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Project:
Resources pilot centre for cross-border preservation of the aquatic biodiversity of Prut River MIS ETC 1150

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GA4: PRUT RIVER INVESTIGATION

HYDROCHEMICAL PARAMETERS

pH, dissolved oxygen, biochemical oxygen demand

According to the provisions of the *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*, the assessment of the chemical status of surface waters requires the monitoring of general (chemical and physico-chemical) parameters, nutrients and specific pollutants. For determination of general parameters, such as pH, content of dissolved oxygen (O_2) and biochemical oxygen demand (BOD_5), there were performed 57 analyses.

The values of **pH** in the given period of investigations varied between 7.95 and 8.28, what corresponded to the class of water quality I, according to the *Regulation on environment quality requirements for the surface waters* (2013) (Fig. 1). In spring time the values of pH deviated unsignificantly from the mean value – 8.18. A significant deviation was registered in June in the Lower Prut. At that time the water temperature was of 23-24°C, and it is assumed that the decrease of pH occured due to the intensification of decomposition of organic substances, the process being accompanied by the production of carbon dioxide.

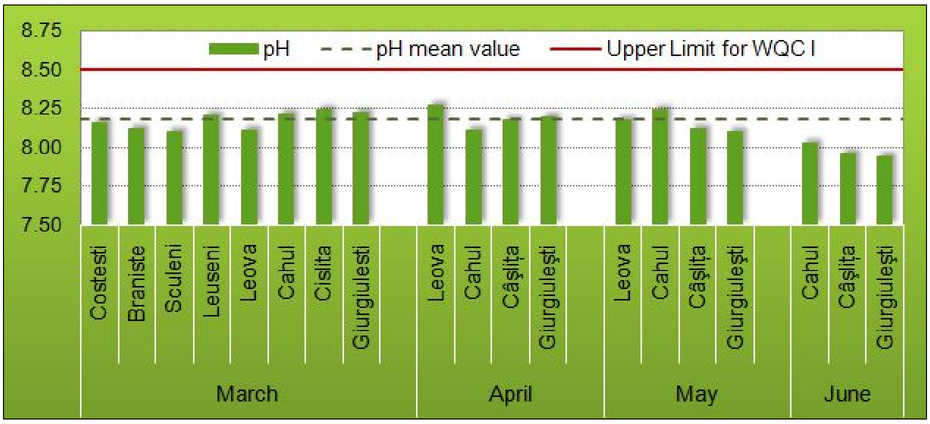


Fig. 1 Fluctuation of pH in the Prut River and Costesti-Stinca reservoir (2015)

The river regime of **dissolved oxygen** was satisfactory in March-April, when water temperature was not higher than 17°C. In that period, at all monitored stations, the level of water saturation with dissolved oxygen corresponded to the class of quality I (Fig. 2). The high level of oxygen saturation at Costesti (Costesti-Stinca lake) and Cislita-Prut stations might be caused by primary producers (Fig. 3).

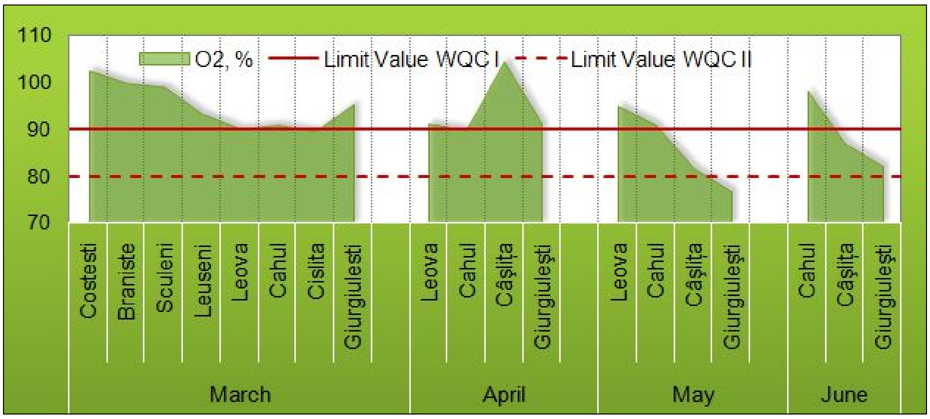


Fig. 2 Dynamics of water saturation with dissolved oxygen in the Prut River and

Costesti-Stinca reservoir (2015)

In May the water temperature in the lower sector of the Prut River reached 24°C. Significant decrease of saturation level with dissolved oxygen in this period, together with the decrease of pH values, clearly demonstrates the presence of substances (organic or unorganic) that consumed oxygen. Therefore, in the beginning of summer the water quality, according to the parameter „saturation with dissolved oxygen”, corresponded to the classes II and III (Fig. 2).

Fig. 3 Sampling station Cislita-Prut

Determination of the **biochemical oxygen demand** was conducted in the natural sample without filtration, decantation and water dilution. In such cases the result of the analysis is influenced, to a certain extent, by the presence of biological components (bacterioplankton, microphytoplankton and microzooplankton), which consume oxygen during sample incubation. According to the obtained results, the values of BOD_5 have varied during the given period of investigations from 1.2 to 2.6 mg/l O_2, what have indicated the class of water quality I (Fig. 4). In conformity to presented data, the highest values of BOD_5 were recorded in March and April at Cislita-Prut station. To remind that in April at this station also the content of dissolved oxygen was higher (Fig. 2). In our view, the correlation between these two parameters - BOD_5 and dissolved oxygen – confirms not only the presence in water samples of easily degradable chemical compounds, but also of primary producers.

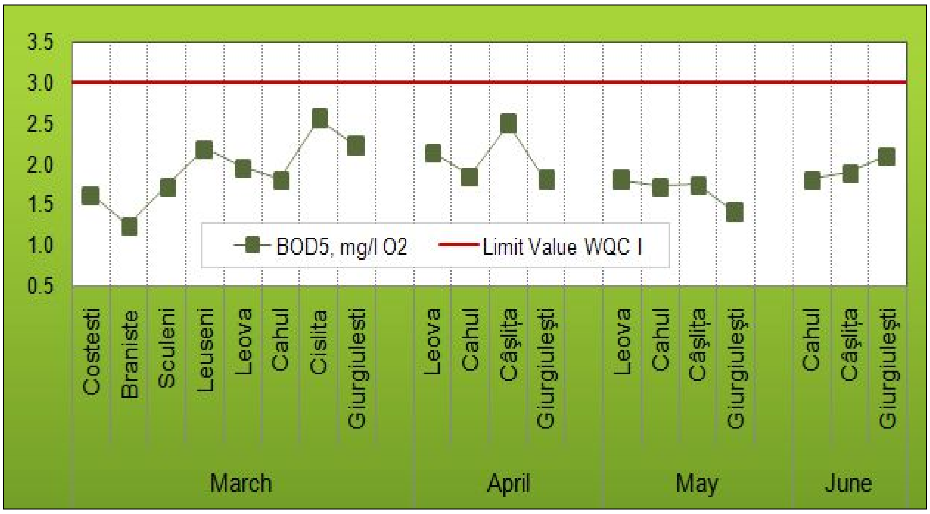


Fig. 4 Dynamics of biochemical oxygen demand (BOD_5) in the Prut River and Costesti-Stinca reservoir (2015)

The increase of temperature stimulates the development of bacterioplankton, and also intensifies the biochemical processes in water bodies. In order to explain the cause of BOD_5 decrease in May, when the water temperature was of 23 - 24°C, the correlation between the BOD_5 values and one of hydrological parameters, and namely the water level, in the Lower Prut was analysed (Fig. 5). According to the presented data, this correlation was a positive one. In this way, it was concluded that in the Lower Prut the fluctuations of BOD_5 were influenced, besides the water temperature and oxygen content, by the hydrological regime of the river, in general, and by the pluvial floods in the beginning of summer, in particular (Fig. 6).

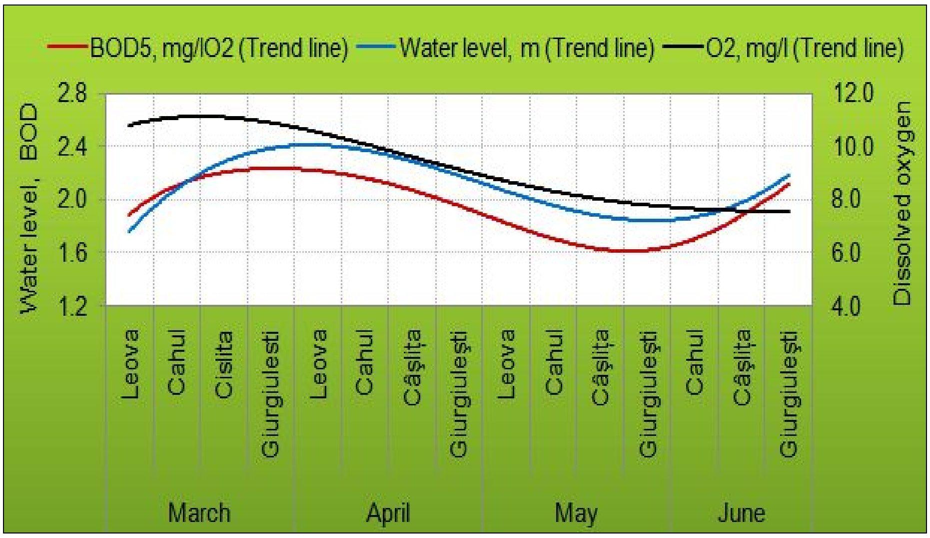


Fig. 5 Correlation between BOD_5 and dissolved oxygen in the Lower Prut (2015)

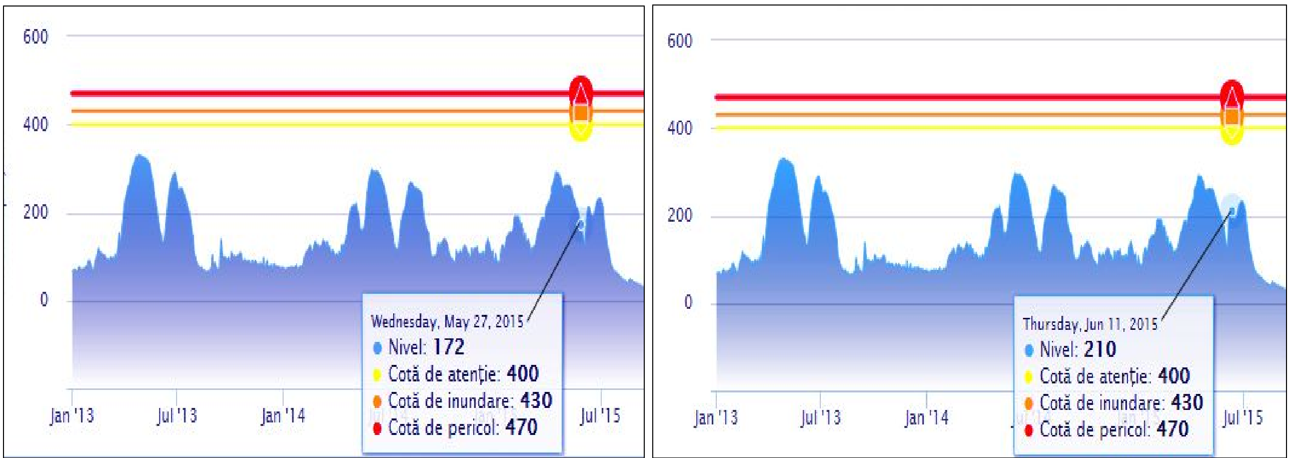


Fig. 6 Water level at hydrological station on Lower Prut in the day of water sampling, May and June 2015[1]

Suspended substances

It is evident the increase of the content of suspensions in the lower sector of the Prut River (Fig. 7).

[1] http://www.meteo.md/mold/grafice/nivelul.htm

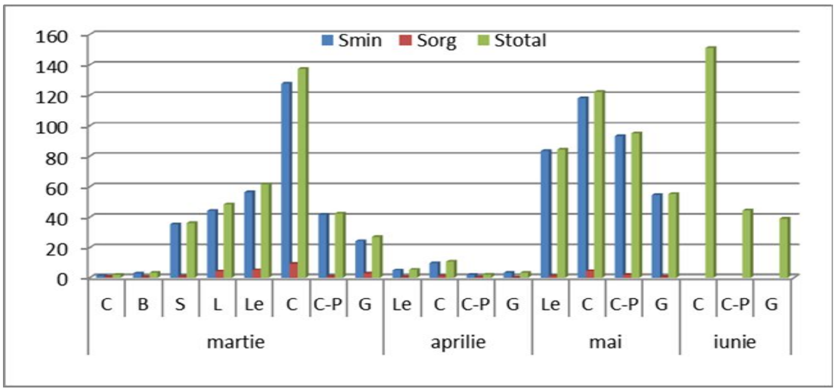


Fig. 7 Dynamics of mineral (Smin), organic (Sorg) and total (Stot) content of suspensions in the Prut River and Costesti-Stinca reservoir, mg/l (C-S – Costesti-Stinca, B – Braniste, S – Sculeni, L- Leuseni, Le-Leova, C – Cahul, C-P – Cislita- Prut and G – Giurgiulesti)

Main ions and mineralization

In the water of the Prut River the content of **hydrogen carbonate and carbonate ions** exceeded that of sulphate and chloride ions, because of this, in most of cases, the water belonged to the hydrogen carbonate class, group of calcium, type II (C^{Ca}_{II}), according to the classification of Aleokin O.A. (1970)

In Costesti-Stinca – Giurgiulesti sector the content of hydrogen carbonate and carbonate ions varied in March – June 2015 from 169.3 mg/l at Giurgiulesti (June) to 285.3 mg/l at Cahul (March). An obvious decrease of concentrations of hydrogen carbonate and carbonate ions at each sampling station from March to June was observed (Fig. 8). In March and April an increase of their content along the Prut River was recorded, but in May-June, opposite, a decrease of their concentrations.

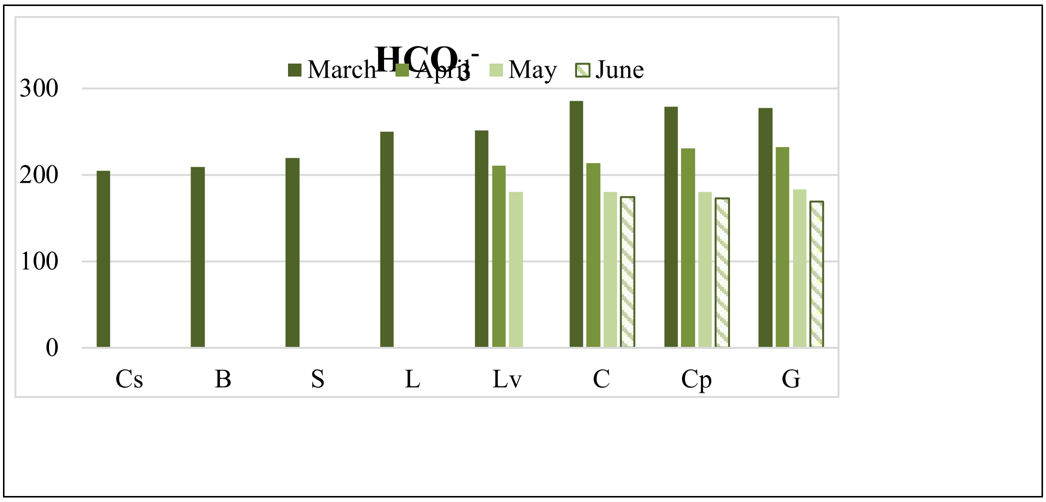


Fig. 8 Hydrogen carbonate ions in the Prut River, 2015, mg/l (Cs - Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Lv - Leova, C - Cahul, Cp - Cislita-Prut, G – Giurgiulesti)

In the studied area of the Prut River only in March and April an evident increase of the content of **sulphate ions** was registered. In the next period of investigations (May-June) this tendency was not observed. The lowest concentrations of sulphates occurred in June, when they ranged 55.1 (Giurgiulesti) – 61.7 (Cahul) mg/l, and the highest concentrations – in March, when they ranged 74.5 (Costesti-Stinca) – 198.3 (Cislita-Prut) mg/l (Fig. 9).

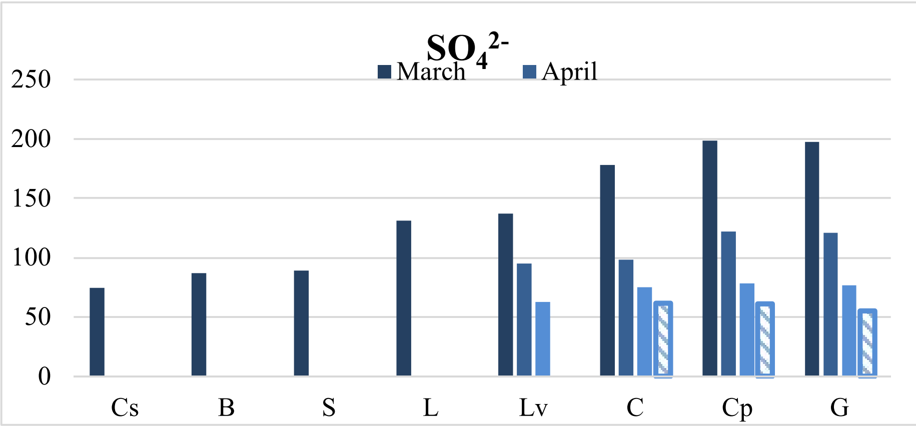


Fig. 9 Sulphate ions in the Prut River, 2015, mg/l (Cs - Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Lv - Leova, C - Cahul, Cp - Cislita-Prut, G – Giurgiulesti)

According to the *Regulation on environment quality requirements for the surface waters* (2013), the waters of the Prut River in March – June 2015, in conformity to the content of sulphate ions, in 63.16 % of cases indicated the class of water quality I, in 21.05% of cases – class II, and in 15.79% of cases – class III.

The content of **chloride ions** in the river waters, in the given period of investigations, in 78.95% of cases not exceeded 40.0 mg/l, excepting that from March on Leova-Giurgiulesti sector, when its value went up to la 48.5 mg/l (Fig. 10). Thus, the waters of the Prut River, according to the content of chlorides, were of “very good” (class I) and “good” (class II) quality.

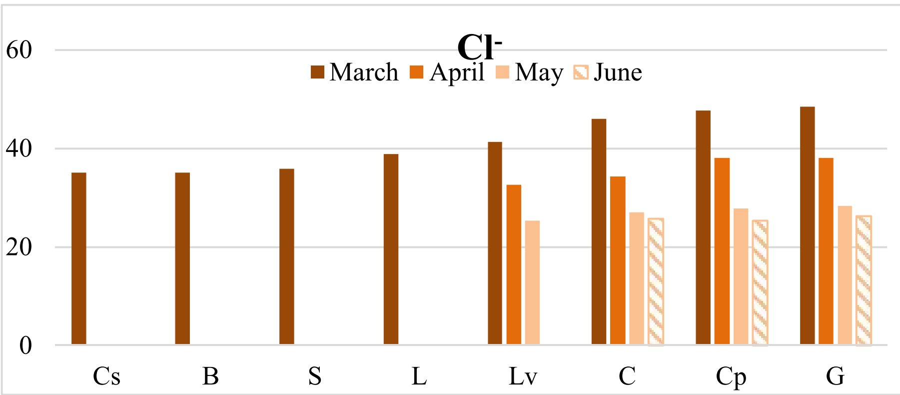


Fig. 10 Chloride ions in the Prut River, 2015, mg/l (Cs - Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Lv - Leova, C - Cahul, Cp - Cislita-Prut, G – Giurgiulesti)

The **water hardness** in the Prut River in March – June 2015 oscillated from 3.60 mg*echiv/l (Giurgiulesti, April) to 6.60 mg*echiv/l (Giurgiulesti, March). Such level of hardness allows usage of water for drinking purposes (Fig. 11).

In conformity to the *Regulation on environment quality requirements for the surface waters* (2013), from March to June 2015 the Prut River waters, in accordance with their hardness, in 36.84% of cases referred to the class of quality I, in 47.37% of cases – to class of quality II, and in the others 15.79% of cases – to the class of quality III.

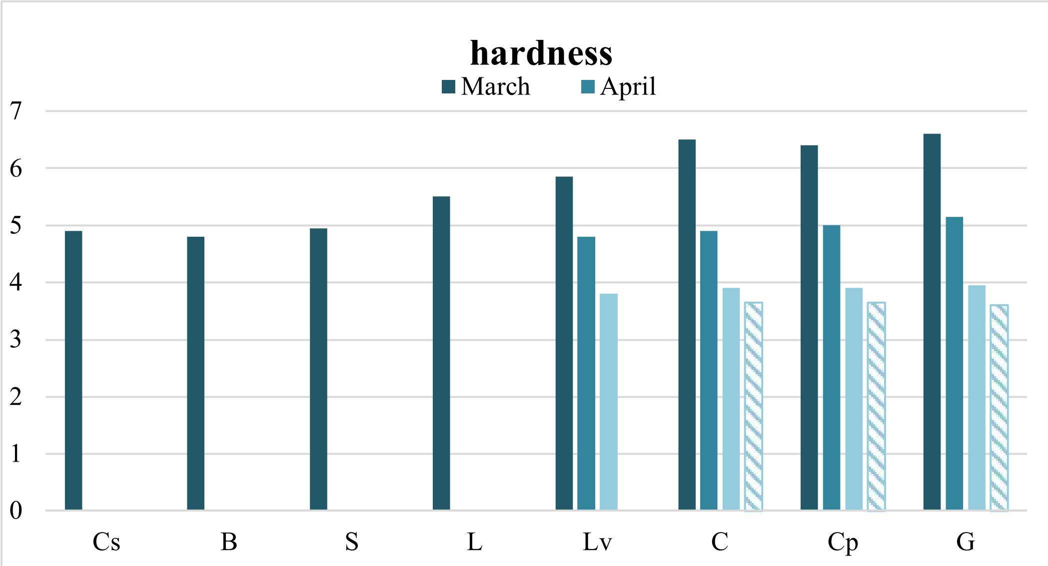


Fig. 11 Prut River water hardness, 2015, mg*echiv/l (Cs - Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Lv - Leova, C - Cahul, Cp - Cislita-Prut, G – Giurgiulesti)

Concentration of **calcium ions** along the Prut River, from Costesti-Stinca to Giurgiulesti, in the same period of time varied in a narrow diapason, for example, in March 2015 it oscillated from 69.1 mg/l (Braniste) to 75.2 mg/l (Giurgiulesti). But sometimes the decrease of calcium concentration from Leova to Giurgiulesti is observed. As example, in May 2015 the concentration of calcium ions at Leova station was of 55.1 mg/l, but at Giurgiulesti one – 52.1 mg/l. This phenomenon might be explained via the influence of the Danube waters, which soft waters penetrate into the Prut, when the water level of the second is low. From March to June 2015 the highest concentration of calcium ions (75.2 mg/l) was recorded in March at Giurgiulesti station.

The content of **magnesium ions** increased along the course of the Prut River in March-June 2015. The lowest concentrations of magnesium ions, which fit to diapason 12.2 -13.4 mg/l, were observed in the first month of the summer 2015.

According to the *Regulation on environment quality requirements for the surface waters* (2013), the content of magnesium in water of the Prut River indicated the class of water quality I.

The concentration of **sodium and potassium** in the Prut River, from Costesti-Stinca to Giurgiulesti stations, oscillated in March from 24.8 (la Costesti-Stinca) to 91.5 mg/l (la Cislita-Prut). These cations are not dominant in the Prut River, but sometimes, as in March 2015 at Cislita-Prut station, they increase suddenly and provoke the change of dominant cation. Probably, this phenomenon is linked with the penetration of household and industrial waste waters into the river, and runoff both from agricultural lands and urban territories.

Taking in account the content of sodium and potassium ions, the waters of the Lower Prut (Gotesti-Giurgiulesti) in 57.89% of cases referred to the class of quality I, in 5.26% of cases – to class II, in 21.05% of cases – to class III, and in the others 15.80% - to class IV.

The waters of the Prut River belonged to the grup of calcium, as namely this cation was the dominant one.

The highest values of **mineralisation** were recorded in March, but the lowest – in June (Fig. 12). In spring months the content of main ions increased suddenly in Leuseni-Giurgiulesti sector, which can be linked with the pollution of the river by urban waste waters. It is worth to mention that the concentration of sulphate, chloride, sodium and potassium ions also were the highest in this part of the river.

In conformity to the *Regulation on environment quality requirements for the surface waters* (2013), the Prut water in March-June 2015, taking in account their mineralisation, in most of cases (63.16%) were of a „very good" quality and in all the others – of „good" quality.

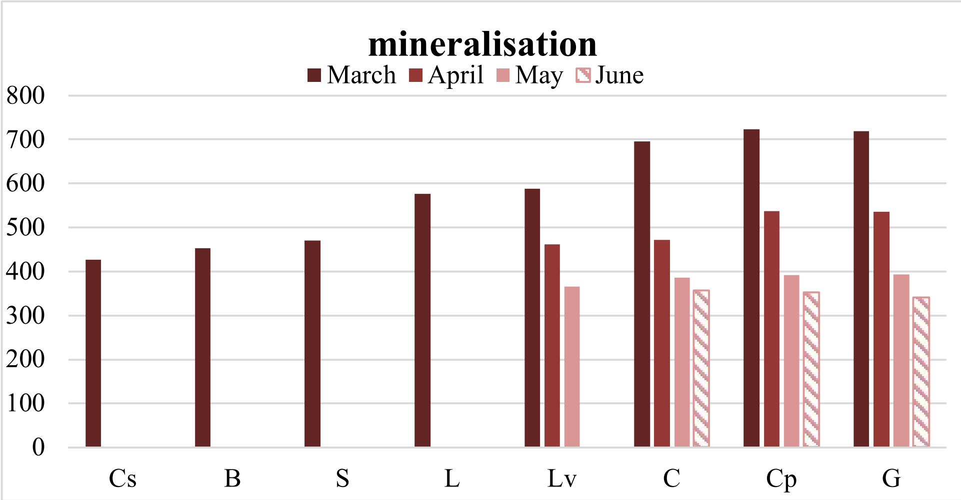


Fig. 12 Mineralisation of the Prut River waters, 2015, mg/l (Cs - Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Lv - Leova, C - Cahul, Cp - Cislita-Prut, G – Giurgiulesti

According to the classification of Aleokin O.A. (1970), only in March 2015 the Prut waters at Cislita-Prut station belonged to the hydrogen carbonate class, group of sodium, type II (C^{Na}_{II}), but in all other cases – to the hydrogen carbonate class, group of calcium, type II (C^{Ca}_{II}), and met the quality requirements for drinking water.

Biogenic elements

Nitrogen compounds. The content of **ammonium ions** in March-June 2015 showed a gradual modification of water quality from the class I to the class IV of quality (Fig. 13). In the lower sector of the Prut River the increase of the content of ammonium ions started in April and lasted till June. The highest value was registered in June 2015 at Cahul station – 1.08 mgN/l.

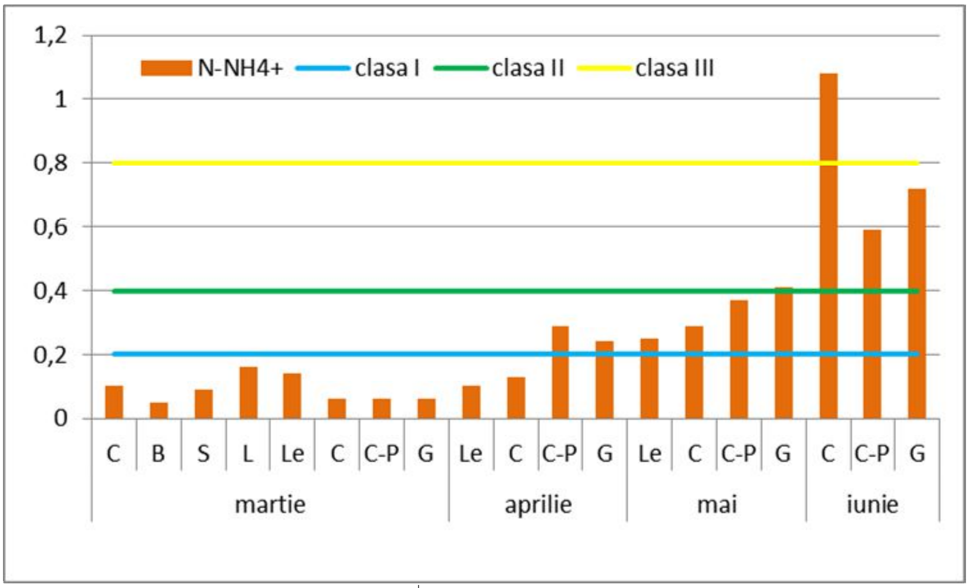


Fig. 13 Dynamics of ammonium nitrogen ($N\text{-}NH_4^+$) in the Prut River waters, 2015, mgN/l (C - Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Le - Leova, C - Cahul, C-P - Cislita-Prut, G – Giurgiulesti)

The content of **nitrite ions** ($N\text{-}NO_2^-$) registered a dynamics similar to that of ammonium ions (Fig. 14). In March and April there were recorded the lowest concentrations of nitrites in water. Their increase along the river course started in May, this peculiarity being maintained also in June, because of this in May and June the content of nitrites indicated the class of water quality II.

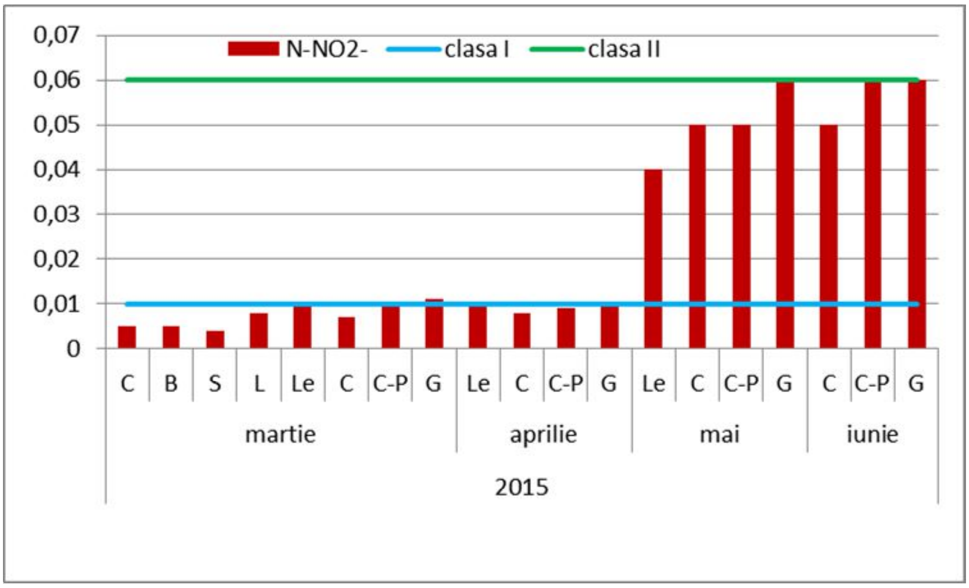


Fig. 14 Dynamics of nitrite nitrogen (N-NO_2^-) in the Prut River waters, 2015, mgN/l (C - Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Le - Leova, C - Cahul, C-P - Cislita-Prut, G – Giurgiulesti)

The analysis of the content of **nitrate nitrogen** in March 2015 put in evidence its lower values in Costesti-Stinca (lower part) – Braniste - Sculeni sector in comparison with Lower Prut (Fig. 15). In general, in the given period of investigations, the highest values of nitrate nitrogen were found in April 2015, at Leuseni and Cahul stations.

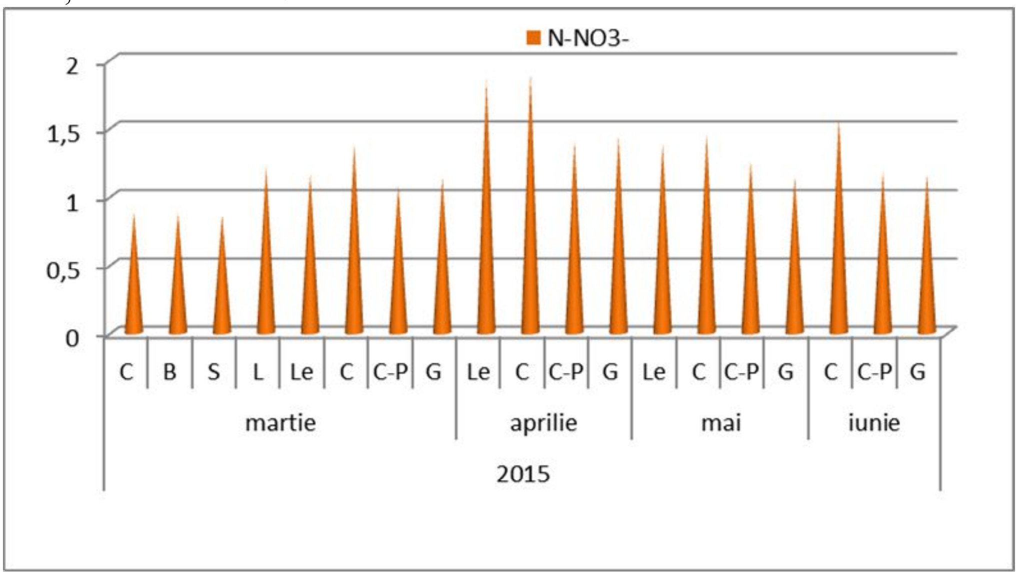


Fig. 15 Dynamics of nitrate nitrogen (N-NO_3^-) in the Prut River waters, 2015, mgN/l (C - Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Le - Leova, C - Cahul, C-P - Cislita-Prut, G – Giurgiulesti)

Phosphorus compounds. In March and April 2015 the content of mineral phosphorus on the entire course of the river was at detection limit of 0.003 mg/l. In May 2015 in the lower part of the river it registered a content of 0.13 mg/l, maintaining this value also in June, which corresponded to the class of water quality III („moderately polluted").

The dynamics of total phosphorus referred the Prut waters to the class of quality I in March and April, to class II in May, and to class III in June. The Fig. 16 presents the ratio between the mineral and organic forms of phosphorus. The ratio had the following form: in March and April - Pmin < Porg, in May - Pmin > Porg, and in June - 1:1.

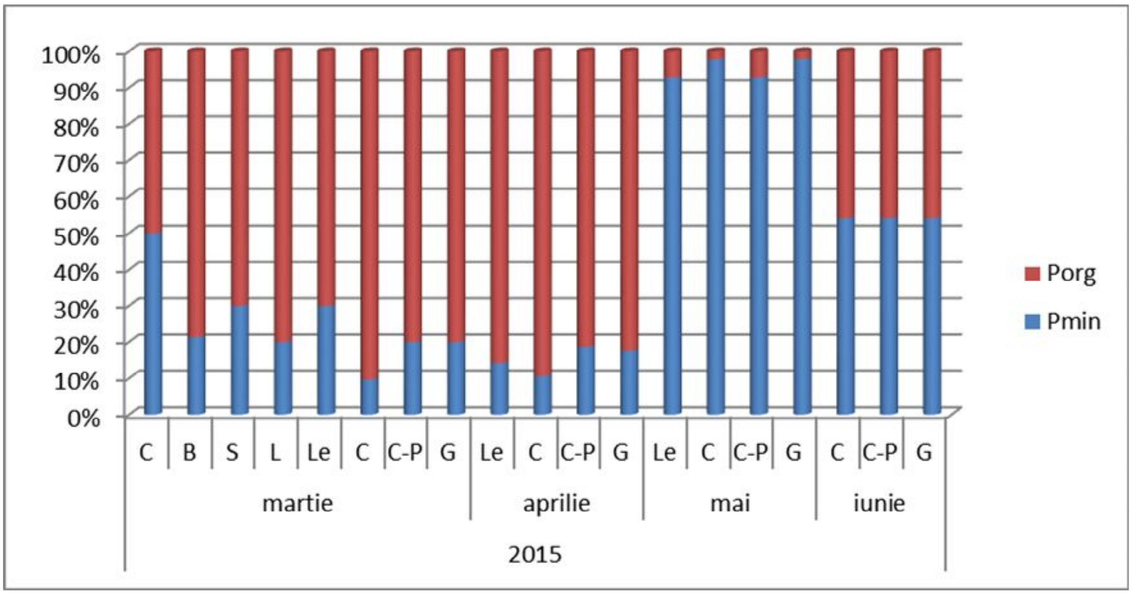


Fig. 16 Ratio between the mineral (Pmin) and organic (Porg) forms of phosphorus in the Prut River waters, 2015 (C - Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Le - Leova, C - Cahul, C-P - Cislita-Prut, G – Giurgiulesti)

In the dynamics of **silicon** it was observed that its content started to increase with the beginning of vegetation period, in April. Later, in May and June this biogenic element reached about a three time higher contents than in March (Fig. 17).

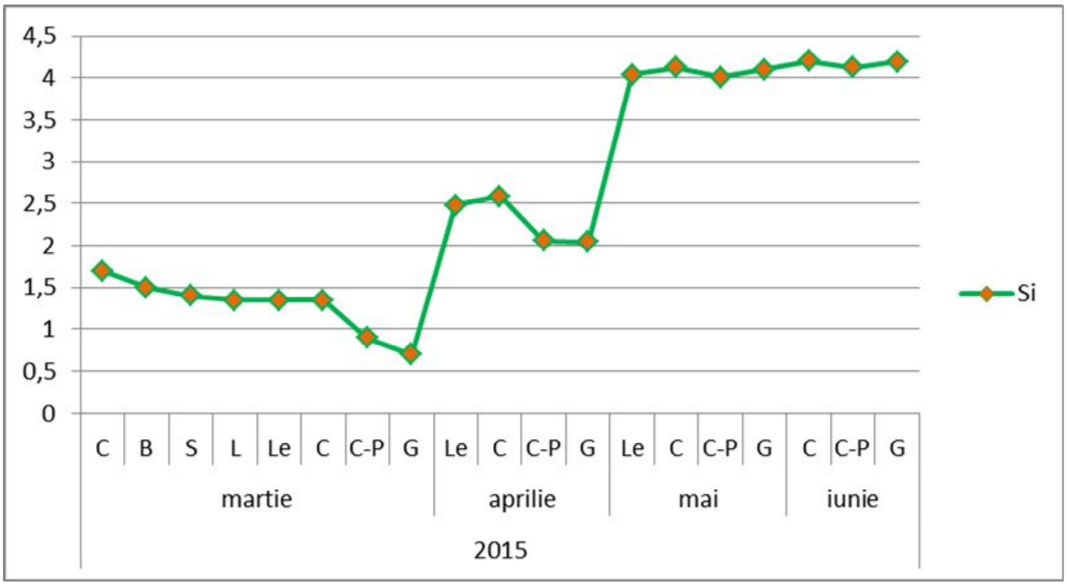


Fig. 17 Dynamics of silicon in the Prut River waters, 2015, mg/l (C- Costesti-Stinca, B - Braniste, S - Sculeni, L - Leuseni, Le - Leova, C - Cahul, C-P - Cislita-Prut, G – Giurgiulesti)

HYDROBIOLOGICAL PARAMETERS

Bacterioplankton

The obtained results put in evidence a large diapason of variation of both the density of total bacterioplankton and saprophytic bacteria from March 2015 to June 2015 in the Prut River. The most loaded with planktonic bacteria is the Leova-Giurgiulesti river sector (Fig.18). For example, in May the total number of planktonic microflora (Ntot) reached 8.3 million cells/ml, and the number of saprophytic bacteria – 7 thousand cells/ml at Leova station.

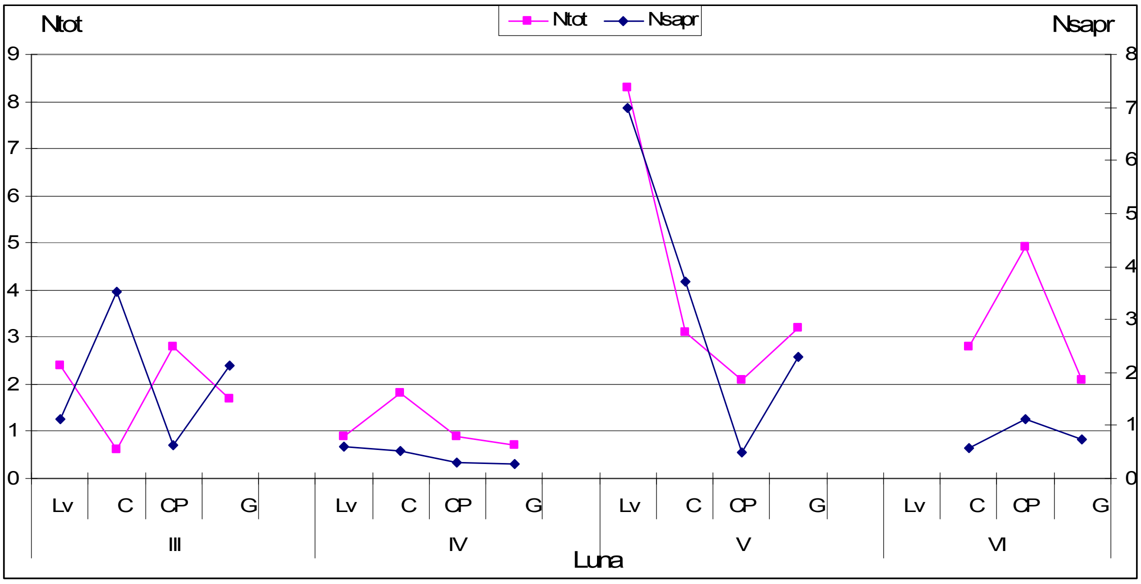


Fig. 18 Dynamics of total number of planktonic bacteria (Ntot, million cells/ml) and number of saprophytic bacteria (Nsapr, thousand cells/ml) in the Prut River, March - June 2015 (Lv - Leova, C - Cahul, CP - Cislita-Prut, G – Giurgiulesti)

Also a high intensity of physiological activity of bacterioplankton was observed at these stations in warm months (May - June) (Fig. 19).

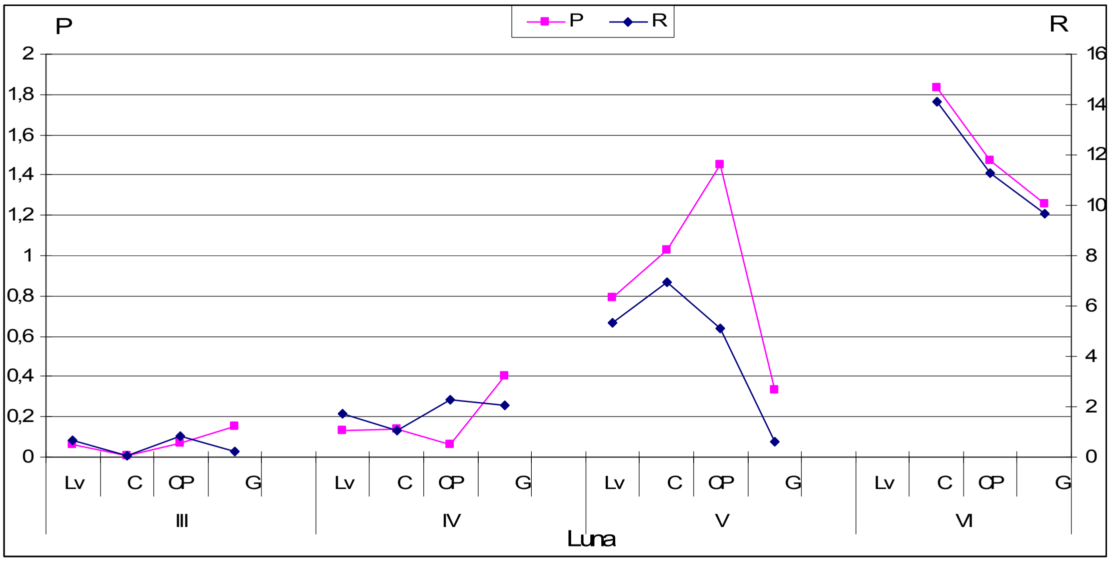


Fig. 19 Monthly dynamics of bacterioplankton production (P, cal/l in 24 hours) and destruction (R, cal/l in 24 hours) in the Prut River, March – June 2015 (Lv - Leova, C - Cahul, CP - Cislita-Prut, G – Giurgiulesti)

The monthly numerical dynamics of functional bacterioplankton is presented in Tab. 1. It was determined that among physiological groups of baterioplankton the most numerous was that of ammonifying bacteria – 1.724 thousand cells/ml, which indicated the presence of an increased content of easily accessible organic matter in the Prut water.

Table 1 Density of ecophysiological groups of microorganisms (thousand cells/ml) in the Prut River, March – June 2015

Station	Month	1*	2	3	4	5	6	7	8
Leova		1	0.17	0.1	0.23	1.5	0.41	0.164	0.255
Cahul		3.5	0.34	0.06	0.05	0.61	2.2	0.069	0.29
Cislita-Prut	III	0.8	0.011	0.4	0.11	0.38	0.85	0.077	0.148

Giurgiulesti		2.25	0.012	0.41	0.02	0.73	0.92	0.085	0.174
Leova		0.7	0.27	0.6	0.55	0.4	0.2	0.038	0.116
Cahul		0.2	0.045	0.45	0.5	0.1	0.25	0.06	0.067
Cislita-Prut		0.3	0.1	0.66	0.45	0.3	0.02	0.116	0.131
Giurgiulesti	IV	0.31	0.04	0.55	0.41	0.55	0.01	0.128	0.158
Leova		5	3	0.6	0.79	0.8	0.22	0.093	0.263
Cahul		3.2	0.7	0.6	0.9	1	0.22	0.05	0.29
Cislita-Prut		3.9	0.1	0.41	0.3	0.3	0.38	0.075	0.268
Giurgiulesti	V	2	0.05	0.59	0.37	1.3	0.45	0.071	0.222
Cahul		0.6	0.05	0.7	1	0.5	0.1	0.17	0.191
Cislita-Prut		1.2	0.08	0.83	0.4	0.8	0.35	0.128	0.131
Giurgiulesti	VI	0.9	0.15	0.65	0.48	0.45	0.25	0.13	0.219

* groups of microorganisms: 1- ammonifying bacteria, 2 – denitrifying bacteria, 3 – phosphate solubilizing bacteria,4 – phosphate mineralizing bacteria, 5 – amylolytic bacteria, 6 – cellulosolytic bacteria, 7- phenolytic bacteria, 8 - petrolytic bacteria**.**

Phytoplankton

During 08.03.2015 – 07.07.2015 there were collected 38 samples of phytoplankton from Costesti-Stinca reservoir and the Prut River, stations: Costesti, Braniste, Sculeni, Leuseni, Leova, Cahul, Cislita-Prut and Giurgiulesti. At each station the water transparency and temperature were measured, and experiments on assessment of phytoplankton primary production and destruction of organic compounds were carried out (8 experiments).

From March to June 2015 the phytoplankton of the Prut River was represented by 57 species and intraspecies taxa of algae, of which: *Cyanophyta* - 5, *Bacillariophyta* - 32, *Chlorophyta* - 14, *Euglenophyta* - 5, *Chrysophyta* - 1. The bacillariofite and green algae dominated the componence of phytoplankton.

In March – April 2015 the phytoplankton registered a density of 2.16 million cells/l in Costesti-Stinca reservoir and ranged 0.92-7.69 million cells/l in the Prut River (Fig. 20). The enough high for spring time the values of phytoplankton density were conditioned by the development of species *Oscillatoria planctonica* Wolosz., *Aphanizomenon flos-aquae* (L.) Ralfs in March and of species *Synechocystis aquatilis* Sanv. at Cislita-Prut station in April. In May and June 2015 the values of phytoplankton density were much lower, oscillating in the lower sector of the river in the diapason 0.62-1.36 million cells/l (Fig. 20).

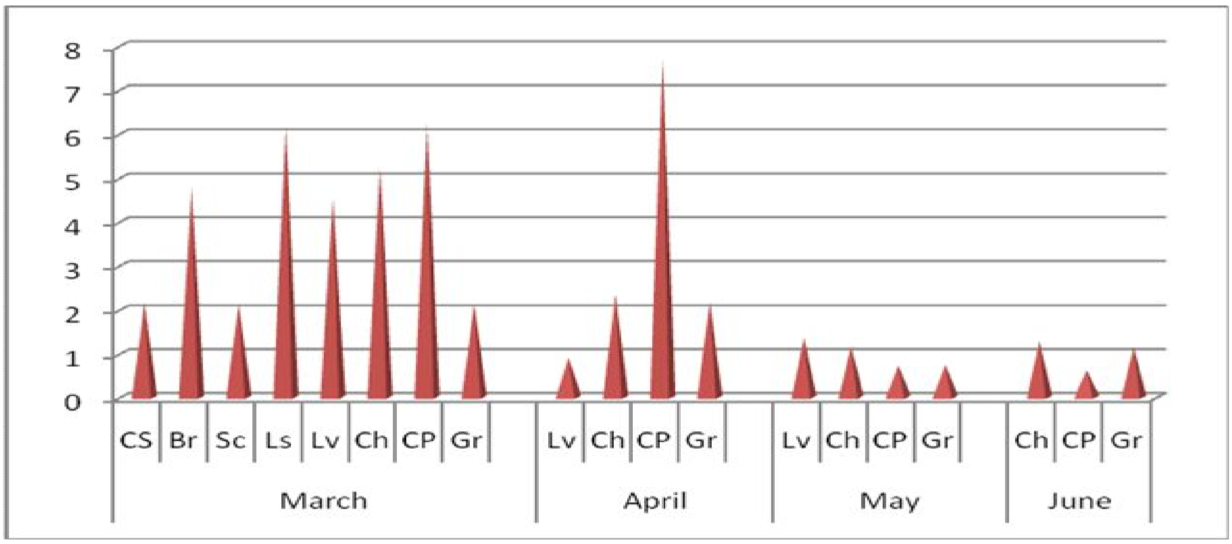


Fig. 20 Density (million cells/l) of phytoplankton in the lower part of Costesti-Stinca reservoir (CS) and the Prut River, March – June 2015 (Br- Braniste, Sc-Sculeni, Ls-Leuseni, Lv- Leova, Ch-Cahul, CP-Cislita-Prut, Gr-Giurgiulesti)

In March the phytoplankton biomass was very low in Costesti-Stinca reservoir (0.65 g/m^3) and downstream it, at Braniste station (0.97 g/m^3), and higher from Sculeni to Giurgiulesti stations, with variations from 2.97 to 6.43 g/m^3 (Fig. 21).

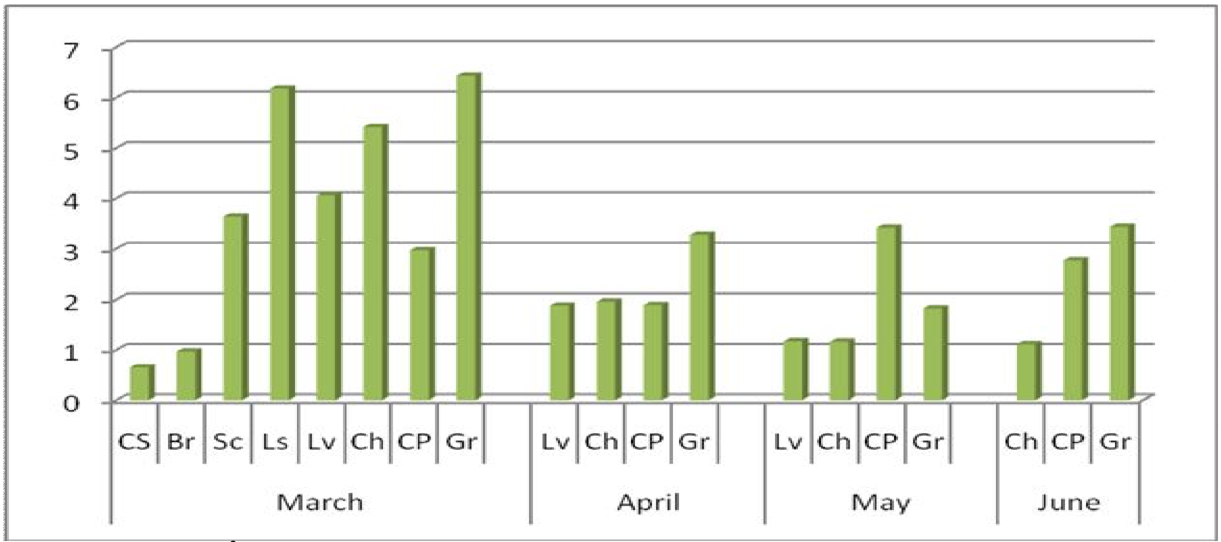


Fig. 21 Biomass (g/m^3) of phytoplankton in the lower part of Costesti-Stinca reservoir (CS) and the Prut River, March – June 2015 (Br- Braniste, Sc-Sculeni, Ls-Leuseni, Lv- Leova, Ch-Cahul, CP-Cislita-Prut, Gr-Giurgiulesti)

In March, although the phytoplankton density consisted mainly of blue algae, the bacillariofite algae of large size from *Synedra, Navicula, Nitzschia* and other genera contributed to the formation of phytoplankton biomass.

In April-June the phytoplankton biomass diminished considerably and ranged 1.11-3.44 g/m^3, the species of planktonic algae being present in smaller quantities.

In April-May 2015 the values of primary production in the lower sector of the Prut River were placed in the diapason 0.2- 2.69 gO_2/m^{-2} 24h, the highest values being recorded at Cislita-Prut station in April and Leova station in May, and the lowest – at Cahul, Cislita-Prut and Giurgiulesti stations in May (Fig. 22).

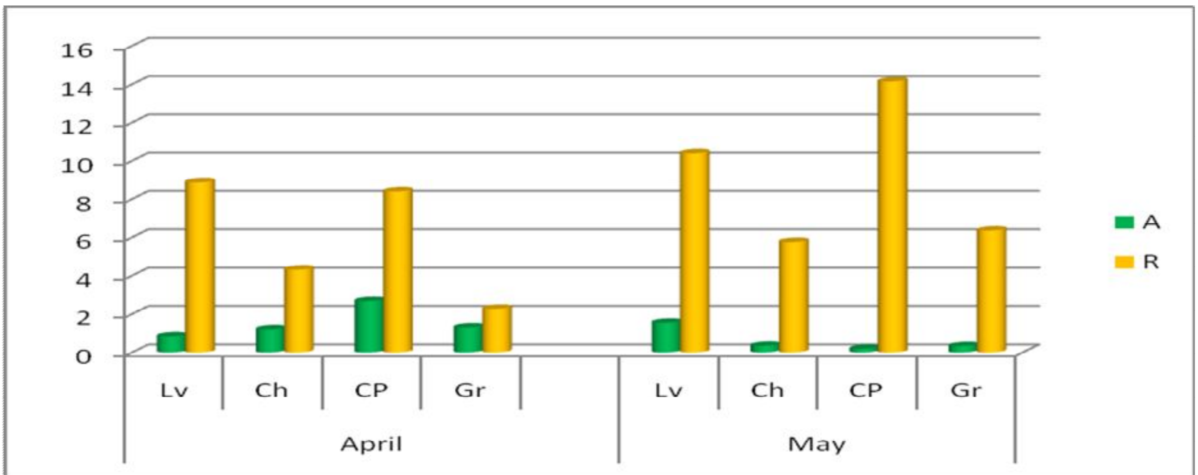


Fig. 22 Dynamics of primary production of phytoplankton (A - gO^2/m^{-2} 24h) and destruction of organic substances (R- gO^2/m^{-2} 24h) in the Prut River, April - May 2015 (Lv- Leova, Ch-Cahul, CP-Cislita-Prut, Gr-Giurgiulesti)

From the point of view of vertical distribution of phytoplankton in the Prut River, the highest values of its production were recorded in superficial horizons of the river. With the increase of the depth, the intensity of photosynthesis decreases, due to the reduction of water transparency and increase oft turbidity.

The values of destruction of organic substances ranged 2.28-14.16 gO_2/m^{-2} 24h, being higher at Leova and Cislita-Prut stations. In the lower sector of the Prut River the intensity of destruction processes exceeded by far that of production processes, thus, the ratio A/R recorded values less than 1. According to the values of self-cleaning index A/R, the Prut waters in April 2015 referred to the classes of quality III and IV, excepting at Leova station (class V), but in May 2015 – to the class of quality V at all monitored stations (Fig. 23).

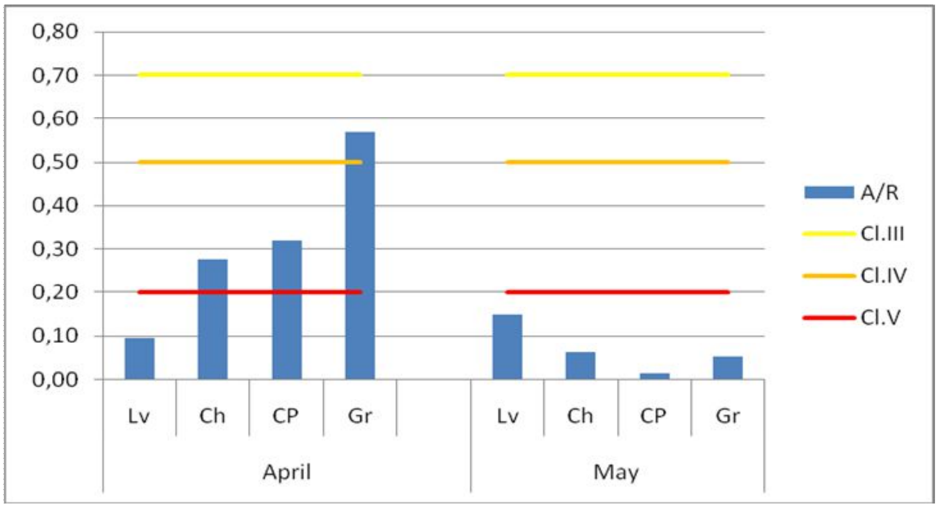


Fig. 23 Dynamics of A/R ratio in the lower sector of the Prut River, April – May 2015 (Lv- Leova, Ch-Cahul, CP-Cislita-Prut, Gr-Giurgiulesti)

From March to June 2015 the values of saprobic index, calculated on the ground of quantitative parameters of planktonic algae, ranged 1.36-2.36 (Fig. 24). In conformity to these figures, in most of cases the quality of the Prut waters fit to classes II ("good") and III ("moderately polluted"), and only in March at Braniste and Leuseni stations it fit to class I ("very good").

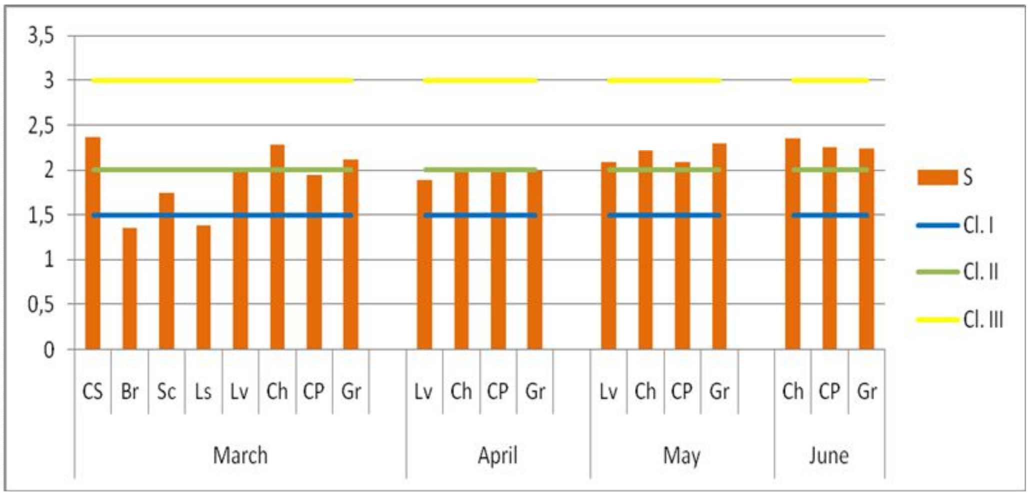


Fig. 24 Values of saprobic index (S) in the lower sector of Costesti-Stinca reservoir (CS) and the Prut River according to indicator species of phytoplankton, March – June 2015 (Br- Braniste, Sc-Sculeni, Ls-Leuseni, Lv- Leova, Ch-Cahul, CP-Cislita-Prut, Gr-Giurgiulesti)

Zooplankton

From 8th March to 7th July 2015 there were collected 19 quantitative samples of zooplankton from the Prut River and Costesti-Stinca reservoir, as following: Costesti – 1, Braniste – 1, Sculeni – 1, Leuseni – 1, Leova – 3, Cahul – 4, Cislita-Prut – 4 and Giurgiulesti – 4.

31 taxa from the main groups of zooplankton were identified in collected materials: 17 – rotifers (54.8 %), 13 – copepods (42 %) and 1 – cladocerans (3.2 %)

In order to analyse the zooplanktonic communities from structural and functional point of view, a range of quantitative parameters and biocenotic indices were calculated: density (N, ind./m^3), biomass (B, mg/m^3), productivity (P, mg/m^3/24 h), abundance (A, %), and saprobic index (I_S).

The spatial and temporal dynamics of the structure of zooplankton communities at monitored stations is given in Fig. 25. According to obtained data, from point of view of biomass, the copepods are the dominant group.

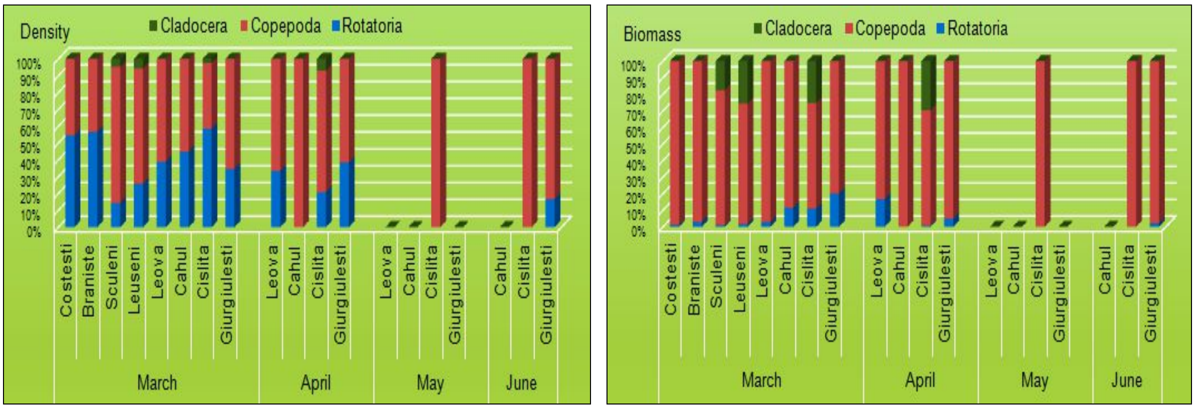


Fig. 25 The share (%) of main groups of zooplankton in the formation of its density and biomass in the lower sector of Costesti-Stinca reservoir and the Prut River, March-June 2015

From point of view of density, the rotifers dominated at many stations in the beginning of spring (March) (Fig. 26). This is a common phenomenon for this group of zooplankton, which abundant development in our region starts in early spring.

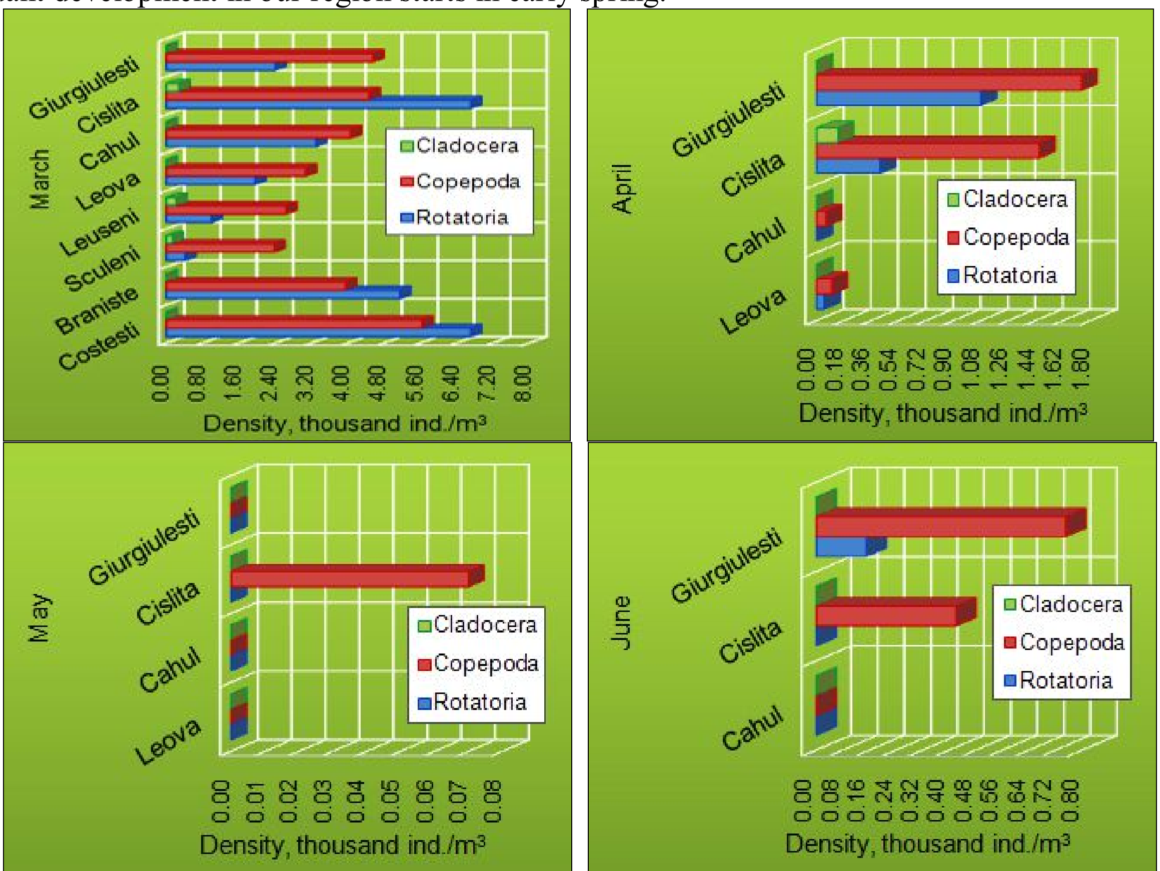


Fig. 26 Density (thousand ind./m^3) of main taxonomic groups of zooplankton in the Prut River and Costesti-Stinca reservoir

The species richness is an important parameter in the assessment of monitored ecosystems. According to obtained data, it was concluded that the diversity of zooplankton in the given period of investigations was one quite typical for the ecosystem of the Prut River from the last years, but it should be taken in account that this parameter is influenced by the number of collected samples (Fig. 27).

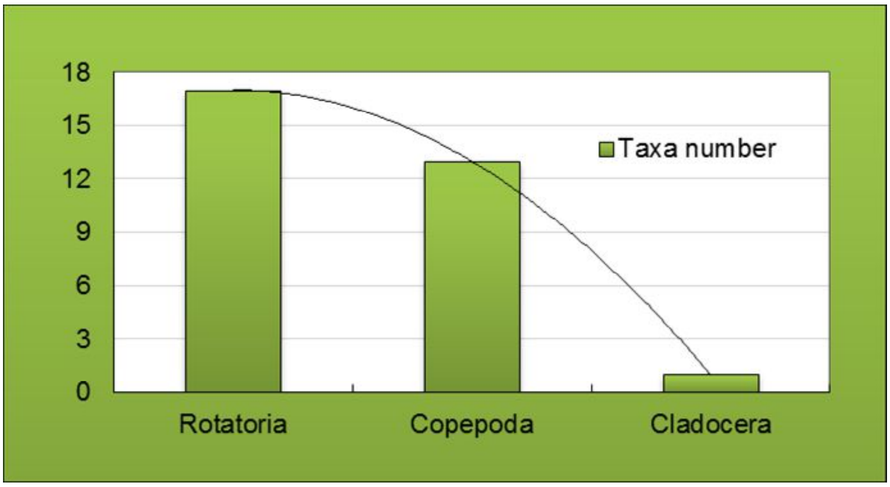
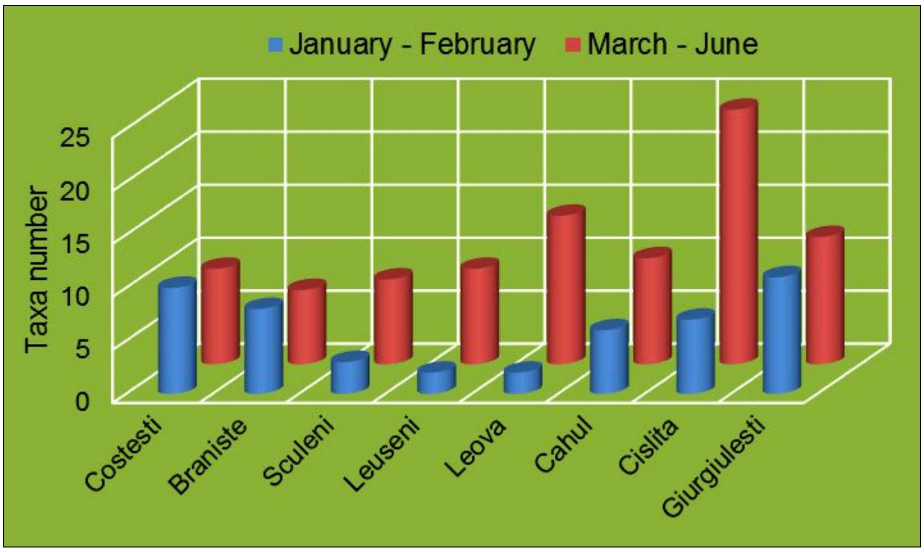


Fig. 27 The number of taxa from the main groups of zooplankton in the Prut River and Costesti-Stinca reservoir (March - June 2015)

All identified taxa of rotifers are accidental forms (F < 25 %), of which more constant were the species from *Brachionus* genera. The juvenile forms of copepods (st. *nauplius* and st. *copepodit*) are constant elements (F = > 50 %) of zooplankton in middle and lower parts of the Prut River. This situation is a common one for rivers with an increased content of suspended substances[2]. The others representatives of *Copepoda* (10 taxa) are accidental forms. Domination of accidental elements is quite typical for fluvial zooplankton communities (Zinevic, Parpală, 2007). The group of *Cladocera* is the less represented in fluvial zone of the Prut River – it consisted of only one species (*Chydorus sphaericus)*.

The Fig. 28 shows the distribution of taxa number along the course of the Prut River in winter season and spring - beginning of summer. According to these data, the species diversity of zooplankton at Costesti, Braniste and Giurgiulesti stations is enough constant. In Sculeni – Cislita-Prut sector the taxa number varied significantly, because of river hydrological conditions in spring months.



[2] http://www.icpdr.org/main/activities-projects/joint-danube-survey-1.

Fig. 28 The number of zooplankton taxa in the Prut River and Costesti-Stinca reservoir in two hydrological seasons of 2015: January – February and March - June

More than 70% of identified taxa (22 species) are indicator organisms. Their classification according to zones of saprobity is given in Fig. 29.

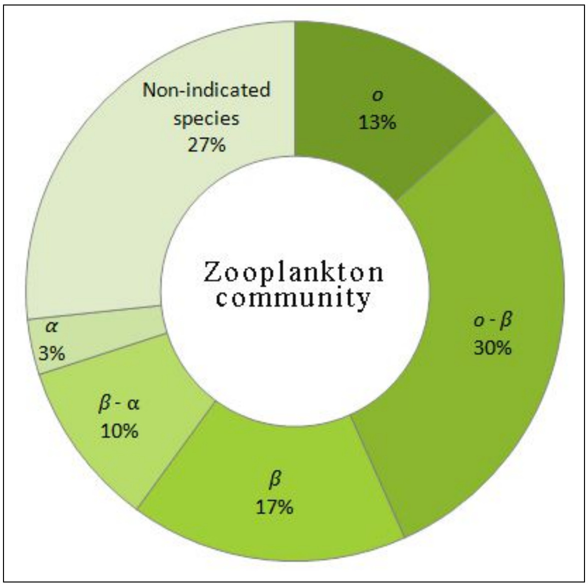


Fig. 29 Distribution of zooplankton indicator species according to zones of saprobity, the Prut River and Costesti-Stinca reservoir, March – June 2015

It conclusion, the indicator species of zooplankton showed a large spectrum of zones of saprobity – from *α*-mesosaprobe to *oligo*-mesosaprobe, and the most of species were representatives of *oligo*-*β*-mesosaprobe zone. As the instant samples of zooplankton are not representative for a reliable calculation of the index of saprobity in streams, the obtained data may be used only in addition with other chemical and biological quality elements.

Macrozoobenthos

There have been collected and analysed more than 30 samples of benthic macroinvertebrates from the Prut River during March – July 2015, stations: Costesti-Stinca, Braniste, Sculeni, Leuseni, Leova, Cahul, Cislita-Prut, and Giurgiulesti. All samples from Costesti-Stinca and one sample from Cislita-Prut, when the water level was high, were collected by dredge.

The highest value of density was registered in March at Braniste station - 10190 ind./m^2 of zoobenthos without mollusks and total zoobenthos, the significant part of this value consisted of *Tubifex sp.div* - 9120 ind/m^2 (Fig. 30)

The highest value of total biomass was registered in May at Giurgiulesti station - 1040.564 g/m^2, of which 1039.4 g/m^2 (99.9%) were formed by *Unio pictorum* (Linnaeus, 1758). It is worth to stress that this is a very rare case when *U. pictorum* was recorded at Giurgiulesti station (Fig. 32).

The lowest value of macrozoobenthos density was recorded in March at Costesti-Stinca station - 39 ind./m^2 (Fig. 30-31).

The lowest value of total biomass was found at Cahul station – 0.404 g/m^2 and of total biomass without mollusks - at Giurgiulesti station – 0.16 g/m^2 (Fig. 32-33).

In March, among sampling stations, the highest biodiversity was identified at Braniste station - 30 invertebrate taxa. The lowest level of biodiversity was registered at Giurgiulesti station - only 4 species (Fig. 34).

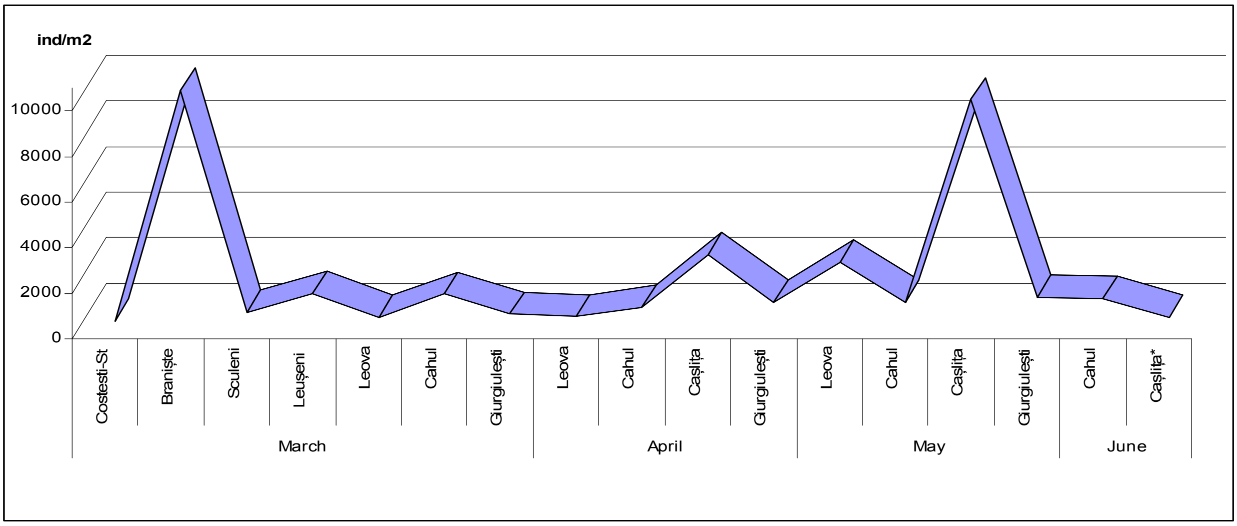


Fig. 30 Density (ind./m^2) of total zoobenthos in the Prut River, March– June 2015

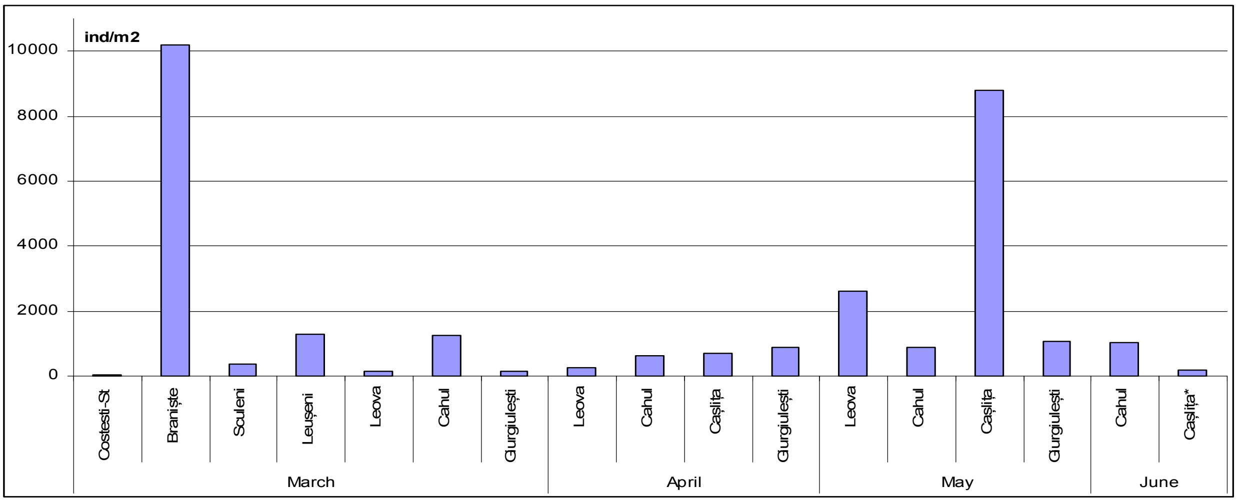


Fig. 31 Density (ind./m^2) of zoobenthos without mollusks in the Prut River, March –June 2015
* dredge sample

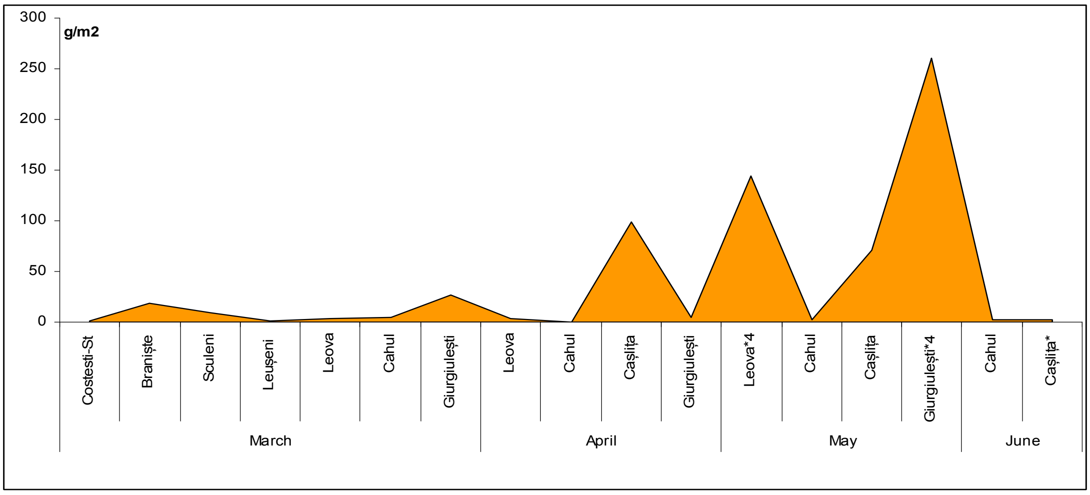


Fig. 32 Biomass (g/m^2) of total zoobenthos in the Prut River, March –June 2015

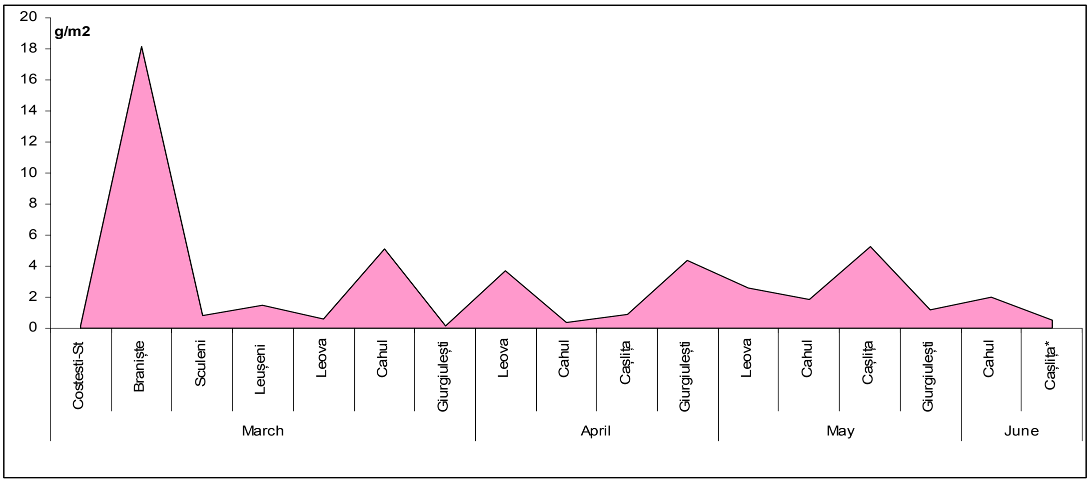


Fig. 33 Biomass (g/m^2) of zoobenthos without molluscs in the Prut River, March –June 2015

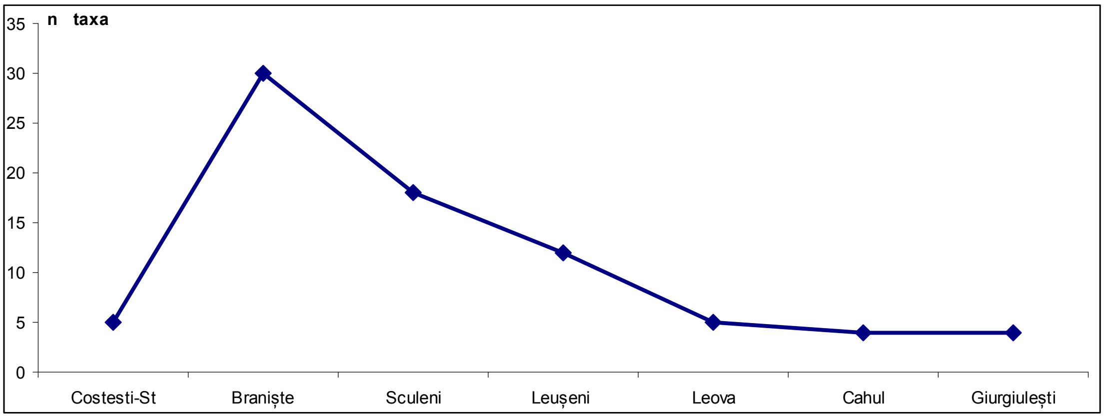


Fig. 34 Biodiversity of benthic macroinvertebrates by station, March 2015

Ichthyofauna

Control fishing performed in the given period of investigation in Beleu lake by stationary nets revealed the following ichthyofaunistic peculiarities: 1) the most abundant species in spring captures were: White bream, Roach, Bleak, Danube ruffe and Ruffe, Prussian carp, juveniles of Asp and Freshwater bream; 2) less abundant were the juveniles of White-eye bream, Vimba bream, Common nase, Orfe, Sichel, etc, which are species with divers status of rarity and which penetrate into the river with the increase of water level (Tab. 2, Fig. 35).

Table 2 Values of ecological indices of fish species sampled in Beleu lake in spring 2015 by stationary nets with mesh size of 20x20, 30x30, 40x40 mm

	Species	Stationary net ø 20x20 mm						Stationary net ø 30x30 mm						Stationary net ø 40x40 mm					
		D(%)		C(%)		W(%)		D(%)		C(%)		W(%)		D(%)		C(%)		W(%)	
1	*Rutilus rutilus* (Linnaeus, 1758)	6.94	D4	100.0	C4	6.9	W4	2.98	D3	33.33	C2	0.99	W2	-	-	-	-	-	-
2	*Blicca bjoerkna* (Linnaeus, 1758)	25.14	D5	100.0	C4	25.1	W5	13.10	D5	66.67	C3	8.73	W4	3.30	D3	50.00	C2	1.65	W3
3	*Alburnus alburnus* (Linnaeus, 1758)	2.31	D3	83.3	C4	1.9	W3	-	-	-	-	-	-	-	-	-	-	-	-
4	*Carassius gibelio* (Bloch, 1782)	4.05	D3	33.3	C4	1.3	W3	**29.76**	**D5**	**66.67**	**C3**	**19.84**	**W5**	**23.08**	**D5**	**83.33**	**C4**	**19.23**	**W5**
5	*Hypophthalmichthys molitrix* (Valenciennes, 1844)	-	-	-	-	-	-	-	-	-	-	-	-	3.30	D3	33.33	C2	1.10	W3
6	*Gymnocephalus cernuus* (Linnaeus, 1758)	**20.52**	**D5**	**100.0**	**C4**	**20.5**	**W5**	**8.93**	**D4**	**66.67**	**C3**	**5.95**	**W4**	-	-	-	-	-	-
7	*Gymnocephalus baloni* Holcík & Hensel, 1974	**32.95**	**D5**	**100.0**	**C4**	**32.9**	**W5**	**16.07**	**D5**	**66.67**	**C3**	**10.71**	**W5**	-	-	-	-	-	-
8	*Perca fluviatilis* Linnaeus,1758	0.58	D1	16.7	C1	0.1	W2	4.17	D3	33.33	C2	1.39	W3	1.10	D2	16.67	C1	0.18	W2
9	*Ballerus sapa* (Pallas, 1814)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	*Chondrostoma nasus* (Linnaeus, 1758)	-	-	-	-	-	-	0.60	D1	16.67	C1	0.10	W2	-	-	-	-	-	-
11	*Vimba vimba* (Linnaeus, 1758)	-	-	-	-	-	-	2.38	D3	16.67	C1	0.40	W2	3.30	D3	33.33	C2	1.10	W3
12	*Cyprinus carpio carpio* Linnaeus, 1758	-	-	-	-	-	-	9.52	D4	66.67	C3	6.35	W4	15.38	D5	66.67	C3	10.26	W5
13	*Leuciscus idus* (Linnaeus, 1758)	-	-	-	-	-	-	-	-	-	-	-	-	2.20	D3	33.33	C2	0.73	W2
14	*Pelecus cultratus* (Linnaeus, 1758)	-	-	-	-	-	-	0.60	D1	16.67	C1	0.10	W2	-	-	-	-	-	-
15	*Sander lucioperca* (Linnaeus, 1758)	-	-	-	-	-	-	0.60	D1	16.67	C1	0.10	W2	10.99	D5	83.33	C4	9.16	W4
16	*Aspius aspius* (Linnaeus, 1758)	2.31	D3	66.7	C3	1.5	W3	1.19	D2	16.67	C1	0.20	W2	8.79	D4	66.67	C3	5.86	W4
17	*Alosa tanaica* (Grimm,1901)	**5.49**	**D4**	**66.7**	**C3**	**3.7**	**W3**	-	-	-	-	-	-	-	-	-	-	-	-
18	*Silurus glanis* Linnaeus,1758	-	-	-	-	-	-	2.38	D3	33.33	C2	0.79	W2	7.69	D4	33.33	C2	2.56	W3
19	*Scardinius erythrophthalmus* (Linnaeus, 1758)	**4.34**	**D3**	**33.3**	**C2**	**1.4**	**W3**	-	-	-	-	-	-	-	-	-	-	-	-
20	*Abramis brama* (Linnaeus, 1758)	0.87	D1	33.3	C2	0.3	W2	7.74	D4	50.00	C2	3.87	W3	**20.88**	**D5**	**100.00**	**C4**	**20.88**	**W5**

D1 Subrecedent: <1.1%
D2 Recedent: 1.1%-2%
D3 Subdominant: 2.1%-5%
D4 Dominant: 5.1%-10%
D5 Eudominant: >10%

C1 Accidental: < 25%
C2 Accesory:25.1%-50%
C3 Constant: 50.1%-75%
C4 Euconstant:75.1%-100%

W1 Accidental: <0.1%
W2-W3 Accesory:0.1%-5%
W4-W5 Caracteristic:5.1%-100%

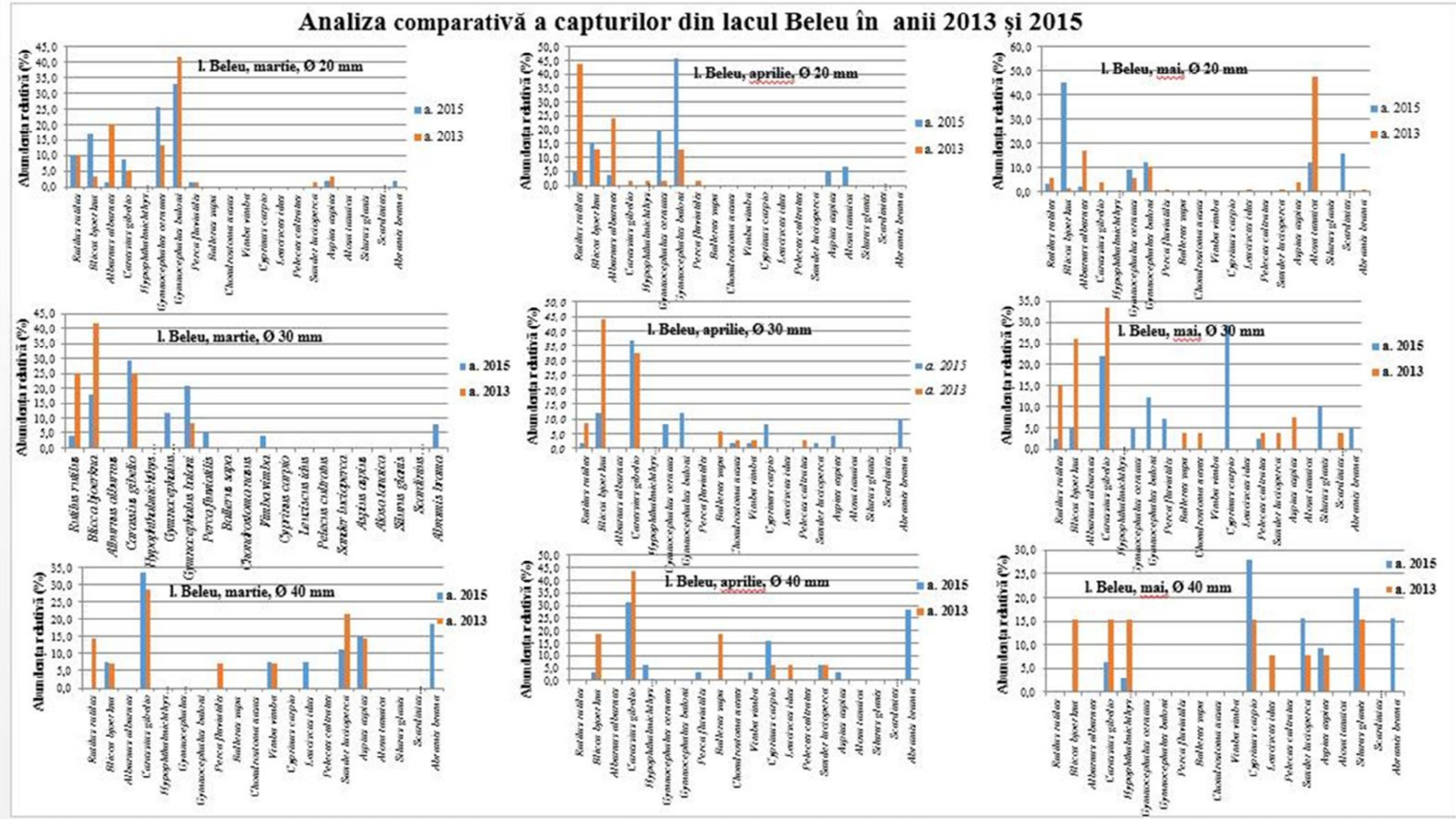


Fig. 35 Comparative analyse of fish captures from Beleu lake (by stationary nets) from spring 2013 and spring 2015

The differences in the composition of captures from springs of 2013 and 2015 (Fig. 35) are explained, firstly, by the particularities of thermal regime of these years. As example, in the end of March 2013 the lake water temperature was in average of 3.5 °C that meant a very cold beginning of the given season. However, later the dynamics of the temperature took rapidly an ascending character and, in this way, in the end of April it has in average 16 °C, but by the end of May - already 21.5 °C. In these conditions the lake ichthyofauna was relatively poor in the beginning of the spring, being dominated by few euritherm and euritope species as *Rutilus rutilus* (Linnaeus, 1758), *Blicca bjoerkna* (Linnaeus, 1758), *Carassius gibelio* (Bloch, 1782), species of *Gymnocephalus,* and some ichthyophagous species as *Aspius aspius* (Linnaeus, 1758) and *Sander lucioperca* (Linnaeus, 1758), which intensified the feeding before the reproduction season. In April-May the reproduction migrations of some species, which are strategically dependent on the presence of large spawning surfaces from the lake (*Cyprinus carpio* (Linnaeus, 1758), *Silurus glanis* (Linnaeus, 1758, *Alosa tanaica,* etc.), occurred.

Entire spring of 2015 was characterized by relatively low temperatures. By the end of March the water temperature reached 8 °C, but later the temperatures went down for a long period of time, thus, in the end of April the lake water temperature was of only 9 °C. That temperature regime was the most confortable for such euritherm species as *Abramis brama* (Linnaeus, 1758), *Gymnocephalus sp.* and *Carassius gibelio* (Bloch, 1782), which dominated in captures during the whole period of study. Trophic and reproductive migration of Freshwater bream (*Abramis brama* (Linnaeus, 1758)) from the Prut and Danube rivers into the lake was more evident in spring of 2015 by comparison with spring of 2013. Opposite, *Alosa tanaica* was much less numerous comparatively with spring of 2013, when it was a eudominant, euconstant and characteristic species for May.

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