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# THE ECOLOGICAL STATUS OF QUALITY OF THE CÂRCINOV STREAM BASED ON THE ANALYSIS OF THE MACROZOOBENTOS

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***Abstract***
*The present work was carried out based on the bibliographic material related to this fear, the data taken from the Argeș - Vedea Watershed Administration and personal research in the field, with the aim of establishing the ecological quality status of the Cârcinov Stream in the sampling points. The objectives considered to achieve the proposed goal were the following:*
- *Ecological zoning of the river based on the macrozoobenthos;*
- *Identification of the main taxonomic groups in macrozoobenthos;*
- *Ecological characterization of monitoring points based on ephemera fauna analysis.*
- *Establishing the quality ecological status of the Cârcinov Stream based on the macrozoobenthos analysis.*

*Keywords: Cârcinov, ecological status, macrozoobenthos.*

## 1. INTRODUCTION

The Cârcinov Basin, in the Cândești Piemont, has an area of 202.75 square km. The unit slopes from north to south over a length equal to 37.75 km and an average width of 6.125 km (max.width = 9.25 km and min.width = 3 km). Botești commune is in the northeast of the basin (Diaconu, 2000).

Crossed along it by the Cârcinov stream, Botești commune is composed of two villages (Botești and Moșteni-Greci), it is 47 km from Pitesti municipality, the seat of Argeș county and 25 km from Topoloveni town (PM Argeș-Vedea, 2021).

The unit in which Valea Cârcinovului falls is not only a morphological element or a morpho-hydrographic artery, but it also offers the interested party a complex landscape with intense morphodynamics. From the observations made, we found that the Cârcinov Stream evolved on a friable geological substrate, predominantly sandy, the valley having specific climatic conditions, imposed by the channeling of air masses along it, by a variegated carpet of soils and a vegetation in which the species of steppe and zonal type forest with the azonal ones of the meadow.

Valea Cârcinovului presents, from an economic-geographical point of view, features that set it apart from the entire Cândești plateau: developed settlements, well-circulated communication routes, highly


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diversified agriculture due to the relief and varied soils. From this interference of natural and anthropic elements, a geographical complex or a landscape was born, the analysis of which highlights, first, the existing links between these components (Diaconu, 2000).

Among the rivers that originate and develop within the limits of Cândești Piedmont, Cârcinovu is the most important, both in terms of length and surface area of the hydrographic basin. Starting from Beleti to the north, Valea Cârcinovului bifurcates, both ramifications bearing the same name, Cârcinovul. Due to this fact, the need for a specific name for each individual valley was felt. Thus, the branch, which originates from below Dealul Pietrelor and passes to the west of Cândestii din Deal, then through Botești and Dobrești where it joins Valea Grecilor (Fig. 1), was named Cârcinovul de Est, and the branch that originates under Dealul Corbului (599m) and passes through the town of Negrești, it was given the name of Western Cârcinovu (Fig. 1). The Eastern Cancer represents the most developed branch in terms of length and surface. It springs from the northern extremity of the Cândești Piedmont, namely from the point called Poiana la Rudari (702m), and its tributary on the right, Valea Mare (Fig. 1) originates under Dealul Pietrelor (744.6m), the highest point of the region. From Dealul Pietrelor to Topoloveni, where it enters the Argeșului meadow (Fig. 1), the Cârcinovu crosses aprox. 38 km, going down about 500m (PM Argeș-Vedea, 2021).

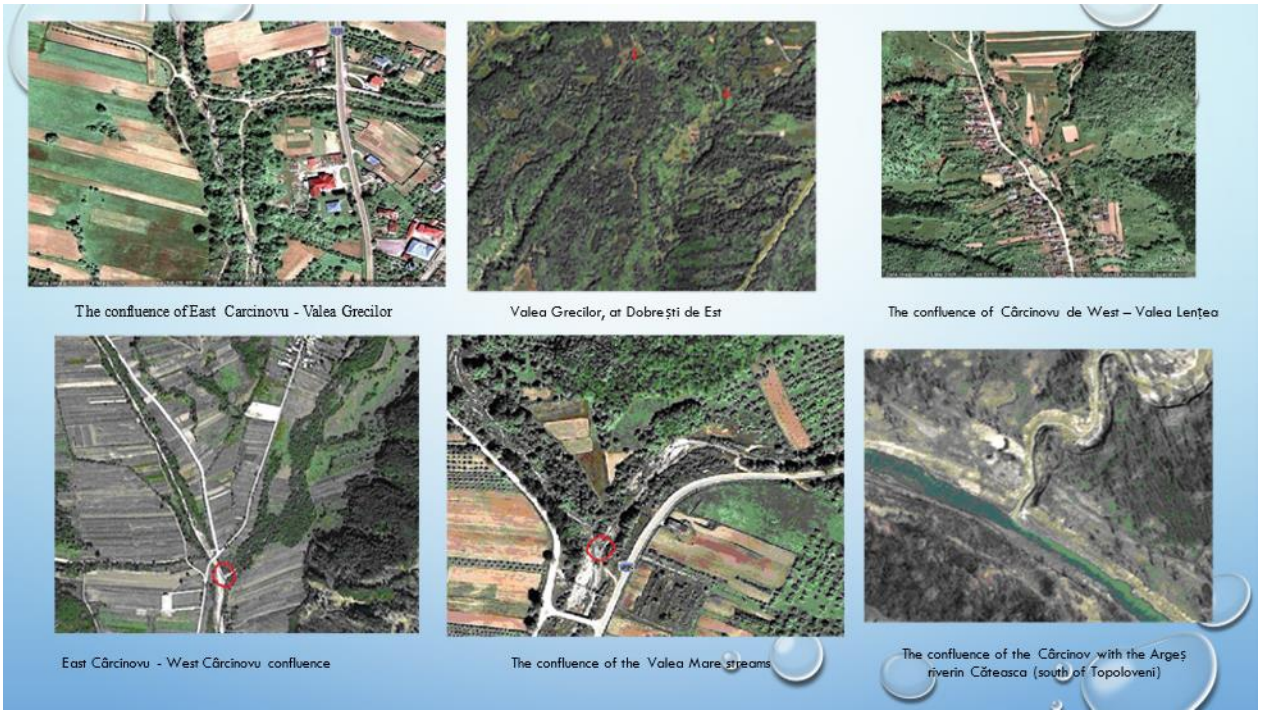


***Figure 1. Aspects regarding the Cârcinov Hydrographic Basin (download Google Earth)***

## 2. MATERIALS AND METHODS

To establish the benthic zoocenosis structure of Cârcinov Stream, 3 sampling stations were established: Moșteni - Greci, Cârcinov West Confluence - Valea Grecilor, location - Dobrești and Beleti Bridge -


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Cârcinov West - Cârcinov East confluence. In establishing the sampling stations, the hydrological and morphological structure and the anthropogenic impact were considered. The choice of the sampling stations was made on a strict distance criterion, dividing the studied sector into three approximately equal areas, the Moșteni-Greci location being considered the standard, given the very low anthropogenic influence, as well as the fact that there are no human settlements upstream of it stable.
The sampling stations were:

**Station 1 - Moșteni-Greci village, location: approximately 800 m**

- ✓ one arm
- ✓ bouldery substrate with very large stones;
- ✓ grassy banks with boulders;
- ✓ water speed approximately 0.5-1 m/s;
- ✓ average depth 10 cm
- ✓ average air temperature 10.5 – 20.4 °C
- ✓ water temperature 8°C;
- ✓ bed width approximately 1m
- ✓ total transparency.

**Station 2 - Confluence Cârcinov de West - Valea Grecilor, location - Dobrești**

- ✓ slow, sandy, grassy banks;
- ✓ substrate with gravel and sand;
- ✓ semi-anthropized area, arable land
- ✓ average depth 25-30 cm;
- ✓ traces left by the flood
- ✓ the bed of evil 3-4 m;
- ✓ meadow vegetation, willows
- ✓ household garbage depots

**Station 3 - Beleti Bridge - West Cârcinov - East Cârcinov confluence**

- ✓ substrate, stony, sandy
- ✓ the right bank - smooth and with vegetation, the left bank - a little steep and grassy
- ✓ traces left by floods;
- ✓ average depth 20-30 cm
- ✓ the width of the bed approximately 8-10 m
- ✓ semi-anthropized area, arable land
- ✓ household garbage depots
- ✓ willow vegetation
- ✓ traces of the arrangement of the bed to prevent floods.

To determine the qualitative and quantitative structure of the benthic biocenosis, samples were taken using a Surber Sampling benthic net, according to the work methodology. Later, the samples fixed in


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4% formalin were transported and processed in the Hydrobiology laboratory of the University of Pitesti. To identify the species, representative determinants from the Romanian and international specialized literature were used. For the ephemeroptera fauna, a series of ecological indices were calculated: the ecological spectrum, the frequency, the constancy of the species, the relative abundance, the index of ecological significance (W). The determination of the ecological state of quality was made in accordance with the working methodology developed within the Management Plan of the Arges-Vedea Watershed.

## 3. RESULTS AND DISCUSSIONS

After processing the samples, the obtained results are listed in the figures V.1, V.2, V.3.

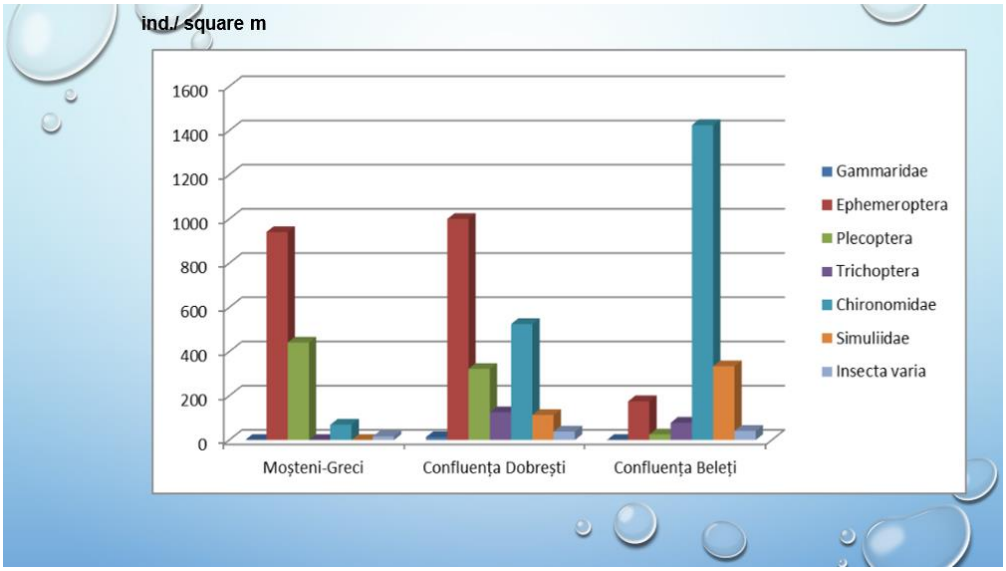


***Figure 2. The benthic zoocenosis structure of the Cârcinov stream - September 2018***

- Ephemeroptera reach their maximum abundance at the Dobrești confluence (1000 ind./$m^2$), and show a low numerical density at the Beleti confluence (175 ind./$m^2$)
- The situation is similar with plecopters; in the other stations, the number of individuals/$m^2$ decreases progressively downstream.
- trichoptera remain at low values in the Dobrești and Beleti confluence areas, below 150 ind/$m^2$;
- chironomids have a very high density at the Beleti confluence.


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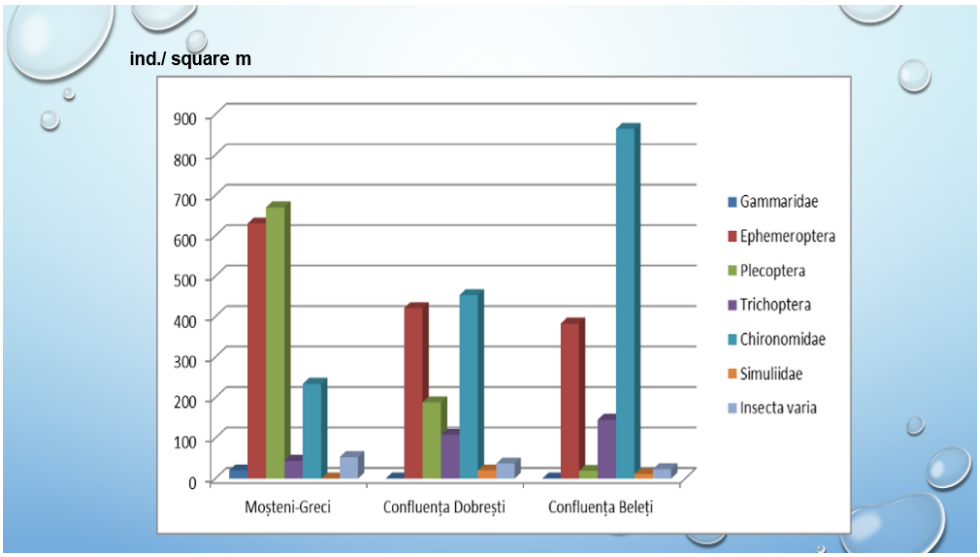


***Figure 3. The benthic zoocenosis structure of the Cârcinov stream - March 2019***

- The numerically dominant groups are ephemeroptera, plecoptera and chironomids;
- ephemeroptera reach their maximum abundance in the area of Moșteni-greci village (630 ind/$m^2$), and a low abundance is recorded at the Beleti confluence.
- in the other stations, the number of ephemeroptera specimens / $m^2$ decreases progressively from upstream to downstream, as the flow speed decreases, and the anthropic influence is more and more pronounced.
- in the case of plecoptera, their abundance decreases progressively from upstream to downstream, reaching the maximum value in the village of Moșteni-Greci (670 ind./$m^2$) and the minimum at Beleti (19 ind./$m^2$).
- a special case is that of the Chironomids, which are known as indicators of clean water, register a considerable increase in the Dobrești and Beleti confluence areas (453 ind/$m^2$, respectively 864 ind/$m^2$), the probable explanation being given by the fact that before the period of sampling, heavy rains were recorded that led to the overflow of the stream, thus bringing a large organic load from the minor bed, leading to an increase in the quality class.


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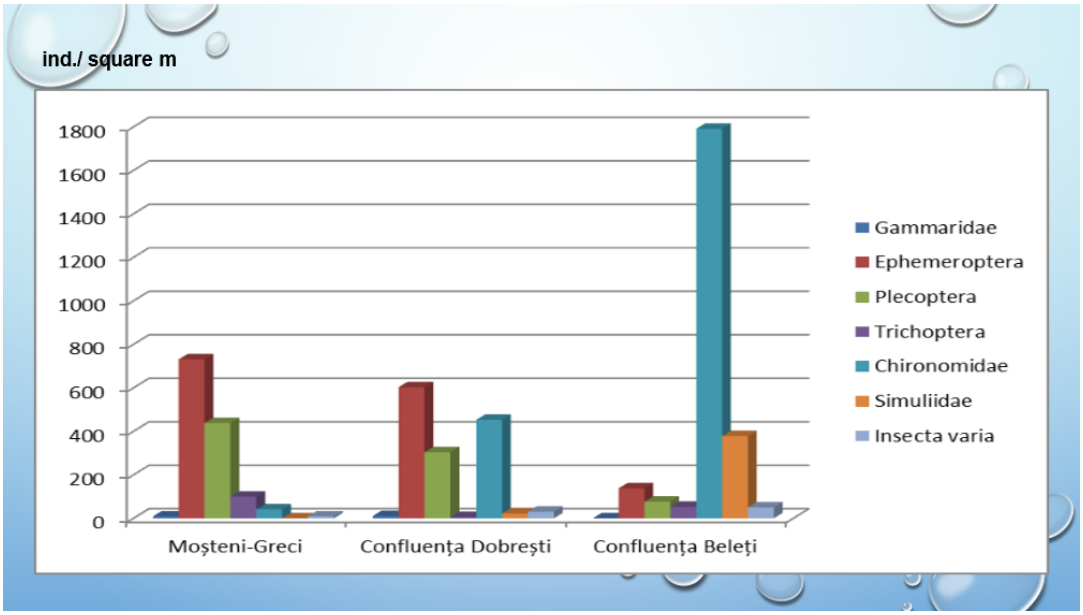


***Figure 4. The benthic zoocenosis structure of the Cârcinov stream – June 2019***

- ✓ Ephemeroptera are found in a very large number in Moșteni-Greci village (731 ind./$m^2$), and a low density is present at the Beleti confluence (138 ind/$m^2$)
- ✓ in the case of plecopters, their number decreases progressively until a minimum point reached in the Beleti confluence area where the number of specimens decreases to 75 ind/$m^2$
- ✓ as far as Trichoptera are concerned, they do not exceed 100 ind/$m^2$ in the village of Moșteni-Greci, with a steep drop of up to 10 ind/$m^2$ in the Beleti confluence area.
- ✓ In places where their frequency is very high, their larvae play a very important role in the life of running waters. They are known to be the most sensitive insect larvae to water pollution and the best indicators of water pollution. These, along with Ephemeroptera and Trichoptera, have a role in evaluating the good functioning of lotic systems.
- ✓ Gammarids are predominant at the Beleţi confluence, they are indicators of clean water, the explanation of the large number in this station was given previously.

From the analysis of the ephemeroptera fauna of the Cârcinov river, they were identified 14 species of 7 genres belonging to 6 families from all three suborders (Table 1)
The data on the main ecological parameters of the ephemeroptera fauna are given in tables 2 - 5. The following parameters were determined: the frequency of species in each sampling station, the abundance, constancy and category of each species. *Baëtis alpinus* occurs predominantly in the upstream stations and is a quality indicator of the first class, while *Baëtis rhodani* was identified mostly in the downstream stations as a quality indicator of the II and III classes, similar with *Ecdyonurus venosus* and most species of *Epeorus* sp. gender. *Rhitrogena semicolorata* (lithoreophilic species) was


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identified in all stations, which shows that the bottom layer is rocky, turbid and the flow speed quite high.

***Table 1. List of ephemeroptera species identified in the Cârcinov Stream***

| **ORD. EPHEMEROPTERA** | | |
|---|---|---|
| **SUBORDER** | **FAMILY** | **SPECIES** |
| EPHEMEROIDEA | EPHEMERIDAE | ***Ephemera danica*** |
| BAËTOIDEA | LEPTOPHLEBIIDAE | ***Paraleptophlebia submarginata*** |
| | EPHEMERELLIIDAE | ***Ephemerella ignita*** |
| | CAËNIDAE | ***Caenis macrura*** |
| | BAËTIDAE | ***Baëtis alpinus*** |
| | | ***Baëtis lutheri*** |
| | | ***Baëtis muticus*** |
| | | ***Baëtis rhodani*** |
| | | ***Baëtis vernus*** |
| HEPTAGENOIDEA | ECDYONURIIDAE | ***Ecdyonurus dispar*** |
| | | ***Ecdyonurus torrentis*** |
| | | ***Ecdyonurus venosus*** |
| | | ***Epeorus sp.*** |
| | | ***Rhithrogena semicolorata*** |

***Table 2. The ecological characterization of the Cârcinov Stream biocenosis from the point of view of the ephemeropteran fauna – Station 1***

| **SPECIES** | **F%** | **Constancy of the species** | **n** | **A** | **W** | **Wx** | **Category of species** |
|---|---|---|---|---|---|---|---|
| *Baëtis alpinus* | 100 | EUCONSTANT | 1480 | 58.54 | 58.54 | W5 | CHARACTERISTIC |
| *Baëtis vernus* | 33 | ACCESSORIES | 17 | 0.67 | 0.22 | W2 | ACCESSORIES |
| *Rhithrogena semicolorata* | 100 | EUCONSTANT | 683 | 27.02 | 27.02 | W5 | CHARACTERISTIC |
| *Ecdyonurus torrentis* | 100 | EUCONSTANT | 80 | 3.16 | 3.16 | W3 | ACCESSORIES |
| *Ecdyonurus venosus* | 33 | ACCESSORIES | 31 | 1.23 | 0.40 | W2 | ACCESSORIES |
| *Epeorus sp.* | 100 | EUCONSTANT | 148 | 5.85 | 5.85 | W4 | CHARACTERISTIC |
| *Paraleptophlebia submarginata* | 100 | EUCONSTANT | 72 | 2.85 | 2.85 | W3 | ACCESSORIES |
| *Ephemera danica* | 33 | ACCESSORIES | 17 | 0.67 | 0.22 | W2 | ACCESSORIES |


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***Table 3. Ecological characterization of the Cârcinov Stream biocenosis from the point of view of the ephemeropteran fauna – Station2***

| SPECIES | F% | Constancy of the species | n | A | W | $W_X$ | Category of species |
|---|---|---|---|---|---|---|---|
| *Baëtis alpinus* | 100 | EUCONSTANT | 1058 | 48.94 | 48.94 | W5 | CHARACTERISTIC |
| *Baëtis rhodani* | 100 | EUCONSTANT | 201 | 9.30 | 9.30 | W4 | CHARACTERISTIC |
| *Baëtis vernus* | 66 | CONSTANT | 46 | 2.13 | 1.40 | W3 | ACCESSORIES |
| *Rhithrogena semicolorata* | 100 | EUCONSTANT | 584 | 27.01 | 27.01 | W5 | CHARACTERISTIC |
| *Ecdyonurus dispar* | 66 | CONSTANT | 88 | 4.07 | 2.69 | W3 | ACCESSORIES |
| *Ecdyonurus torrentis* | 100 | CONSTANT | 63 | 2.91 | 2.91 | W3 | ACCESSORIES |
| *Ecdyonurus venosus* | 100 | EUCONSTANT | 61 | 2.82 | 2.82 | W3 | ACCESSORIES |
| *Epeorus sp.* | 33 | ACCESSORIES | 21 | 0.97 | 0.32 | W2 | ACCESSORIES |
| *Paraleptophlebia submarginata* | 0 | EUCONSTANT | 0 | 0.00 | 0.00 | W1 | ACCIDENTAL |
| *Ephemera danica* | 66 | ACCESSORIES | 25 | 1.16 | 0.76 | W2 | ACCESSORIES |
| *Ephemerella ignita* | 33 | ACCESSORIES | 13 | 0.60 | 0.20 | W2 | ACCESSORIES |
| *Caenis macrura* | 33 | ACCESSORIES | 2 | 0.09 | 0.03 | W1 | ACCIDENTAL |

***Table 4. Ecological characterization of the Cârcinov Stream biocenosis from the point of view of the ephemeropteran fauna Station 3***

| SPECIES | F% | Constancy of the species | n | A | W | $W_X$ | Category of species |
|---|---|---|---|---|---|---|---|
| *Baëtis alpinus* | 100 | EUCONSTANT | 432 | 22.69 | 22.69 | W5 | CHARACTERISTIC |
| *Baëtis lutheri* | 33 | ACCESSORIES | 5 | 0.26 | 0.09 | W1 | ACCIDENTAL |
| *Baëtis rhodani* | 66 | CONSTANT | 453 | 23.79 | 15.70 | W5 | CHARACTERISTIC |
| *Baëtis vernus* | 100 | EUCONSTANT | 90 | 4.73 | 4.73 | W4 | CHARACTERISTIC |
| *Rhithrogena semicolorata* | 100 | EUCONSTANT | 651 | 34.19 | 34.19 | W5 | CHARACTERISTIC |
| *Ecdyonurus torrentis* | 33 | CONSTANT | 8 | 0.42 | 0.14 | W2 | ACCESSORIES |
| *Ecdyonurus venosus* | 100 | EUCONSTANT | 89 | 4.67 | 4.67 | W3 | ACCESSORIES |
| *Epeorus sp.* | 100 | EUCONSTANT | 92 | 4.83 | 4.83 | W3 | ACCESSORIES |
| *Paraleptophlebia submarginata* | 100 | EUCONSTANT | 82 | 4.31 | 4.31 | W3 | ACCESSORIES |
| *Ephemerella ignita* | 66 | CONSTANT | 2 | 0.11 | 0.07 | W1 | ACCIDENTALE |

From the point of view of the ecological spectrum (figure 5) it can be observed that in the upstream stations, respectively Moșteni-Greci and upstream, respectively Beleți, the best represented is the Ecdyonuriidae family, having a weight of 50% at the Moșteni Greci station, respectively 46% at the Beleți station, gradually decreasing to 30% downstream.
Baetids are best represented in the Moșteni-Greci station, where they are dominant (40%), in the case of the other stations, the percentage being approximately equal, between 25 - 30%.
Ephemeridae families; Leptophlebiidae; Ephemereliidae and Caenidae have a share below 15% in all stations.


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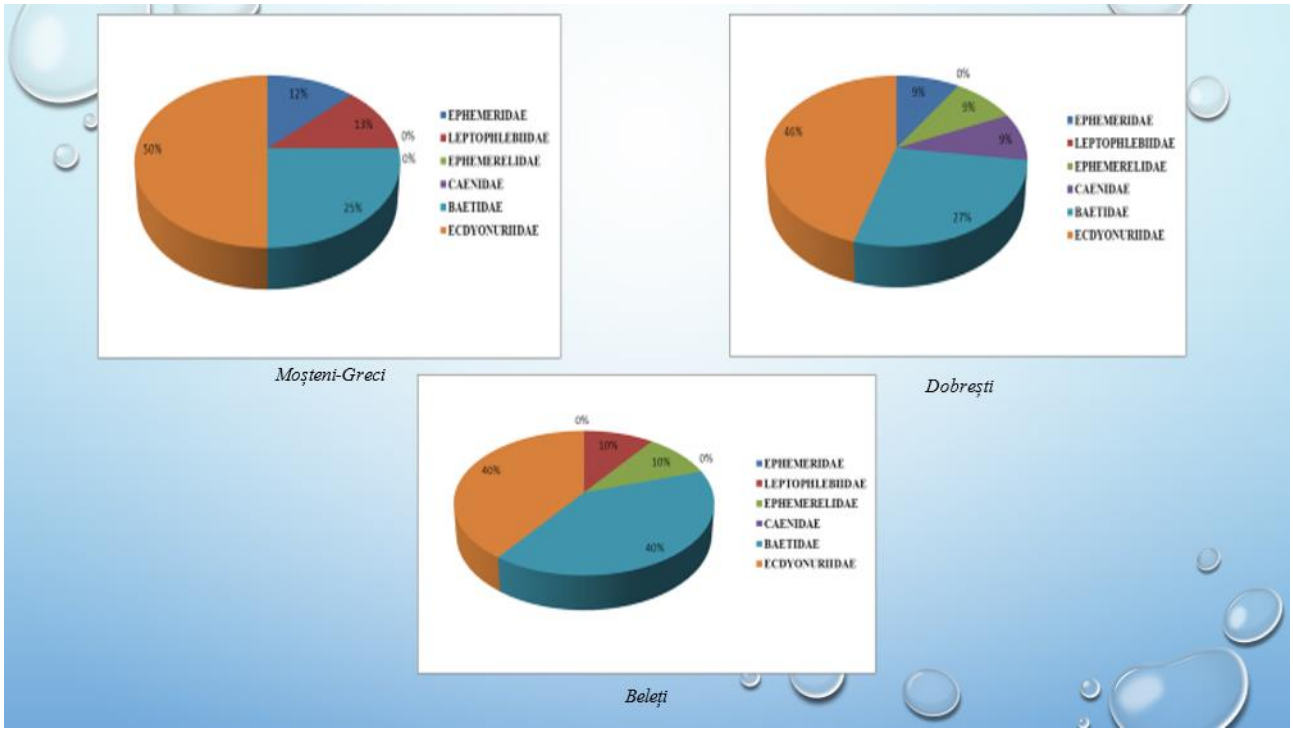


***Figure 5. The ecological spectrum by families of the ephemeropteran fauna of the Cârcinov Stream***

## 4. CONCLUSIONS

After studying the data obtained from the field, the following conclusions can be drawn:

The ecological state of quality of the Cârcinov Stream for the studied sector falls into the I - II quality class.

From the point of view of the ecological state of the water quality of the Cârcinov Stream, the following can be observed:

- the groups of zoobenthic organisms identified are: Ephemeroptera, Plecoptera, Trichoptera, Chironomidae, Simuliidae and Diptera varia;
- chironomids are the ones that dominate numerically, their density being very high;
- The number of plecoptera and simuliid is approximately constant throughout the river, maintaining low values;
- for ephemeroptera, their density is included in the usual standards for rivers in the hilly area;
- the degree of relative cleanliness, the water of the Cârcinov Stream, from the point of view of saprobity, is in the oligosaprobic zone in the region of the upper course of the river and β mesosaprobic - in the region of the middle and lower course of the river;
- the ecological quality status of the Cârcinov Stream falls within the limits of the Water Framework Directive 2000/60/EU - at least good ecological status - varying from very good in the first stations to good.


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