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ASPECTS CONCERNING THE CLOGGING OF PUCIOASA LAKE

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Abstract

Pucioasa Lake, situated upstream from the locality bearing the same name, was put into operation in 1975. The initial volume was 10.764 million m^3, yet the main problem is the intensive storage of alluvial deposits, due to the fact that it retains most of the solid flow brought by Ialomiţa River and by its tributaries. This has led to an intense clogging with a substantial reduction of the water volume held, so that, in 2006, the calculated volume for a height of 418 m was of 6.47 million m^3, in the context of a relatively cleaned basin after the high floods of 2005 and 2006, generated by the evacuation operations. After the years 2007 and 2008, when no high floods were recorded and so no cleaning, but just massive storage of alluvial deposits, in 2009 the water volume at 418 m was just of 3.59 million m^3, which gave birth to a clogging of about 63% of the initial volume. The reasons leading to the clogging situation are: the change of the rivers' slope in the upstream area, the increase of the river's erosion level, its location downstream from the confluence with Ialomicioara Leaotei, with a hydrographic basin developed largely in the deforested Subcarpathian area, made up of easily erodible materials.

Keywords: lake, Pucioasa, clogging, water volume.

INTRODUCTIVE NOTIONS. GEOGRAPHIC POSITION

In general, a dam lake represents a complex system, tending to clog, from a morphological perspective. Due to the fact that this type of system is realized anthropically, for different purposes, the analysis of the factors influencing the clogging processes is strictly necessary to locate them from the perspective of the occurrence of this phenomenon in the lake basin, generated by the alluvial deposits triggered by another complex of interdependent factors. The hydrographic basin of the Pucioasa Lake has an area of 428.3 km^2, representing 4.14% of the total area of the Ialomiţa hydrographic basin (10.350 km^2), of which 73% is situated in the alpine area (313.15 km^2) and 27% in the Subcarpathians (115.15 km^2) - Fig. 1.

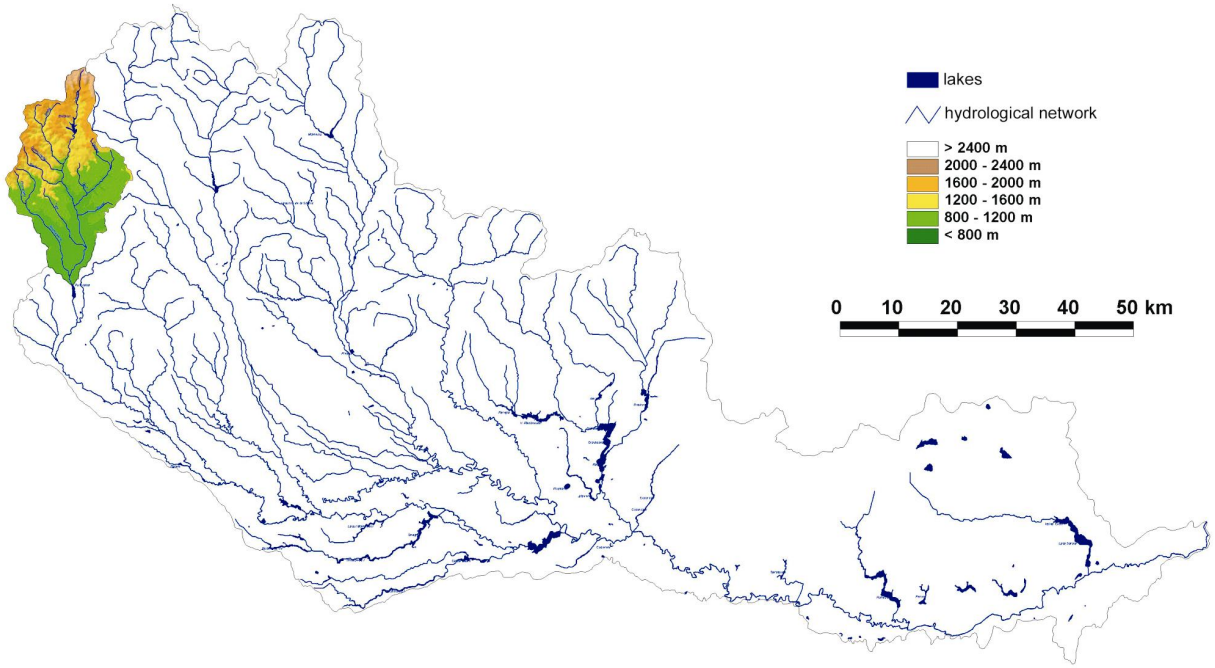

Fig. 1. Geographic position of the hydrographic basin of the Pucioasa Lake

The lake's hydrographic basin gathers the waters of the hydrographic basins of the Upper Ialomiţa River and of the tributaries that come together in the respective Subcarpathian area, upstream from the lake. From the alpine area, important are the hydrographic basins of the tributaries merging downstream from the

Scropoasa Lake, because along the alpine Ialomița, there are two more storage lakes, the one just mentioned and Bolboci Lake. Pucioasa Lake, included in the arrangement system of Ialomița River, is situated in the homonymous locality. Its form is elongated, reaching a maximum length of 2.3 km, a maximum width of 0.4 km and a total area of 90.54 ha (at a normal retention level) and 115 ha for a maximum level. Its functions are complex and its initial volume was of 10.764 million m^3. The geological units have changed in the storage area of the Ialomița basin, in its upper area, because the main source areas for the sedimentary component in the zone under analysis are represented by the southern compartment of the crystalline-Mesozoic area of the Oriental Carpathians (the Unit Leaota-Bucegi-Postăvaru - Piatra Mare), and the internal and external flysch of the same Carpathian segment. The lithological component, through its specific physical-mechanical and chemical properties intervenes in the dimensions of the production of alluvial deposits in suspension and imposes the clogging rhythm of the storage lakes. The research works presented in the present paper, focused on the southern extremity of the upper sector of Ialomița basin – the storage lake from Pucioasa, makes a quantitative connection between the geological bed and the storage-depositing processes, due to the construction of the storage lakes from Bolboci and Pucioasa, in the upper, alpine area of this lake (Fig. 2).

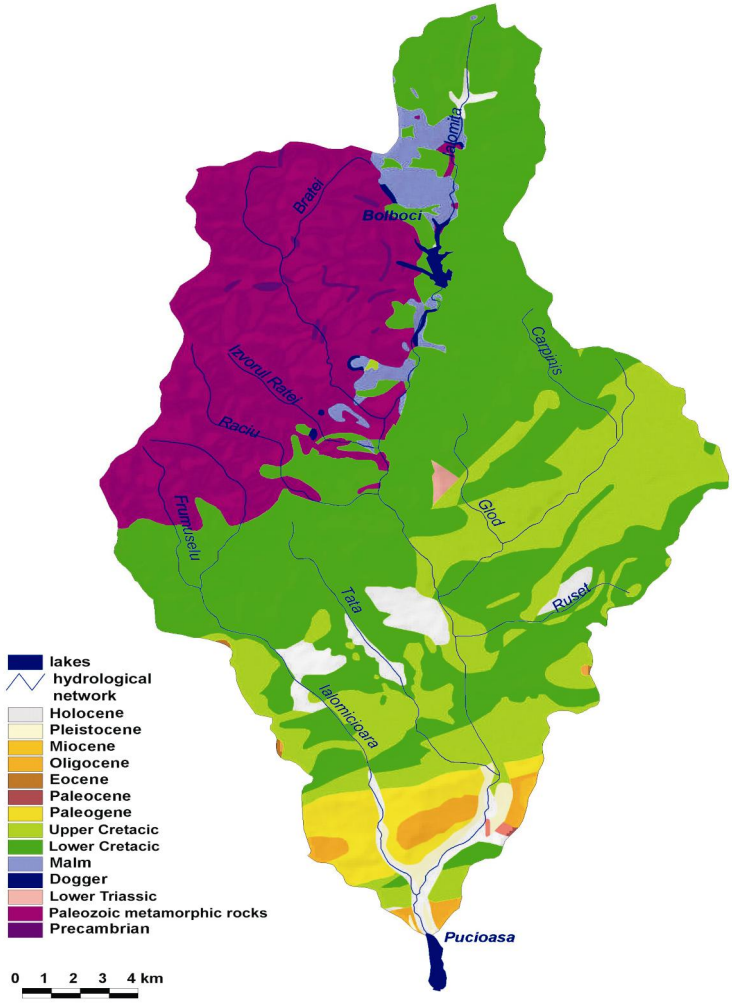

Fig. 2. Geological map of the hydrographic basin of Pucioasa Lake

The actual specific processes generating alluvial deposits in the alpine area are related to the freezing and melting processes and to the fluvial-torrential ones, which affect especially the lakes situated in the alpine areas and in the upper hydrographic basins of the tributaries, which are mainly the Ialomicioara of the Leaota Mountains and the Ialomicioara of the Păduchiosu Mountain. In the present case, a special concern goes to the tributaries characteristic for the Subcarpathian area, where the lithological substratum, the precipitations - which are frequently torrential or last for long periods of time – favor the appearance and development of some complex slope-related geomorphological processes.

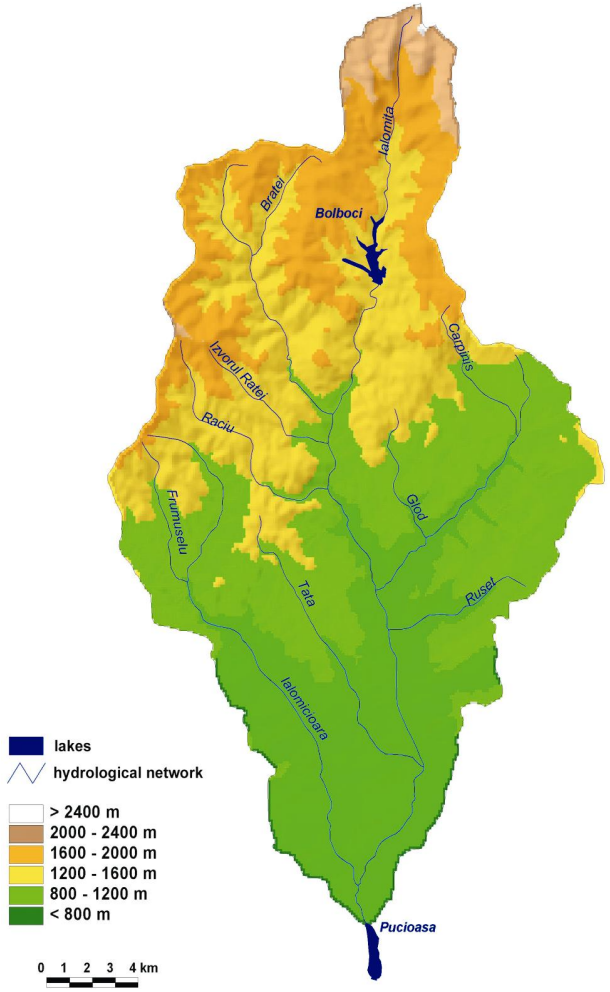

Fig. 3. Hypsometric map

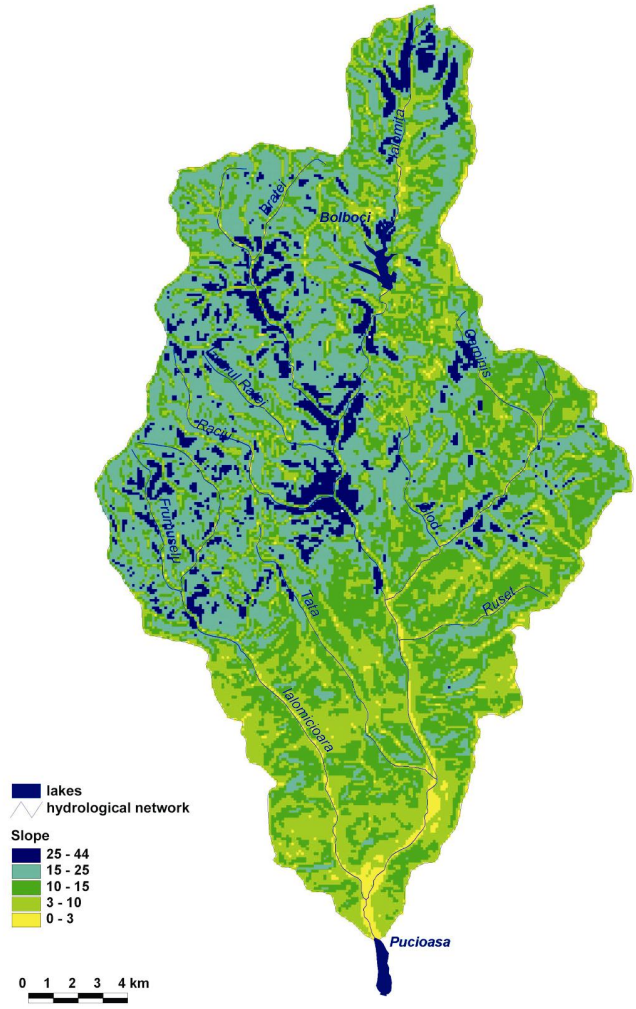

Fig. 4. Slope map

2. WORK DATA AND METHODS

The analysis of the dams' impact on the relief dynamics was carried out relying on a series of methodologies, which included observations out in the field, in the laboratory and data processing. In the present study, to highlight the present situation of the clogging condition of the lake basin and the changes that intervened in its configuration, we analyzed the bathymetric maps and interpreted the measurements realized by the National Administration of the Romanian Waters, the Office of Buzău-Ialomița (Administrația Națională Apele Române, Direcția Apelor Buzău – Ialomița). In this sense, we compared the bathymetric maps realized in the years 1985, 1993 and 2009, the data resulted following the calculation of the surfaces between the altitudes of 405 and 418 m, and also the results of the calculations concerning the comparative water volumes.

3. RESULTS

Seeing that the topographic surface adjacent to a lake basin represents its main provider of alluvial deposits, we were interested in the morphodynamics of the relief of the hydrographic basin. The realization of this lake triggered a change in the rivers' slope, an increase of the erosion level from 395m (initially) to 410m (storage lake level). This was also the result of its location in a Subcarpathian area that is lithologically made up of easily erodible materials and also deforested (fig. 3-4). The volume of the flow of alluvial deposits in suspension grows from Moroeni (0.5 kg/s), at the entrance in the Subcarpathians, to 2.8 kg/s at Pietroşița, reaching 4.12 kg/s at Fieni and 5.6 kg/s at the entrance in Pucioasa Lake (V. Loghin, 2001). During a year, the largest quantities of alluvial deposits in suspension are transported during the months of

April-June, and the lowest during September-October.

As far as the seasonal repartition is concerned, the first place is occupied by the summer (40-50%), and the last by the autumn (8-10%). The specific module (γ) for normal waters is 1 t/ha/year, at the contact between the mountains and the Subcarpathians, reaching values of 2-5 t/ha/year, and even up to 10 t/ha/year in the Subcarpathian area. As far as the tributaries of Ialomița are concerned, one can notice that the largest volumes of alluvial deposits recorded on Ialomicioara are transported in the summer (over 60% of the yearly total), and the lowest in the autumn (6.92%). During the high flood phenomena, the tributaries of Ialomița can transport impressive quantities of alluvial deposits in suspension. For instance, during the high flood of 2001, Ialomița River, at Moroeni (Town), transported 6 t/ha/an, and in Fieni (Town), after the confluence with Ialomicioara River, it reached 16 t/ha/year of alluvial deposits accumulated in the storage lake from Pucioasa (tables 1-2).

Table 1. Morphometric elements of the Ialomiţa River and its tributaries in the dam sectors of the water courses

No.	River	Confluence Section	L km	F km^2	H med. m	Q amm m^3/s	W am m mil. m
1.	Ialomiţa	b. Bolboci	10.75	54	1680	1.05	33
2.	Ialomiţa	b. Dobreşti	22	134	1634	2.85	90
3.	Ialomicioara I		14	75	1004	1.10	34
4.	Ialomiţa	Ialomicioara	45	333	1223	4.88	154
5.	Ialomicioara II		27	95	903	1.09	34
6.	Ialomiţa	b. Pucioasa	54	448	1121	5.60	176

Table 2. Typical hydrograph of the high flood waves characteristic for the first dam sections

Storage lake	Unitary hydrograph				Maximal flows for different security levels (m^3/s)						
	Q max. (mc/s)	T cr. (ore)	Tt	γ	20%	10%	5%	1%	0.5%	0.1%	0.01%
Pucioasa	410	9	65	0,26	-	-	-	410	-	775	-

Source: Data from the Hydrological station of Târgovişte, quoted by O. Murărescu (2004).

So, while the lake's initial water volume of 1974 of the Pucioasa Lake was 10,764,000 m^3, the clogging led to a water volume of 5,679,153 m^3 in 1993 (the lake was 47% clogged, respectively 5,084,847 m^3) - fig. 5-6.

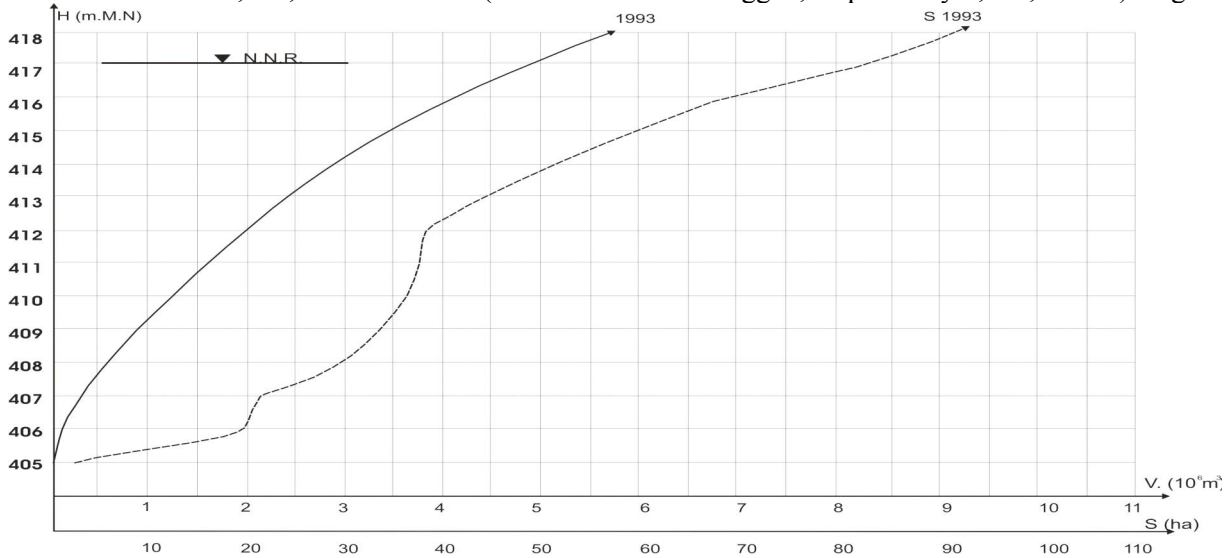

Fig. 5. Volume and clogging curve in 1993 (processing after Romanian Waters, RA, Buzău-Ialomiţa)

On the level of the above-mentioned year, one can notice that the clogging degree was higher compared to the one of 1985, when the water volume was of about 6 million m^3. So, one can notice a progressive clogging from 1974 to 1993. The same situation occurred as well until the bathimetric measurements of 2009, as one can see in Fig. 7-8.

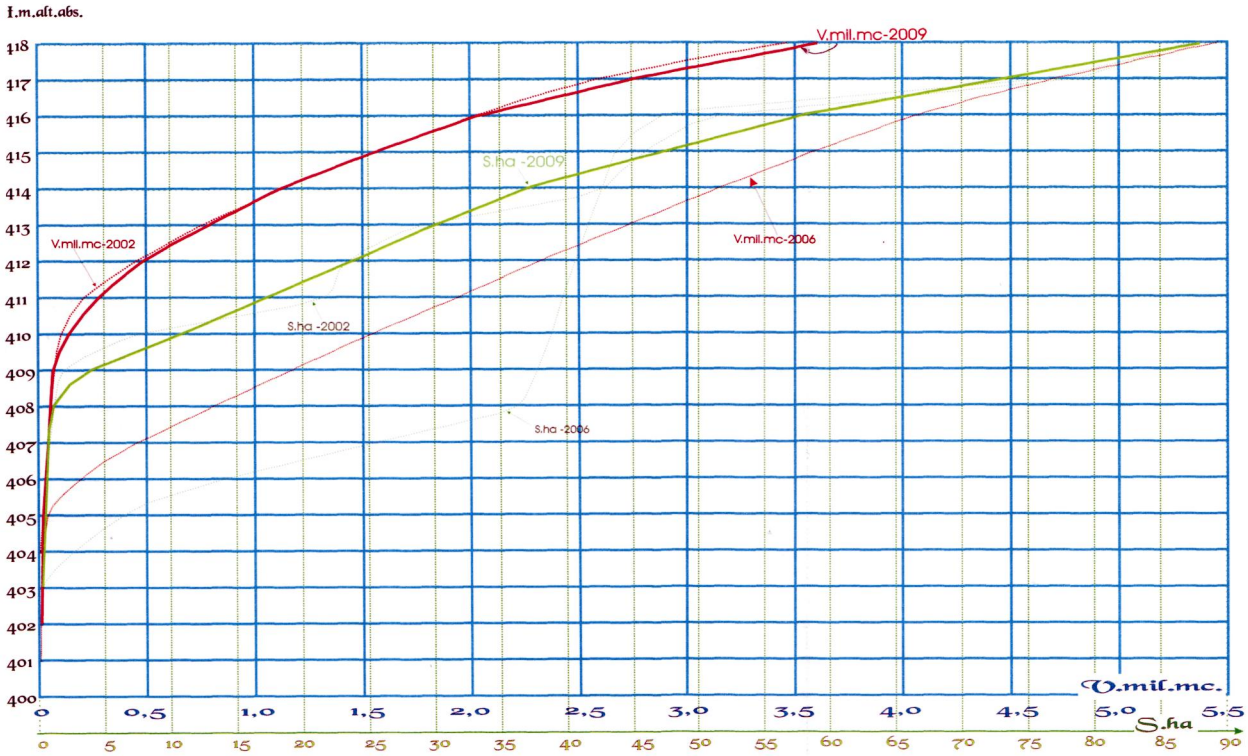

Fig. 6. Volume and clogging curve in 2009 (source: Romanian Waters, RA, Buzău-Ialomiţa)

On the level of the last year of reference of this study, it was noticed that the water volume at the level of 418 m was 3.59 million m^3, and intermediately, in the year 2006, the water volume was 5.47 million m^3 (fig. 8). The situation of the year 2006 can be considered the result of the controlled evacuation maneuvers from the period of the high floods of 2005-2006, which caused the washing of the lake basin. During the years immediately following this period (2007-2008) no special high-flood phenomena were recorded, which led to the supposition that no such works are needed, which favored the massive storage of alluvial deposits, the situation being approximately similar to that of the year 2002.
Actually, the clogging of the lake basin in the year 2009 was of 63%, with sediment thicknesses of 10-12m, including the development of a fluvial-lacustrine plane at the tail of the lake and the modification of the direction of the water entrance in the river, which had an obvious impact on the lake's functionality.

CONCLUSIONS

The results of this research allow us to conclude that the storage lake from Pucioasa has gone through an intense clogging during its existence, its retention capacity decreasing by up to 60% compared to the initial one, with sediments whose thickness goes over 10 m, despite the realization of wash-ups generated by the lake discharges following some special high-flood type hydrological phenomena. The intense clogging of the lake basin might have a major impact on the functionality of the storage lake, especially as far as the regulation of the river flow regime and the attenuation of the high flood waves are concerned.

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