (spring) and ~57% (autumn). Also, the relative abundance of Cladocera varies between 4.78 and 18.93% and of Copepods between 14.2 and 24.14%.

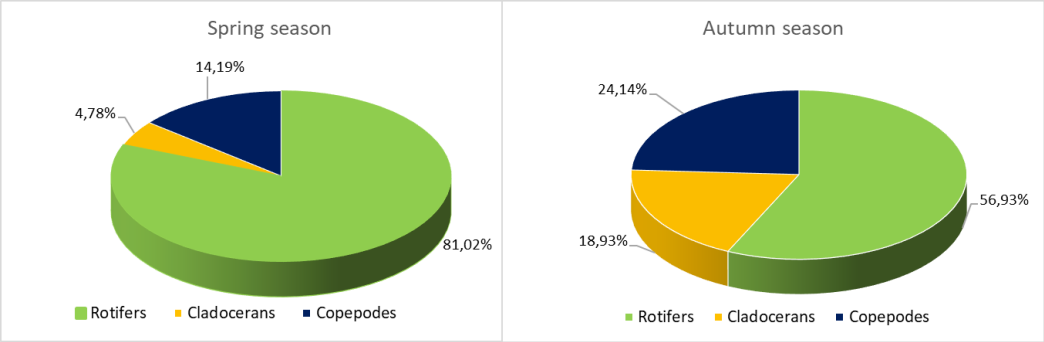

Figure 7 Relative abundance of Rotifera, Cladocera, and Copepoda, in the zooplankton community of Cârja farm

Diversity, uniformity, and similarity of the zooplankton communities
Table 1 shows the values for the diversity, evenness and similarity indices obtained for the two aquatic ecosystems studied.

Table 1 Values for the Shannon - Wiener Index (H'), Evenness Index (J) and the Sorensen Similarity Index (SI)

	Mălina farm		**Cârja farm**		**Between pond**
Group/Indices	**H'**	**J**	**H'**	**J**	**SI**
Rotifera	2.56	0.78	2.07	0.72	56
Cladocera	2.04	0.85	1.03	0.46	50
Copepoda	1.23	0.69	1.06	0.66	80

Comparing the two farms using the Shannon-Wiener diversity index (H'), it is observed that the Mălina farm has a greater diversity and uniformity of the taxonomic composition than the Cârja farm. If the Rotifera and Copepoda values are relatively close for the Cladocera group, the value for the Mălina farm is almost double that obtained for the Cârja farm.

The same fact is observed by following the values of the Evenness Index (J). In the Mălina farm, the values obtained for all three groups are higher than in the Cârja farm. This shows us that the zooplankton has a more diverse and balanced structure. The lowest value obtained for the Cladocere group (from Cârja farm) shows us that there is a lack of uniformity in the distribution of species within the community. This means that certain species are more dominant or more abundant compared to others.

Comparing the degree of similarity of the taxonomic composition, one notes an 80% similarity between the two ponds for the Copepoda group and 56% Rotifera.

4. Conclusions

Zooplankton is a very good source of proteins and lipids for fish not only in the larval and juvenile stages but also for adult fish. Therefore, the quality and quantity of zooplankton is important for the success of increasing fish production.

The qualitative analysis of the zooplankton community in the studied aquatic ecosystems highlighted the presence of three taxonomic groups: Rotifera, Cladocera and Copepeda, represented by some species that varied depending on the farm and the sampling season. Also, the abundance and numerical density varied depending on the season.

In the Mălina farm, the Rotifera group was the best represented (25 species), but in terms of absolute abundance, the Cladocera group dominated.

In the Cârja farm, the Rotifera group was dominant both in terms of the number of species (18 species) and absolute abundance.

The Copepoda group is represented in both farms by a small number of species, but the dominant ones are the young forms (nauplii and metanauplii).

The existence of young forms is of great importance for zooplankton community structure concerning population dynamics and trophic aspects since in the early phases the organisms can occupy trophic niches different from those of the adults. [I. F.,Neves, et.al., 2003].

The diversity of the Mălina farm is higher than that of the Cârja farm (for all zooplankton groups).

The Evenness Index varies between a maximum of 0.85 (the Cladocera group from the Mălina farm) and a minimum of 0.46 (the Cladocera group from the Cârja farm). A high similarity between the two farms is for the Copepoda group where 80% of the species are common.

The lower values of all the indicators in the Cârja farm may be due to the fact that zooplanktonophagous fish species such as *Aristichthys nobilis* are grown in this basin.

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