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## STUDY WATER QUALITY IN CUEJDEL LAKE

BY

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**Abstract.** This paper presents a synthesis of our researches on the main physico-chemical and biological parameters of the Cuejdel lake's ecosystem was made, representing the variation limits of these parameters during the years 2006-2016, and in 2016 complex investigations have developed, which have highlighted the evolution and specificity of this aquatic basin. In this study, classical methods, supplemented with original techniques: scientific documentation, periodic movement in the field and sampling from established stations (queue, center and dam, from tributaries and downstream of the lake) were applied. The purpose of investigations over ten years was to determine the degree of trophicity for the studied lake and the degree of eutrophication of its water.

**Keywords:** eutrophication; surface water quality parameters; ecosystem; trophicity; biodiversity.

### 1. Introduction

The process of degradation of environmental factors across the globe has seen a steady ascendant course over the past decades, an increasingly worrying trend, with the amount of pollutants reaching figures that go beyond imagination and continue to grow in almost geometric progression. A general

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threat to all surface waters, not spectacular but more dangerous by consequences than acute pollution, is the progressive, often latent, almost unnoticed pollution, but which accumulates the effect of small sources with diffuse pollution and takes chronic forms.

Our subject is such a pollution type: the eutrophication, process of evolution of their quality, especially characteristic of artificial lakes, which brings particular problems from the water treatment technologies point of view. The eutrophication process should not be judged by one criteria or another, but with a set of criteria. In fact, the syntheses elaborated did not subordinate to this vision, reaching the view that this type of organic pollution concerns the abiotic compartment of the ecosystem, at the biotic level, only its effects being felt. The abundant literature that appears continuously on the concrete cases of eutrophication is increasingly perceived by the difficulties of interpretation and typology of the basins affected by this process.

We consider that only analyzing a number of essential and edifying components of the subsystem and integrating them into a complex image of the ecosystem, dominated by a complex systemic interpretation, associated with a cyber vision can lead us to a correct understanding and interpretation of the eutrophication process.

Regarding the evolution of the water quality in the lake, a first aspect is related to the initial preparation of the lakes cuvette. These cuvettes include land which, prior to the accumulation, was not in contact with water and may contain deposits of polluting substances. Even in the natural condition, vegetation and other organic substances on these lands can lead to an organic soil pollution of the lakes after their realization. Therefore, it is necessary to pay special attention to the problem of cleaning the banks and bottom of future storage lakes. Secondly, during the exploitation, there are some phenomena that did not take place naturally in the natural situation. From the modifying factors that influence or even cause changes in the physico-chemical characteristics of water, we mention: the density difference, which, in different characteristic areas of the complex arrangements, is determined by the difference in temperature, salinity, suspended matter, etc.; speed variations; evaporation, air currents, dissolution or precipitation of various minerals, etc. ; biological activity.

These factors are correlated, the variation of one bringing appreciable changes to the others.

## **2. Experimental**

The natural dam Cuejdel Lake, from Neamț district is located 25 km from Piatra Neamț city, has recently formed (1978), by sloping and sliding. It is the largest lake of natural dam in Romania. It has a length of 1 km, an area of 2.2 ha, a maximum depth of 16 m and a volume of 907.000 m<sup>3</sup>.

The extremely interesting and unique particularities of this lake justify the complexity of a scientific study on flora, fauna and ecosystem biodiversity

in the area. It represents a “witness” in the study and evolution of trophic chains, in the first stage of formation of these kind of ecosystems.



Fig 1 – Cuejdel lake, Neamț district (1990).

The lake has origins in a large land sliding, over 35 ha, which has affected the left side of the valley of Cuejdel, since 1978, in a few steps, until 1991, when the mass of the land slip has totally blocked the riverbed.

The slip was determined by the particularities of the geological substrate, the abundant rainfall, also by the 1990's earthquake, but we considered that the main cause is man's action. Through the construction of the old forest road in this area, man cut off the slope from the base of the left side, triggering the initial sliding and the avalanche of slides that followed.

The anthropic actions continue today, by the construction of the new forest road in the period 2003-2004, deforestation, non-ecological tourism, etc.

Some important characteristics of this lake are related in Table 1.

**Table 1**  
*Important Characteristics of Cuejdel Lake*

Crt. no.	Characteristics	Cuejdel lake
1	Origin	Natura
2	Age	Since 1978
3	Maximum depth	16.08 m
4	Surface	122.000 m <sup>2</sup>
5	Total volume	906.970 m <sup>3</sup>
6	Flora	<i>Typha, Polygonum, Mentha</i> etc.
7	Phytoplankton	The euplanctonic species are dominant
8	Zooplankton	Rotifers are dominant
9	Bacteria-flora	Amonificators are dominant

The research has been supplemented with global data on sediment, hydro-chemical and hydro-biological conditions of the lake, also with the synthesis of the results of experiments on the cultivation of some algae in the area, namely chemical and biochemical determinations of algal biomass and aquatic macrophytes. We studied the variation limits of these parameters during the period 2000-2003, and in 2004 complex investigations have developed that have highlighted the evolution and specificity of this aquatic basin.

Classical methods have been applied, supplemented with original techniques: scientific documentations, periodic movement in the field and sampling of the established stations (at Lake Cuejdel, samples will be taken from the stations: queue, center and dam, in the "center" area, samples from tributaries and downstream of the lake). For the study of algae and bacteria, methods appropriate to the proposed objectives were applied, and for cormophytes the following were determined: floristic area; spectrum of geo-elements; spectrum of bio-forms; the spectrum of ecological indices - U, T, R., using the principles and methods of the central European school, developed by Braun-Blanquet and adapted to the conditions of our country by Al Borza and N. Boşcaiu. Fauna's research was conducted on the ground and continued in the laboratory, using the methods specific to each group of animals investigated.

Investigations on the current sediment in the Cuejdel natural dam have taken into account the geochemical parameters of the evolution of the eutrophication process: interstitial water content (U105<sup>0</sup>C), sediment reaction, organic substance content, dissolved phosphorus (PO<sub>4</sub><sup>3-</sup>) and mineral forms of nitrogen (NH<sub>4</sub><sup>+</sup>, NO<sub>3</sub><sup>-</sup>). The analyzes were carried out on samples taken from four stations: the feed source (1), the tail of the lake (2), the lake center (3) and the dam area (4). For essential biogenic elements, the results are expressed in mg/100 g of wet sediment and, respectively, in mg / liter of interstitial water.

Our research points out that the values of these parameters vary - from one area to another - within limited limits because of the relatively small size of this ecosystem and the fact that there are no sources of anthropogenic pollution in its hydrographic basin. The main characteristics of sediment for the period 2006 - 2016 are given in Table 2.

**Table 2**  
*The Main Characteristics of Sediment for the Period 2006 – 2016*

Crt. no.	The determined parameter	Variation limits
1	pH, [units]	6.10,...,6.90
2	Organic matter, [%]	4.66,...,7.18
3	NH <sub>4</sub> <sup>+</sup> , [mg/100 g sediment]	0.60,...,5.01
4	NO <sub>3</sub> <sup>-</sup> , [mg/100 g sediment]	0.41,...,0.74
5	PO <sub>4</sub> <sup>3-</sup> , [mg/100 g sediment]	0.008,...,0.16

### 3. Results and Discussions

The water of the investigated ecosystems for the last ten years shows a poor alkaline reaction, good oxygenation, moderate hardness, and class I

qualitative values and oligotrophy levels for the other hydro-chemical parameters analyzed, with no significant difference between the sampling periods.

Concentrations of phosphorus and nitrogen are low, characteristic of oligotrophic waters. Global loading in mineral salts reveals a moderate degree of water mineralization. The values of the determined parameters highlight a Category I for water quality conform the Romanian standards.

Plankton's algae-flora is one of the main primary producers, which initiates the other trophic cycles within the ecosystem. For the determination of the algal component, the feed samples (Cuejdel stream), the lake and the exhaust ones were taken. For the qualitative analysis of the algae samples of water and perifiton's algae were collected, which were fixed by two methods: one sample was treated with 4% formalin and another sample was treated with Utermohl reactive (IHK) 3 ml/l.

The qualitative analysis of the algae in the samples was appreciated by the nomination of systematic groups and the number of identified taxons.

#### 4. Conclusions

The results of the algal determinations reveal a well-defined phytoplankton biodiversity, although the lake ecosystem is very young.

In the Cuejdel lake were determined six systematic algae groups, which showed significant quantitative differences between 2006 and 2016.

*Cyanophytaes* were identified in significant quantities at lake entry, dam and the exit of the lake, which shows a relative pollution, mainly due to anthropogenic influences.

There is a reduction (in 2008) in the number of algae from the causes mentioned at the beginning of this synthesis, but algal biodiversity is maintained, as compared to previous years. The algae-flora structure shows that this lake is being formed at the beginning of the algal biodiversity evolution.

The planktonic algae flora analyzes the oligotrophic character of the lake ecosystem, with a slight tendency to mesotrophy.

The floral inventory of the researched area comprises 144 species of superior plants belonging to 48 families. Of the species, five are *Pteridophyta*, two are *Gymnosperms* and 137 are *Angiosperms*.

These species are included in the Conspectus of Cormorant Species in the area of Cuejdel Natural Dam, made in May - September 2008.

The lake was formed in a forested area of pure beech forests that alternate with spruce forests. There is no sign of a typical forest vegetation, as beech and spruce trees reach the same altitude, obviously on the right bank of the lake, facing upstream. They are arranged in the form of cross-pieces on the length of the lake, the strips alternating with the spruce.

Although the Cuejdel Lake is relatively new, around it was a compact girdle with aquatic and palustre plants, belonging to various vegetable

associations. Lake's fauna is represented by a very varied animal world: worms, mollusks and some arthropods.

It presents in quantitative terms lower numerical values in 2008 compared to the previous years, mainly explained by the effect of the large amounts of rainfall in the year. The low numerical development of the zooplankton and the identified species indicate that the trophic lake base is relatively low, indicating a quality of oligotrophic water. Vertebrates occupy an important place within the ecosystem structure studied, being represented by different species of fish, batrachians, reptiles, birds and mammals.

The microbiological analysis of the water samples taken from the Cuejdel lake consisted of the quantitative determination of germs from six eco-physiological groups with major implications in the biogenic elements circuit (N, C, S). The microbiological investigations carried out on the Cuejdel lake during the period 2006-2016 consisted of the quantitative determination of nine eco-physiological groups of bacteria, which made the biogenetic circuit (C, N, S), as well as three groups of sanitary quality indicator bacteria water.

The results of microbiological determinations in 2008 reveal an increase in the number of bacteria mainly due to anthropogenic influences.

The Cuejdel lake is a particularly interesting ecosystem in terms of biodiversity, geological and geo-morphological features, but also landscape - features, revealed by this study.

The data obtained confirms the previous conclusions of this study and fully justifies the fact that this area is in line with the Natural Reservations criteria.

The physicochemical and biological characteristics make this lake a water quality class I and an oligosaprobe category with a trend towards mesotrophy. Also, biodiversity, highlighted by our research, includes many species to be protected and conserved as in Natural Reservations, so protected by the law.

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## STUDIUL CALITĂȚII APEI LACULUI CUEJDEL

(Rezumat)

Se prezintă o sinteză a cercetărilor noastre privind principalii parametri fizico-chimici și biologici ai ecosistemului lacului Cuejdel, reprezentând limitele de variație ale acestor parametri în anii 2006-2016, iar în anul 2016 s-au dezvoltat investigații complexe, care au evidențiat evoluția și specificitatea acestui bazin acvatic. În acest studiu au fost aplicate metode clasice, completate cu tehnici originale: documentația științifică, deplasări periodice în câmp și prelevarea de la stațiile stabilite (coada lacului, centrul și barajul, de la afluenți și în aval de lac). Scopul investigațiilor pe parcursul celor zece ani a fost determinarea gradului de troficitate a lacului studiat și a gradului de eutrofizare a apei acestuia.

