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THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE LAKE WETLANDS IN THE CENTRAL GROUP OF THE EAST CARPATHIAN MOUNTAINS

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Abstract

In order to study the lake wetlands in the Central Group of the East Carpathian Mountains, we have chosen 6 anthropic lakes and 3 natural ones. The lake wetlands develop mainly in the area upstream the lake tail, at the outlet of the main watercourses. The most developed wetland areas can be found in Roşu Lake, at the mouth of the rivulets Licaş and Suhard, and in the area of Crucii Lake, appeared recently following a landslide. The dominant herbaceous vegetation is made up of bulrush, reeds and wetlands lawns, while the tree vegetation is made up of alders, willows and poplars.

Keywords: wetlands, lakes, East Carpathian Mountains.

1. Introduction

The natural lake units of the East Carpathian Mountains are quite rare, but important from a genetic and hydrological viewpoint (Lala, Buhăescu, Roşu, Crucii, Sfânta Ana etc.). Most of these lakes are anthropic, built to produce hydropower and for water supply etc. (Izvorul Muntelui, Frumoasa, Colibiţa etc.).

For the present study we had in view the analysis of the physical and chemical parameters of the natural and anthropic lake wetlands in the Central Group of the East Carpathian Mountains (fig. 1). We have chosen the most representative units of this kind, especially as they play a very important role in the diminution of the floods on the river courses of the main hydrographic arteries belonging to this region.

Concerning the Romanian wetlands, in general, and the wetlands of the Carpathian Mountains, there are generally isolated studies concerning the vegetation or the fauna, but there are no complex studies on their inventory, typology, geographic

distribution etc. Only a few complex works can be quoted: Romanescu, Romanescu, 2008; Romanescu et al., 2005; Romanescu et al., 2008. Complex limnological works have been published by: Gâştescu, 1963, 1971, 1979, 1990, 1998; Pandi, 2004; Pişota, 1958, 1971; Sorocovschi, 2003, 2005; Teodor, 1999; Trufaş, 1961 etc.

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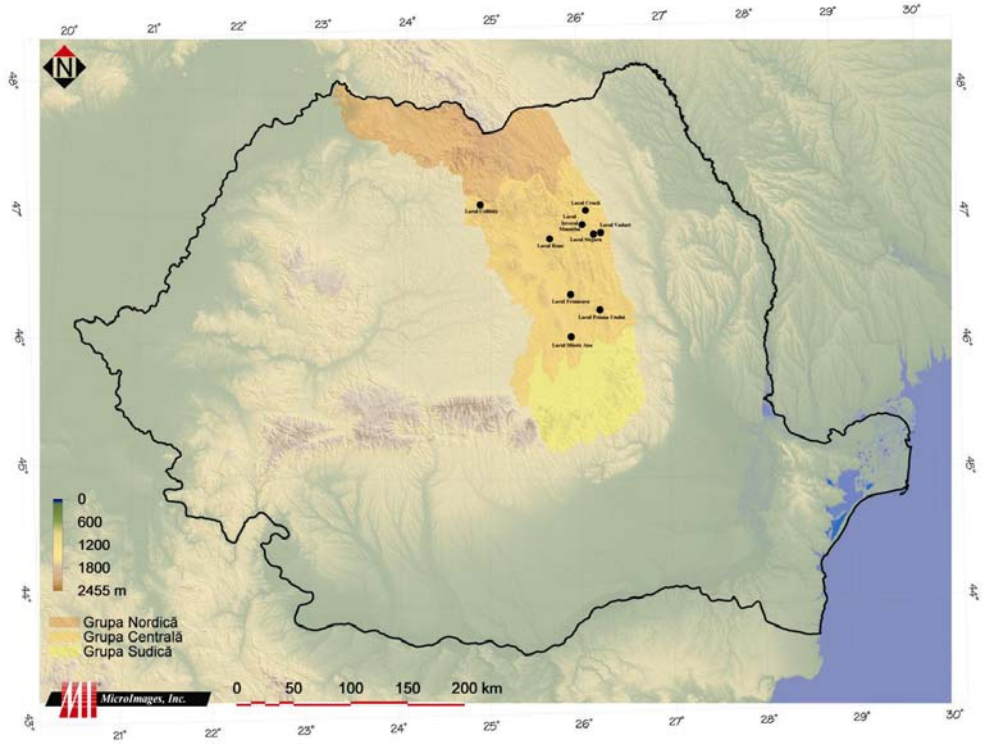

Figure 1. Geographic position of the lake wetlands in the Central Group of the East Carpathian Mountains

2. Methodology

In order to measure the physical and chemical parameters in the waters of the lake wetlands, we used a HACH multiparameter. We monitored the following characteristics: temperature, pH, water tension, and total content of dissolved salts (TDS), electrical conductivity, salinity, dissolved oxygen and organic carbon in the sediments.

The sampling of the mud, in order to determine the quantity of organic mud in the sediments from the bottom of the lake, was achieved using a Van Graff cup. The organic carbon analysis was carried out in the Geo-archaeology laboratory through calcination.

For larger surfaces we chose several sampling points in order to highlight the differences between compartments. For the small surfaces we took just one

sample. The samples were taken only from the surface. For the entire water profiles we took samples only from Lacul Roşu. The data obtained in this wetland will represent the object of a different study.

In order to determine the vegetal makeup we chose the areas where the typical wetland vegetation was dominant; these areas were near the border or, more rarely, covering the water surface. Most of the typical wetland plants can be found at the tail of the lake, in the area of maximum clogging.

3. Results and discussions

The present study focused on a number of 9 lakes, out of which 3 are natural (Roşu, Crucii and Sfânta Ana) and 6 artificial (Colibiţa, Izvorul Muntelui, Stejaru, Vaduri, Poiana Uzului, Frumoasa). Out of the natural lakes, 2 appeared following landslides (Roşu, Crucii) and one was formed in a volcanic crater (Sfânta Ana). Out of the artificial lakes, 3 were built to produce power (Izvorul Muntelui, Stejaru, Vaduri) and 3 to supply water in different towns (Colibiţa for Bistriţa, Poiana Uzului for Dărmăneşti-Târgu Ocna, Frumoasa for Miercurea Ciuc).

All the wetlands have an unconsolidated substratum, except for Poiana Uzului lake, which in the downstream sector has a rocky substratum.

The waters are part of the sweet waters category, their pH is alkaline and the substratum, with the exception of Lacul Roşu and some sectors of Sfânta Ana, is mineral. The quantity of dissolved oxygen (also because the wetlands are situated in the alpine area), is relatively high, which allows for the existence of a specific fauna, especially for the kind of fauna that likes clean waters (trout).

The wetlands of the anthropic lakes differ in size, depending on the way the waters are used. For the small waters, the emersed wetlands get larger and for the big waters they diminish. The best conditions are found at the mouth of the main running waters, in the avulsion area and on the banks with gentle slopes. For the natural lakes, they can be found as well inside the water surface, especially in the case of Lacul Roşu, at the mouth of the rivulets Suhard and Licaş or at the waterway. Following the fact that the slopes are abrupt and the lakes developed in the valleys, the wetlands cannot extend laterally, being forced to develop in a linear way, especially upstream.

The perspectives of biodiversity protection and improvement in the lake wetlands from the Central Group of the East Carpathian Mountains depend on the destination of these units. The artificial lakes are controlled by man and their level of protection cannot be satisfactory. In the case of the natural lakes, except for Crucii Lake, the status of National Park or Nature Reserve has been adopted, and the protection level is assured.

Wetland: Poiana Uzului Lake
Geographic coordinates: Lat. $46^0$34' N; Long. $26^0$24' E

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Poiana Uzului Lake	Lacuster	Limnetic	Rocky/ unconsolidated substratum	Rocky bedrock	Permanently flooded	0.0 Sweet	9.30 Alkaline	Mineral	+:	2	1

Vegetation: waterside lawn, poplar, alder.
Fauna: common heron, stork.
History: Storage lake meant to supply with water the towns of Dărmăneşti and Târgu Ocna. The protection area overlaps the abrupt slopes. The wetland is not large, being present at the tail of the lake. The lake has a dam with butresses, 84 m high and 507 m long. It has a surface of 334 ha at high waters, a length of 3.75 km, a volume of 98 mln.m^3 and a maximum depth of 64.7m.
T^0C – 26
TDS – 50 mg/l
Electrical conductivity – 50 µS/cm
U - -133^{mV}
O_2 – 7.4mg/l

Figure 2. Poiana Uzului Lake Storage

Wetland: Frumoasa Lake
Geographic coordinates: Lat. $46^0$22' N; Long. $25^0$48' E

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Frumoasa Lake	Lacuster	Limnetic	Unconsolidated substratum	Gravel Sand	Permanently flooded	0.0 Sweet	8,86 Alkaline	Mineral	=:	2	2

Vegetation: Waterside lawn.
Fauna: Unimportant ecologically.
History: Storage lake meant to supply water for Miercurea Ciuc town and to reduce flooding. It was inaugurated at the beginning of the year 1986 and has a dam made of padding with reinforcing prisms made of ballast achieved from local materials and an argillaceous central core. The dam's maximum height is 38m and the length of the crowning is 506m. The upstream berm is situated at 838m, being 8m wide and the downstream berm is situated at 836m. At maximum level, the lake is 27 m deep and holds a volume of 10 mln.m^3 water.
T^0C – 22,7
TDS – 73 mg/l
Electrical conductivity – 73 µS/cm
U - -105^{mV}
O_2 – 8.3 mg/l

Figure 3. Frumoasa Lake storage, meant to supply water for Miercurea Ciuc town

Wetland: Sfânta Ana Lake
Geographic coordinates: Lat. $46^0$22' N; Long. $25^0$94' E

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Sfânta Ana Lake	Lacuster	Limnetic	Unconsolidated substratum	Silt	Permanently flooded	0.0 Sweet	9.97 Alkaline	Mineral	++:	1	1

Vegetation: Mixed forest and lake waterside lawn.
Fauna: Very rarely heron, egret etc.
History: Lake of volcanic origin, installed in the crater of a former volcano. It is situated in the Ciomatu Mare Massif on the left bank of Olt River, near Tuşnad spa. It is situated at an altitude of 946m, being circular in shape, molded on the shape of a recent crater. The lake has a surface of 19.50ha, a length of 620m and a maximum length of 460m. Its maximum depth is 7.7m and at present it has the status of complex (geologic, floristic and faunistic) reserve. The lake's trophic capacity is low because of the mofetta exhalations and of the lack of oxygen, especially at depths over 3-4m.
T^0C – 25
TDS – 8 mg/l
Electrical conductivity – 8 µS/cm
U - -173^{mV}
O_2 – 5.9 mg/l

Figure 4. Sfânta Ana volcanic lake of the Ciomatu Mare Massif

Wetland: Izvorul Muntelui Lake

Geographic coordinates: Lat. $47^0$06' N; Long. $25^0$57' E

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Izvorul Muntelui Lake	Lacuster	Limnetic	Unconsolidated substratum	Silt	Permanently flooded	0.0 Sweet	8.85 Alkaline	Mineral	=:	3	2+

Vegetation: Waterside lawn, alder, willow, poplar.

Fauna: Heron, wild duck.

History: Lake created in 1960. It has the following morphohydrometric characteristics: dam height 127m; height at the crowning 520m; length of the crowning 435m; length at the basis 127m; maximum width at the basis 119m; volume of concrete 1,652,000 m^3; normal water level 509m; average length of the storage lake 35km; width of the storage lake 200-2000m (Hangu area); storage lake surface (for normal water level) 3260 ha; upstream height 508m; downstream height 364.50m; maximum water volume 1250 mln.m^3; total volume 1230 mln.m^3; serviceable volume 930 mln.m^3; volume of protection against high flood 100 mln.m^3; water volume below the exploitation level 200 mln.m^3; average depth of the storage lake 18m; maximum depth at the dam 94m; average flow 42 m^3/s; installed flow 178 m^3/s; feed pipe length 4655m; feed pipe diameter 7m; total waterfall 148,5m; net waterfall 140m; installed power 210 MW (6 turbines); energy produced yearly 436.5 GWh. The purpose of this lake is multifold: hydropower, fish breeding, recreation, flood reduction, landscape etc. At the tail of Izvorul Muntelui lake (anthropic lake) the level fluctuations are important and sometimes the area is emersed.

T^0C – 25

TDS – 48 mg/l

Electrical conductivity – 48 µS/cm

U - -107.3^{mV}

O_2 – 10.3 mg/l

Figure 5. Izvorul Muntelui Lake tail in the area of the viaduct

Wetland: Izvorul Muntelui Lake
Geographic coordinates: Lat. $46^0$56' N; Long. $26^0$06' E

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Izvorul Muntelui Lake	Lacuster	Limnetic	Unconsolidated substratum	Silt	Permanently flooded	0.0 Sweet	8.61 Alkaline	Mineral	=:	3	2+

Vegetation: Mixed forest.
Fauna: Heron, wild ducks. Unimportant ecologically.
History: Lake created in 1960. Multifold purpose: hydropower, fish breeding, recreation, flood reduction, landscape etc. At the dam, Izvorul Muntelui lake (anthropic lake) has significant level fluctuations related to the climate regime and to the use regime (70-80m).
T^0C – 24
TDS – 43 mg/l
Electrical conductivity – 43 µS/cm
U - -92.0^{mV}
O_2 – 10.4 mg/l

Figure 6. Izvorul Muntelui Lake near the dam

Wetland: Stejaru (Bâtca Doamnei) Lake
Geographic coordinates: Lat. $46^0$55' N; Long. $26^0$10' E

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Stejaru (Bâtca Doamnei) Lake	Lacuster	Limnetic	Unconsolidated substratum	Silt	Permanently flooded	0.0 Sweet	8.30 Alkaline	Mineral	=:	2	2

Vegetation: Alder, willow, poplar.
Fauna: Heron, egret. Unimportant ecologically.
History: Storage lake on Bistriţa River, built in 1962 by creating a dam and a lateral embankment on the left side in an area of the channel. It is fed by the waters of Izvorul Muntelui Lake, by means of the feed pipe of the power plant, to which are added the former course of Bistriţa River, with a low flow, and Doamnei Rivulet, a tributary on the right side. It is situated at an altitude of 325m, and has a surface of 235 ha, a length of 3200m, a maximum width of 1050m and a maximum depth of 15.5m. Purposes: hydropower, water supply for Piatra Neamţ town and flood reduction. Its clogging degree is high. The best preserved are the wetlands situated at the tail of the lake.
T^0C – 21,5
TDS – 49 mg/l
Electrical conductivity – 49 µS/cm
U - -73.1^{mV}
O_2 – 6.3 mg/l

Figure 7. Stejaru (Bâtca Doamnei) Lake on Bistriţa River

Wetland: Lacul Vaduri
Geographic coordinates: Lat. $46^0$55' N; Long. $26^0$12' E

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Vaduri Lake	Lacuster	Limnetic	Unconsolidated substratum	Silt	Permanently flooded	0.0 Sweet	8.15 Alkaline	Mineral	=:	2	2

Vegetation: Waterside lawn, alder, willow.
Fauna: Unimportant ecologically.
History: Small storage lake meant for hydropower. It was built in 1966 and has a surface of 119 ha. It is situated on Bistriţa River, at an altitude of 350m.
T^0C – 14,5
TDS – 53 mg/l
Electrical conductivity – 53 µS/cm
U - -60.6^{mV}
O_2 – 8.3 mg/l

Figure 8. Vaduri Lake on Bistriţa River

Wetland: Crucii (Cuejdel) Lake
Geographic coordinates: lat. 47^{0}03' N; long. 26^{0}21' E.

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Crucii (Cuejdel) Lake	Lacuster	Limnetic	Unconsolidated substratum	Silt	Permanently flooded	0.0 Sweet	8.73 Alkaline	Mineral	+:	1	1

Vegetation: Reed, mace reed, bulrush.
Fauna: Wild ducks, frogs, snakes.
History: It is a landslide lake, formed when Cuejdiu rivulet was dammed in 1978. It keeps the morphology of a recent lake with slight clogging tendencies and a slight tendency of decrease of the water level. It is situated in Stânişoarei Mountains, in the middle course of Cuejdel, a tributary situated on the left side of Cuejdiu, about 21 km away from Piatra Neamţ Town. It has a surface of 2.2 ha, a length of 1 km, an average width of 102m, a maximum width of 185m, a water volume of about 907,000 m^3 and a depth of 16m. The landslide that blocked Cuejdel rivulet has a surface of 35 ha. It occurred in several stages, beginning with 1978 and culminating in 1991, when the entire valley was blocked. The natural dam has a height of 25-30m and a length of 80m.
T^0 – 20,6^{0}C
TDS – 78 mg/l
Electrical conductivity – 78 mS/cm
U- -97.5mV
O_2- 6.9 mg/l.

Figure 9. Crucii Lake formed following a landslide

Wetland: Colibiţa Lake
Geographic coordinates: lat. $47^0$16'60'' N; long. $24^0$93'54'' E.

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Colibiţa Lake	Lacuster	Limnetic	Unconsolidated substratum	Silt	Permanent	0.0 Sweet	9.8 Alkaline	Mineral	+:	3-2	2-1

Vegetation: Coniferous trees.
Fauna: Low ecological importance.
History: Storage lake on Bistriţa Ardeleană in Călimani Mountains (Bistriţa-Năsăud County). It is meant to supply water for Bistriţa Town. It was built between 1977-1991and has the following features: 270 ha, 13 km length, 65 mln.m^3 volume. It is situated at an altitude of 804m.
T^0 – 21.8^0C
TDS – 28mg/l
Electrical conductivity – 28µS/cm
U- -118^{mV}
O_2- 6.4mg/l; 77%; 130mbar.

Figure 10. Colibiţa Lake, supplying water for Bistriţa Town

Wetland: Lacul Roşu
Geographic coordinates: lat. $46^0$47' N; long. $25^0$47' E.

Wetland	System	Subsystem	Class	Subclass	Water regime	Salinity	pH	Soil type	Evolution	Level of protection	Perspectives
Roşu Lake	Lacuster	Limnetic	Unconsolidated substratum	Silt	Permanently flooded	0.0 Sweet	8.04 Alkaline	Organic	+:	2	1

Vegetation: Mace reed, bulrush, osier, willow, alder, wetland lawn.
Fauna: Wild ducks, frogs, snakes.
History: Lake formed following a landslide triggered by a strong rain in July 1837. The landslide diluvium, coming from Ghilcoş (Ucigaşu) Mountain, dammed Bicaz rivulet. It used to be known as well as Lacul Ucigaş ("the killing lake"). It is fed by the waters of the rivulets Oii, Licaş, Suhard etc. It is situated at an absolute height of 983m, it has a surface of 11 ha, a water volume of 580,000 m^3 and a maximum depth of 11.5m. The lake is shaped as an "L" and about 100 years ago it had a maximum length of 1300m and a minimum length of 650m. Because of clogging, actually it is 900m long and 435m wide.
T^0 – 17.8^0C
TDS – 151.6 mg/l
Electrical conductivity – 151.6 S/cm
U- -56.8mV
O_2- 9.23 mg/l, 108.9%.

Figure 11. Roşu Lake and Suhard Mountain

A particular case is represented by Crucii Lake, formed following a landslide that dammed Cuejdel rivulet. This lake is found in a relatively isolated area. For this reason, its natural evolution has not been influenced by man's activity. Lately, numerous tourists have come to visit the area, especially during the weekend, which can affect the wetland in the areas situated on the borders of the lake.

The dominant herbaceous vegetation is made up of sedge, reeds and wetland lawns, and, reed plots, while the tree vegetation is made up of alder, willow and poplar.

4. Conclusions

The lake wetlands of the Central Group of the East Carpathian Mountains are relatively limited following the fact that the lakes had to develop in valleys with steep slopes. A more important development of the lake wetlands can be noticed in the case of the natural lakes (Roşu and Crucii) and in the upstream sector of the anthropic lakes, at the mouths of the main rivers that feed them. Sfânta Ana Lake has a relatively limited wetland area because its strongly alkaline waters do not permit the development of rich vegetation.

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References

Gâştescu P. (1963), *Lacurile din R.P.Română-geneză şi regim hidrologic,* Editura Academiei Române, Bucureşti.

Gâştescu P. (1971), *Lacurile din România – limnologie regională*, Edit. Academiei R.S.România, Bucureşti.

Gâştescu P. (1979), *Lacurile Terrei*, Edit. Albatros, Bucureşti.

Gâştescu P. (1990), *Fluviile Terrei,* Edit. Sport-Turism, Bucureşti.

Gâştescu P. (1998), *Limnologie şi Oceanografie*, Edit. H.G.A., Bucureşti.

Pandi G. (2004), *Lacul Roşu. Studiu hidrogeografic,* Editura Casa Cărţii de Ştiinţă,

Cluj-Napoca.
Pişota I. (1958), *Lacurile de pe flancul nordic al Munţilor Făgăraş.* In: Realizări în geografia R.P.Române, Editura Ştiinţifică, Bucureşti.
Pişota I. (1971), *Lacurile glaciare din Carpaţii Meridionali. Studiu hidrologic,* Editura Academiei Române, Bucureşti.
Romanescu Gh., Romanescu G. (2008), *Inventarierea si tipologia zonelor umede si apelor adânci din Grupa Nordica a Carpatilor Orientali*, Editura Terra Nostra, Iasi.
Romanescu Gh., Romanescu G., Minea I., Ursu A., Margarint M.C., Stoleriu C. (2005), *Inventarierea si tipologia zonelor umede din Podisul Moldovei. Studiu de caz pentru judetele Iasi si Botosani*, Editura Didactica si Pedagogica, Bucuresti.
Romanescu Gh., Romanescu G., Stoleriu C., Ursu A. (2008), *Inventarierea si tipologia zonelor umede si apelor adânci din Podisul Moldovei*, Editura Terra Nostra, Iasi.
Teodor S. (1999), *Lacul de baraj şi noua morfodinamică. Studii de caz pentru râul Argeş,* Editura Vergiliu, Bucureşti.
Trufaş V. (1961), *Lacurile din relieful glaciar al Munţilor Şurianu,* MHGA, VI,1, Bucureşti.