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## TAXONOMIC DIVERSITY AND THE ROLE OF ALGAEFLORA FOR BIOLOGICAL DEPURATION OF WATERS FROM RIVER COGÂLNIC (R. MOLDOVA)

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**Abstract:** During 2004-2005 there were performed studies regarding the taxonomic structure of the algae flora in river Cogâlnic in order to point out the role of the algae during the process of water quality improvement and the role of the indicator of the most representative species. River Cogâlnic, or Cunduc, starts from nearby village Iurceni, district Nisporeni and flows into lake Sasac, and runs for a distance of 243 km. Decrease of the analyzed water quality from the river is caused by the sewerage waters from different sectors from town Hinceshti and Cimishlia that are directed into the river without any depuration. We've studied about 118 samples in which we've discovered about 382 species and intraspecific taxonomic units of algae of the following types: *Cyanophyta* -73, *Euglenophyta*-75, *Chlorophyta*-111, *Xantophyta*-3, *Bacillariophyta*-118 and *Chrysophyta*-2. Mass development of the euglena within Colgalnic river, among which are the following types of species *Euglena*-26, *Trachelomonas*-14 and *Phacus*-13, demonstrate a high level of trophicity in water. Among the chloride algae predominate the following species *Scenedesmus*-21, and from cyanophyta species predominates *Oscillatoria*-23. The high taxonomic level of the bacillariophyta algae is determined by species as *Navicula*-27, *Nitzschia*-24 and *Surirella*-16. Most of species refer to categories  $\beta$  and  $\beta$ - $\alpha$ , demonstrating a high level of water pollution. This fact speaks about the high concentration of nitrogen and phosphor compounds in water. It was demonstrated that as far as we go from the places where the sewerage waters flow into the river, the excessive quantities of biological elements decrease clearly. Also, go down the quantity of bicarbonates and oxidizers. Numeric growth of the algae is nothing else but a positive role for water depuration.

**Key words:** algae flora, phytoplankton, taxonomy, depuration, pollution.

### Introduction

During recent decades, small rivers from Republic of Moldova became significant reservoirs of different residual waters. As a result there takes place considerable modifications within the hydro chemical composition of the water and of the algae community. Monitoring studies of the current ecological state of facts of the surface waters continue and demonstrate a high level of water pollution determined by increase of the quantity of ammonium ions, nitrites, nitrates, phosphates, phenols, microelements and of the petrol compounds [1, 3, 4, 6, 7, 8, 9]. Under the influence of the antropical factors there takes place redistribution, concentration and migration, first of all of the hydrobionts.

This phenomenon leads to taxonomic restructuring in algaeocenosis phytoplankton, a fact also stated by other authors, too. [4, 5, 10, 11, 12]. Algae, as units that produce the primary organic substance, play an important factor for existence of the living organisms from the aquatic and ground ecosystems. On the basis of the photosynthesis and respiration, algae contribute to the maintenance of the oxygen balance in water and while assimilating the polluted substances contributes to hydro chemical balance of the water and lead to its biological depuration [4, 10, 11].

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River Cogâlnic, or Cunduc is a small river which starts from nearby village Iurceni, district Nisporeni and runs for about 243 km and flows into the North part of lake Sasac, situated in Ukraine is also influenced by the actions of the antropoc factor.

Degradation of the water qualities of the river is mainly caused by the sewerage waters from industrial, agricultural sectors, as well as from blocks of building and houses. Because of this, the pollution level still remains quite high, the water quality is of class IV (pure quality) – V (polluted) [1, 7, 9]. Taking into consideration the respective situation there appears the necessity to study the taxonomic structure of the algae flora of the Cogâlnic river in order to determine the diversity of the species from algaecenosis and determine their role in the phytoamelioration process of the river waters.

### Materials and methods

In order to determine the taxonomic structure of the phytoplankton in river Cogâlnic and of its two effluents within the area of town Cimishlia, during years 2004 - 2005 there were collected and analyzed 118 samples of plankton algae according to the methodology applied in modern algaeology. The segment of the studied river comprises town Hanceshti, village Gradishte, 6 collection points in town Cimishlia, were are included samples from the effluents before entering and leaving the limits of the town and collection point, village Bogdanovca. The materials were analyzed in the Algological Laboratory of the State University of Moldova using microscope Ergaval being preserved and partially alive. At the same time there was performed the chemical analyses of the river waters within the laboratory of the Republic center for agrochemical maintains applying the methods from gravimetric, photocolitmetric, complexometric etc., hydrochemistry examination of the results has led to discovery of the biological depuration process of the water [2].

### Results and discussions

The taxonomy of the studied phytoplankton algaecenosis is conditioned by the organoleptical, hydrochemical characteristics and the speed with which the water of the rivers is running. The high level of mineralization, being over the limit 2-3 times and the low running speed lead to existence and development of halophyte forms specific to stagnant waters or to those with a very small running (*Caloneis amphisbaena*, *Navicula rhinchocephala*, *N. cryptocephala*, *N. pygmaea*, *Nitzschia hungarica*, *N. tryblionella*, *N. frustulum*, *Cymbella prostrata* *Oscillatoria amphibia*, *O. animalis*, *O. agardhii*, *Spirulina subtilissima*) and of the alcofile forms: *Cosmarium formosum*, *Cocconeis pediculus*, *Caloneis amphisbaena*, *Cymatopleura solea*, *Gomphonema olivaceum*, conditioned by alkali pH-from the water (7,6- 8,85). The small depth of the river assures development of benthonic and planktonic forms, so the separation of the species is practically impossible. Within the flora spectrum there were discovered specific taxons for high atrophied waters: *Scenedesmus disciphormis*, *Tetrastrum elegans*, *Eutetramorus tetrasporus*, *Nitzschia acicullaris*, *Surirella ovalis*, a fact that may serve an index for water pollution.

The algae flora of the studied units during the investigation period (2004-2005) comprises **382 species** and intraspecific species of taxonomic units: *Cyanophyta* -73 comprising 19,1% from the total number of discovered species, *Euglenophyta*-75 (19,6%), *Chlorophyta*-111 (29,1%), *Bacillariophyta*-118 (30,9%) and *Xantophyta*-3 with *Chrysophyta*-2 all in all less that 2%. The analyses of the flora spectrum of the planktonic

algaecenosis has pointed out the structural complexity and the wide variety of the species from 4 filumi: *Bacillariophyta*, *Chlorophyta*, *Cyanophyta*, *Euglenophyta*, from which predominates for the entire period of observations, as a rule bacillariophyta. During spring and autumn season along with diatomite intensely develops *cyanophyta* and *chlorofyta*. During the cold weather period the number of the river's algaeflora diminishes intensely, with domination during this period of the *cyanophyta*, nevertheless the blue-green algae are considered thermophile. Domination of cyanobacteria is due not to the low temperature but to the high concentration of the organic substances in water, because the quantity of the chemical consumption of oxygen before fall in of the sewerage waters from village Gradiste is more than 2,66 times, the maximal admissible concentration being 79,7 mgO/l, and within area of town Cimishlia during winter 2005, the deviations are between 52,2 and 95,4 mgO/l, being with more than 1,74 – 3,18 over the admissible limit. It is widely known the fact that the *cyanophyta* is a mixotrophic organism algae and during the cold water period they pass to the heterotrophic way of nutrition which is not common to other groups of taxonomic algae.

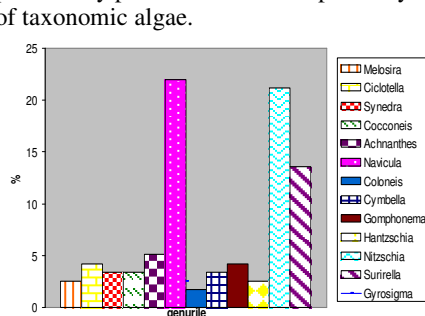


Fig. 1. Taxonomic diversity of diatomite from river Cogălnic, during 2004-2005

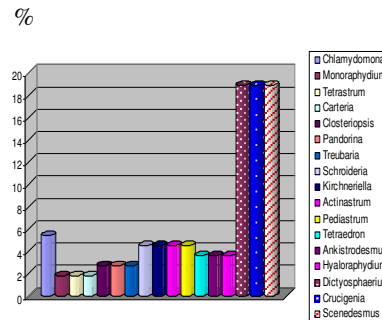


Fig. 2. Taxonomic diversity of *Chlorophyta* river's algaeflora

Filumi *Bacillariophyta* is represented through its highest number of species and intraspecific taxonomic varieties, among which are *Navicula* with 27 species, *Nitzschia*-24 and *Surirella*-16. As we can observe from figure 1, the most numerous from the point of their taxonomic difference are genders *Navicula* the quantity of which is about 22,9% from the total number of the discovered diatomite followed by *Nitzschia*-20,3%, *Surirella* - 13,6%, all the rest are less varied but anyway create a different flora spectrum. Among the analyzed samples were discovered quite frequently species *Navicula hungarica*, *N. cryptocephala*, *N. placentula*, *N. pusilla*, *N. vulpina* and others. From gender *Nitzschia* more frequently is discovered *Nitzschia hungarica*, *N. triblionella*, *N. kützingiana*. From the other genders, during the entire period of studies, there were discovered: *Caloneis amphisbaena*, *Gyrosigma acuminatum*, *Cymatopleura solea* etc. The variety of species change radically depending on their place of collection, for example in the water of the effluents and old course of the river is discovered quite frequently different species of  $\beta$  and  $\beta$ - $\alpha$  *mezosaprobs*. They are mostly discovered nearby the river mouth, but as we go away from it, the diversity of the species decrease, meaning that it affects and modifies the cyanosis algae being affected by polluted waters that flow into the river. High saprobe of the filumi, determined by 30 species among which 25 are  $\beta$  – *mezosaprobs*, denotes clearly a high level of pollution of the waters with organic substances.

From those 111 species of algae from the filumi *Chlorophyta* 10 species belong to order *Volvocales* that belong to following genders: *Chlamydomonas*, *Carteria*, *Eudorina*

and *Pandorina*. The majority of them live in the area where the residual waters flow into the river, having the saprobe  $\rho$  and  $\beta$  – *mezosaprobs*. One of the rare met species here from *Chlorophyta* is *Actinochloris sphaerica*.

Quite numerous and different are algae from class *Chlorococcophyceae*. Within the phytoplankton of the river these dominate during spring, though some species live during the entire year period: *Monoraphidium contortum*, *M. minutum*, *Scenedesmus acuminatus*, *S. quadricauda* etc. The climate conditions during summer period contribute to a more intense vegetation of the respective algae. The most numerous and diverse from the taxonomic point of view is class *Chlorococcales*. Among the samples were discovered 102 species from genders *Monoraphidium*, *Hyaloraphidium*, *Actinastrum*, *Coelastrum*, *Crucigenia*, *Kirchneriella* etc. From this filium, as it can be seen from (fig. 2) predominate genders *Scenedesmus*-21 and *Monoraphidium*-6, being quite diverse. These are discovered mainly in polluted waters and genders *Coelastrum*, *Crucigenia* are ubiquitous and are met anywhere in a quite high quantity.

From the representatives of filium *Cyanophyta* most rich in species and genders is *Oscillatoria* -23, the representatives of which constitute about 31,5% from the total number of cyanophytes, followed by *Anabaena* with 5 species, constituting about 6,8% and *Spirulina* with 4 species. The most frequent met cyanophytae are: *Oscillatoria tenuis*, *O. redekei*, *O. planctonica* and *Dactylococcopsis acicularis*, which very often provoke „water flowering”. The number of the saproindicating species - 18 is dominant by  $\beta$  – *mezosaprobs* - 6, also indicating a moderate pollution of the water.

Algae flora of the river is characterized by a big variety of **euglenophytae** with dominating species of: *Euglena acus*, *E. oxyuris*, *E. viridis*, *Lepocinclis playfairiana* and *Phacus pleuronectes*. From the total variety, the richest species are genders *Euglena*-26 species, *Trachelomonas*-14 and *Phacus*-13 followed by the representatives of the gender *Lepocinclis*, characteristic to very polluted waters, because from 36 species indicating saprobe dominates  $\beta$  – *mezosaprobs* - 19 denoting moderate pollution of the water with adulterate organic substances. **Xantophyta**, as a rule does not present an important role in the studied algaecyanosis. Within the phytoplankton there were discovered only 3 species, vegetating mainly during spring  $\beta$  – oligosaprobate, with saprobate indices of – 1,5.

In order to point out the phyto improvement of the algae over the river's water there was analyzed the dynamics of the biogenic compounds during summer period 2004-2005. After analyzing the results it was concluded that during month of June 2004 the quantity of the biogenic substances under the influence of the algae has been reduced.

The content of the nitrate ions in the place where the sewerage waters flow into the river is higher 2,8 times than downstream, where under the development influence of the quantity of algae takes place reduction of the compound quantity from 2,3mg/l to 8,1mg/l. At the same time takes place reduction of the phosphates quantities with 33,3%, their content decreases from 0,12 mg/l to 0,04 mg/l and of the ammonium ions with about 41,7%, oscillating from 3,6 to 1,5mg/l.

As a result of massive assimilation of different forms of nitrogen, *cyanophyta* develops to such a degree that it causes „water flowering”. Quite intensely develop species of the gender *Oscillatoria* and *Dactylococcopsis*, which creates rust crust under the substratum of silt of the river and sometimes it, gives to the water a green blue shade. This is also confirmed by decrease with about 58,3 % of the ammonium ions, that upstream of town Cimishlia was 3,6 mg/l, center area – 1,5 mg/l, and downstream of the town Cimishlia it is lower about 12 times than upstream the town equal to 0,3 mg/l.

The dynamics of the biogenic substances in the following month of the year is more evident. So, the quantity of the nitrates under the influence of the hydrobionts decrease with 48,0%, from 24,4 to 11,7 mg/l, ammonium ions are reduced from 3,4 to 0,4 mg/l, sulphates - from 723 mg/l to 670 mg/l, and phosphates are completely consumed, their oscillation being from 0,09mg/l, in the place where the sewerage water flows into the river, and downstream phosphates were not discovered. Also, decreased the quantity of the chem consumption of oxygen from water from 67,7 to 58,6.

In August 2004 there was attested a net decrease of the biooxidization from 142 to 49,5 mgO/l, the nitrate ions concentration decreased under the influence of mass development of algae from 22,8 mg/l, from the place of pollution to 15,4mg/l. At a distance of 500 m from the place where the sewerage waters flow into river with a content of 26,8 mg/l nitrates, the quantity of the ions decreases with 4,8 times and increase to 5,6 mg/l. Also is to be mentioned that during August 2005 were determined the most representative data which confirms the contribution of the algae for water depuration. The concentration of ammonium ions oscillates between 0,4 – 0,9 mg/l, and in area of town Hanceshti its quantity is almost reduced. Nitrates in the river's water in areas of Cimishlia oscillates between 6,3 and 43,6 mg/l. After the sewerage waters flow into the river the quantity of ions increase to 17,3 mg/l and is reduced under the influence of hydrobionts up to 6,3 mg/l.

### Conclusions

- Within the algae communities of the studied river Cogâlnic, segment from town Hanceshti - village Bogdanovca, there were discovered 382 species and intraspecific taxonomic units of algae from the following branches: *Cyanophyta* -73, *Euglenophyta*-75, *Chlorophyta*-111, *Xantophyta*-3, *Bacillariophyta*-118 and *Chrysophyta*-2. Mass development in the waters of Cogâlnic river of the euglenae algae among which dominates genders *Euglena*-26, *Trachelomonas*-14 and *Phacus*-13, demonstrates a high level of trophicity of the water. From the chlorophyta algae dominate gender species of *Scenedesmus*-21, and from the cyanophyta – genders species *Oscillatoria*-23. The high taxonomic variety of the *bacillariophyta* algae is determined by gender species *Navicula*-27, *Nitzschia*-24 and *Surirella*-16. The majority of the dominant species refer to category  $\beta$  and  $\beta$ -*a mezaprops*, denoting a net level of water pollution. For this also speaks the high concentration in water of the nitrogen and phosphate compounds.
- On the basis of the above mentioned it may be concluded that: with the diversity of the sewerage waters in river Cogâlnic increases the quantity and variety of the diatomic algae, *chlorophyta* and *cyanophyta*, that in the result contribute to the biological depuration process of the water through assimilation and mineralization of the toxic substances. In general, atrophy of the river's water positively influences development of the algae, both from the point of view of species variety and their quantitative effect.
- It was determined that if we go away from the place where the sewerage waters flow into the river, the excessive quantities of the biogenic elements decrease essentially on the base of the criteria that the quantity of the algae increase. As a result of water flowering in 2004 the level of nitrates decreased with 38,0 %, and the ammonium ions with 68,3 %. Also, under the influence of the algae decrease the quantity of the bicarbonates and of the oxidization process. Increase of the algae quantity, has a positive role for water depuration process.

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