FLORA AND VEGETATION OF SÂNANDREI RESERVOIR (TIMIŞ COUNTY), BEFORE AND AFTER DRAINING

NEACŞU Alina, ARSENE G.-Gabriel, STROIA Ciprian, STROIA Marius

Abstract. The research performed in the area of Sânandrei reservoir, in the period 2005-2010, have allowed us to observe aspects of the lake flora and vegetation, before and after draining (spring of 2007). Our study implied the chemical analysis of the water and the analysis of the flora and vegetation. Therefore, we took water samples and after their analysis, based on the obtained results, we established the quality class of the water in the studied reservoir, this being 5th quality class, corresponding to a poor water quality. This influences in a negative manner the vegetal biodiversity, the aquatic macrophytes - more sensitive to certain substances - being absent from the lake area. Regarding the flora inventory, we have identified in the area 119 cormophyte species, appertaining to 43 botanical families. 36 of these are aquatic and paludicolous plants, the presence of which was directly influenced by the draining. The analysis of flora per life forms indicates the significant presence of hemicryptophytes and annual terrophytes. From the viewpoint of floristic elements, most species are Eurasian and cosmopolite. As for humidity, most species are xeromesophytes, regarding temperature, mesothermals are predominant, and as for soil reaction, the species are mainly weakly-acid neutrophilic and amphitolerant. The data collected for vegetation allowed us to identify 13 vegetal associations. Following the lake draining, the aquatic flora and vegetation have disappeared. Also some paludicolous associations, which feel the lack of water, have disappeared, have been endangered or have reduced considerably the areas they used to occupy. The evolution tendency of the vegetation is towards woody, pioneering associations, such as those edified by willows, edified associations of ruderal species appearing on the shore. We deem it important to continue observing the vegetation dynamics under various view points (vegetal biodiversity, rhythm, competition among species, spatial dynamics of phytocoenoses etc.).

Keywords: water quality, flora, vegetation dynamics, draining.

Rezumat. Flora şi vegetaţia lacului de acumulare Sânandrei (judeţul Timiş), înainte şi după desecare. Cercetările întreprinse în perimetrul lacului de acumulare Sânandrei, în perioada 2005-2010, ne-au permis să surprindem aspecte din flora şi vegetaţia lacului, înainte şi după desecare (primăvara anului 2007). Studiul nostru a presupus analiza chimică a apei şi analiza florei şi vegetaţiei. În acest sens, am prelevat probe de apă şi după analiza acestora, pe baza rezultatelor obţinute, am stabilit clasa de calitate în care se încadrează apa din acumularea studiată, aceasta fiind clasa a V-a de calitate, ceea ce corespunde unei ape de calitate proastă. Acest lucru influenţează negativ biodiversitatea vegetală, macrofitele acvatice mai sensibile la anumite substanţe lipsind din perimetrul acumulării. În ceea ce priveşte inventarierea florei, am identificat în perimetrul acumulării, 119 specii de cormofite aparţinând la 43 de familii botanice. 36 dintre acestea sunt plante acvatice şi palustre a căror prezenţă a fost afectată direct de desecare. Analiza florei pe categorii de bioforme, indică prezenţa însemnată a hemicriptofitelor şi terofitelor anuale. Sub aspectul geoelementelor, majoritatea speciilor sunt eurasiatice şi cosmopolite. Faţă de umiditate, cele mai multe specii sunt xeromezofite, în ceea ce priveşte temperatura, predomină mezotermele, iar faţă de reacţia solului, speciile sunt în principal slab-acid neutrofile şi amfitolerante. Datele prelevate pentru vegetaţie, ne-au permis să identificăm 13 asociaţii vegetale. În urma desecării lacului, flora şi vegetaţia acvatică au dispărut. De asemenea, unele asociaţii palustre, care resimt lipsa apei, au dispărut, sunt ameninţate cu dispariţia sau şi-au redus considerabil suprafeţele ocupate în trecut. Tendinţa de evoluţie a vegetaţiei este către asociaţii lemnoase, pioniere, precum cele edificate de sălcii, pe mal instalându-se asociaţii edificate de specii ruderale. Considerăm important de urmărit în continuare, dinamica vegetaţiei sub diverse aspecte (biodiversitate vegetală, ritm, competiţia dintre specii, dinamica spaţială a fitocenozelor etc.).

Cuvinte cheie: calitatea apei, floră, dinamica vegetaţiei, desecare.

INTRODUCTION

" ... in the old days, the land near the Mureş and along the Tisa, from Seghedin to beyond Titel, used to be marshy" (GRISELINI, 1984). Since the 17th century in Banat, there have been performed draining works with a view to manage waters for different human uses. Today, in Banat, the natural humid areas have decreased as surface due to this reason, at the same time being founded artificial reservoirs, on considerable surfaces. This is also the case of Sânandrei reservoir, built on the course of the Valea Lacului rivulet, in 1971, on an area of 50 hectares, at an altitude of 117 m. The lake is managed by a trading company which, before drainage, used to exploit it for fishing and pleasure. The drainage works, performed in the year 2007, have deeply influenced the vegetal carpet, leading to the extinction of the aquatic flora and vegetation and to the scarcity of the paludicolous one, with direct effects upon biodiversity.

MATERIAL AND METHODS

Our research has been undergone in the period 2005-2010, in the area of Sânandrei reservoir. Thus, we had in view establishing the quality of the water in the accumulation mentioned and the study of the flora and vegetation. On collecting the water samples we took into account the recommendations comprised in the norm no. 121/2006. The chemical analysis of the water samples was also performed according to the quality standards comprised in the norm no. 121/2006, in the laboratory of the National Administration "Romanian Waters" Banat Waters Agency–Timisoara, and consisted in establishing the oxygen regime, the nutrients, the pH, suspensions, and total water hardness. The study of

the flora took place in two stages, on the field and in the laboratory. The study on the field consisted in repeated trips in the mentioned area, on which occasion we accomplished the inventory of the species, we collected the botanical material that could not be inventoried on the field, with a view to the analysis and we made annotations concerning certain relevant aspects of the flora that we have noticed. In the laboratory, we set the botanical material collected, on which occasion we established the inventory of the flora, we assigned to each species the category of geoelement, the bioform and the values of the autecological indices for soil humidity (U), area temperature (T), and soil reaction (R), then performing the synecological analysis of the flora. The study of the vegetation was carried out in keeping with the methodology of the Central-European floristic phytocoenological school, based on which the fundamental study unit of the vegetal carpet is the vegetal association. Thus, we performed phytocoenological sampling and, after data processing, subsequent to comparing to the specialized literature, we established the vegetal associations. Then, we drew up the summary of the vegetation and we analyzed the vegetal associations from various viewpoints. For determining the species, we used CIOCÂRLAN (2009) and Flora R.S.R. Marking down of indices was performed by SANDA et al. (1983). For the study of the vegetation we used SANDA et al. (1998) and SANDA (2002).

RESULTS AND DISCUSSIONS

The results of the chemical analysis performed for the water sample collected from Sânandrei reservoir (Table 1) indicated that the water is of a poor quality, being classified in the 5th quality class as the value found in the case of nitrites corresponds to this class. The values of the other parameters correspond to the limits of the classes 1st – 4th, as it follows: ammonium nitrogen – 4th class, nitrates – 2nd class, phosphates – 1st class, dissolved oxygen – 2nd class, permanganate index – 4th class, biochemical oxygen consumption – 1st class. The pH value was set to 8.5, the suspensions load was reduced, and considering the hardness, it was established that the water is moderately hard. The high value of the nitrogen compounds is explained by the fact that in the area of the reservoir, there used to be located animal farms, where the debris discharge was performed in an uncontrolled manner, and that in the vicinity of the accumulation, there are cereal crops on which chemical fertilization is applied.

Table 1. The results of the chemical analysis performed for the water sample collected from Sânandrei reservoir (according to the analysis report AT 406 / October 30, 2005).
Tabel 1. Rezultatele analizei chimice efectuată pentru proba de apă prelevată din acumularea Sânandrei (conform buletinului de analiză AT 406 / 30. 10. 2005).

No.	Analyzed parameters	U/M	Method of analysis	Obtained value	Quality class – limits approved				
					1st	2nd	3rd	4th	5th
1.	Ammonium nitrogen ($N\text{-}NH_4^+$)	mg N/l	SR ISO 7150/2	1.48	0.4	0.8	1.2	3.2	> 3.2
2.	Nitrites ($N\text{-}NO_2^-$)	mg N/l	SR ISO 6777/96	0.45	0.01	0.03	0.06	0.3	> 0.3
3.	Nitrates ($N\text{-}NO_3^-$)	mg N/l	SR-7890/3-2000	1.81	1	3	5.6	11.2	> 11.2
4.	Phosphates/ Phosphorous ($P\text{-}PO_4^{3-}$)	mg P/l	SR EN 1189-2000	0.01	0.1	0.2	0.4	0.9	> 0.9
5.	Dissolved Oxygen (O_2)	mg O_2/l	SR EN 25813-2000	8.87	9	7	5	4	< 4
6.	Permanganate index (CCO-Mn)	mg O_2/l	SR EN ISO 8467/01	21.2	5	10	20	50	> 50
7.	CBO_5	mg O_2/l	SR ISO 5815/89	0.76	3	5	7	20	> 20
8.	pH	-	SR ISO 10523-97	8.55	6.5 – 8.5				
9.	Suspensions	mg/l	STAS 6953-81	61	-				
10.	Total hardness	^{0} Ge	STAS 3026-76	16.0	-				

The research carried out on the flora materialized by the inventory of 119 species of cormophytes, 36 of them being represented by aquatic and paludicolous plants (Table 2). The reduced diversity of aquatic macrophytes is closely connected to the quality of the water. Moreover, after performing the drainage works, due to the lack of water, aquatic plants such as *Lemna minor* L., *Polygonum amphibium* L., *Potamogeton crispus* L., *P. natans* L., *P. pectinatus* L., *Ranunculus aquatilis* L., *Spirodela polyrhiza* (L.) SCHLEICHEN, *Bolboschoenus maritimus* (L.) PALLAS have gone extinct. Also the paludicolous species have been affected by the lack of water, such that *Mentha aquatica* L., *Butomus umbellatus* L., *Glyceria maxima* (HARTM.) HOLMBERG., *Phalaris arundinaceea* L., *Lysimachia nummularia* L. are absent in the new environmental conditions.

As mentioned at Methods, the flora was analyzed considering several aspects: per categories of life forms, phytogeographical elements and under the aspect of humidity, temperature and soil reaction. Out of the flora analysis, we obtained the following results:

- the predominant life forms are represented by hemicryptophytes (*Symphytum officinale* L., *Sambucus ebulus* L., *Euphorbia cyparissias* L., *Calamagrostis epigeios* (L.) ROTH., *Potentilla reptans* L. etc.) and annual terophytes (*Bidens tripartita* L., *Ambrosia artemisiifolia* L., *Xanthium strumarium* L., *Polygonum persicaria* L., *Datura stramonium* L. etc.);

Table 2. Aquatic and paludicolous plants identified in Sânandrei reservoir.
Tabel 2. Plante acvatice şi palustre identificate în lacul de acumulare Sânandrei.

No.	Bioform	Geoelement	U	Species
1.	H	Eua	4	*Alopecurus pratensis* L.
2.	Th	Eua	4,5	*Bidens tripartita* L.
3.	HH	Cosm	6	*Bolboschoenus maritimus* (L.) PALLAS
4.	HH	Eua	6	*Butomus umbellatus* L.
5.	H	Eua	4	*Calystegia sepium* (L.) R. BR.
6.	HH	Eua	5	*Carex riparia* CURTIS
7.	TH	Eua	4	*Dipsacus laciniatus* L.
8.	Th	Cosm	4	*Echinochloa crus-galli* (L.) BEAUV.
9.	HH	Cosm	5	*Glyceria maxima* (HARTM.) HOLMBERG.
10.	H	Cosm	4,5	*Juncus effusus* L.
11.	HH	Cosm	6	*Lemna minor* L.
12.	HH	Eua	5	*Lycopus europaeus* L.
13.	Ch	Eur	4	*Lysimachia nummularia* L.
14.	H	Eua	5	*Lysimachia vulgaris* L.
15.	H	Cosm	4	*Lythrum salicaria* L.
16.	HH	Eua	5	*Mentha aquatica* L.
17.	H	Eua	4,5	*Mentha longifolia* (L.) HUDSON
18.	HH	Circ	5	*Phalaris arundinaceea* L.
19.	HH	Cosm	5	*Phragmites australis* (CAV.) STEUDEL
20.	G	Cosm	6	*Polygonum amphibium* L.
21.	Th	Eua	4,5	*Polygonum persicaria* L.
22.	MM	Eua	4	*Populus nigra* L.
23.	HH	Cosm	6	*Potamogeton crispus* L.
24.	HH	Cosm	6	*Potamogeton natans* L.
25.	HH	Cosm	6	*Potamogeton pectinatus* L.
26.	HH	Cosm	6	*Ranunculus aquatilis* L.
27.	H	Eua	4	*Ranunculus repens* L.
28.	H	Euc	4	*Rorippa austriaca* (CRANTZ) BESSER
29.	H	Eua	4,5	*Rubus caesius* L.
30.	H	Eua	4	*Rumex crispus* L.
31.	MM	Eua	5	*Salix alba* L.
32.	M	Eua	5	*Salix cinerea* L.
33.	Ch	Eua	4,5	*Solanum dulcamara* L.
34.	HH	Cosm	6	*Spirodela polyrhiza* (L.) SCHLEICHEN
35.	H	Eua	4	*Symphytum officinale* L.
36.	HH	Cosm	6	*Typha angustifolia* L.

- considering the geoelements, most species are Eurasian (the best represented category in our country's cormoflora): *Lycopus europaeus* L., *Calystegia sepium* (L.) R. BR., *Achillea millefolium* L., *Lactuca serriola* L., *Dipsacus laciniatus* L. etc. and cosmopolite (wide spread species, ubiquist): *Lemna minor* L., *Phragmites australis* (CAV.) STEUDEL, *Lythrum salicaria* L., *Convolvulus arvensis* L., *Potentilla reptans* L. etc.;

- related to humidity, most species are xero-mesophytes (grow on dry-weakly humid to weakly humid soils): *Echium vulgare* L., *Daucus carota* L., *Thlaspi arvense* L., *Salvia pratensis* L., *Linaria vulgaris* MILLER etc.;

- regarding temperature, the mesothermals are predominant: *Cichorium intybus* L., *Aristolochia clematitis* L., *Matricaria perforata* MÉRAT, *Carex hirta* L., *Glyceria maxima* (HARTM.) HOLMBERG. etc.;

- as for soil reaction, the species are mainly weakly-acid neutrophilic (grow on soils with pH of 6.0 – 6.8): *Rubus caesius* L., *Potamogeton natans* L., *Salix alba* L., *Urtica dioica* L., *Lathyrus tuberosus* L. etc.) and amphitolerant (with wide ecological amplitude concerning soil reaction)*: Mentha longifolia* (L.) HUDSON, *Ranunculus repens* L., *Elymus repens* (L.) GOULD., *Typha latifolia* L., *Plantago lanceolata* L. etc.

Related to vegetation, after the centralization and processing of the field data, we have identified 13 vegetal associations, presented in what follows:

The summary of the coenotaxonomical units (mainly, based on SANDA et al., 1998):

Cls. LEMNETEA W. KOCH et TX. 1934
Ord. Lemnetalia W. KOCH et TX. 1954
Al. *Lemnion minoris* W. KOCH et TX. 1954

1. *Lemnetum minoris* (OBERD. 1957) MÜLLER et GÖRS 1960 (association of duckweed)

Cls. POTAMOGETONETEA PECTINATI R. Tx. et PRSG. 1942
Ord. Potamogetonetalia pectinati W. KOCH 1926
Al. *Potamogetion pussili* VOLLMAR em. HEJNÝ 1978

2. *Myriophyllo – Potametum* SOÓ 1934, subass. *myriophylletousm spicati* SOÓ 1957 (association of water milfoil and arrowgrass)

Cls. POTAMETEA TX. et PRSG. 1942
Ord. Potametalia W. KOCH 1926

Al. *Nymphaeion* OBERD. 1957 emend. NEUHÄUSL 1959

3. *Polygono – Potametum* natantis SOÓ 1964 = *Polygonetum natantis* SOÓ 1927, subass. *potametosum natantis* SOÓ 1964 (association of arrowgrass with pond smartweed)

Cls. PHRAGMITETEA TX. et PRSG. 1942

Ord. Phragmitetalia W. KOCH 1926 emend. PIGN. 1953

Al. *Phragmition australis* W. KOCH 1926

4. *Scirpo – Phragmitetum* W. KOCH 1926 = *Phragmitetum communis* (ALL. 1922) PIGN. 1953 = *Phragmitetum australis* SCHMALE 1939 = Scirpo – *Phragmitetum austro-orientale* SOÓ 1957 = *Phragmitetum natans* (BORZA 1960) NEDELCU 1967 (willow association)

5. *Typhaetum angustifoliae* PIGNATTI 1953 (association of narrow-leaf cattail)

6. *Typhaetum latifoliae* G. LANG 1973 (association of wide-leaf bulrush)

7. *Glycerietum maximae* HUECK 1931 = *Glycerietum aquaticae* NOWINSKI 1928 (association of manna grass)

8. *Phalaridetum arundinaceae* (HORVATIČ 1931) LIBBERT 1931

9. *Caricetum ripario – acutiformis* KOBENZA 1930 = *Caricetum ripariae* KNAPP et STOFFER 1962 (association of sedge)

Cls. ATREMISIETEA LOHM., PRSG. et TX. 1950

Ord. Artemisietalia LOHM. et TX. 1947

Al. *Arction lappae* TX. 1937 emend. SISS. 1946

10. *Sambucetum ebuli* (KAISER 1926) FELFÖLDY 1942 (danewort weeds)

Cls. SALICETEA PURPUREAE MORR 1958

Ord. Salicetalia purpureae MORR 1958

Al. *Salicion albae* (SOÓ 1930 n.n.) MÜLLER et GÖRS 1958

11. *Salicetum albae* ISSLER 1924 s.l. = *Salicetum albae – fragilis* ISSLER 1926 EM. SOÓ 1957 = *Salix alba – Polygonum hydropiper* DONIȚĂ et DIHORU, 1961 = *Hydroherbo – Salicetum albae* DONIȚĂ et al., 1966 = *Salici – Populetum* (TX.1931) MEJER DREES 1936 = *Populetum albae* (BR. – BL. 1931) BORZA 1937 = *Saliceto – Populeto – Alnetum* SLAVNIČ 1952 (association of white willow)

Cls. ALNETEA GLUTINOSAE Br.-Bl. et TX. ex WESTHOFF et al. 1946

Ord. Salicetalia auritae DOING 1962

Al. *Salicion cinereae* MÜLLER TH. et GÖRS ex PASS. 1961

12. *Rubo – Salicetum cinereae* SONASAK 1963 = *Rubo caesii – Salicetum cinereae* RAȚIU et GERGELY (1979) = *Alno – Salicetum cinereae* (KOBENZA 1950) PASS. 1956 (osier brushwood)

Cls. QUERCETEA PUBESCENTI-PETRAEAE (OBERD. 1948) JAKUCS 1060

Ord. Prunetalia TX. 1952

Al. *Prunion spinosae* SOÓ (1930, 1940) 1950

13. *Pruno spinosae – Crataegetum* HEUCK 1931 = *Carpino – Prunetum* TX. 1952, *Rubo caesii – Prunetum spinosae* RAȚIU & GERGELY 1979, *Prunetum moldavicae* DIHORU (1969) 1970, *Crataego – Prunetum dasyphyllae* JURKO 1964, *Crataegetum danubiale* JURKO 1958 (blackthorn)

Among these, the following have not been encountered subsequent to the drainage:

- *Lemnetum minoris* W. KOCH et TX. 1954,
- *Polygono-Potametum natantis* SOÓ 1964, subass. *potametosum natantis* SOÓ 1964,
- *Myriophyllo-Potametum* SOÓ 1934, subass. *myriophylletosum spicati* SOÓ 1957,
- *Typhaetum angustifoliae* PIGNATTI 1953,
- *Typhaetum latifoliae* G. LANG 1973,
- *Glycerietum maximae* HUECK 1931,
- *Phalaridetum arundinaceae* (HORVATIČ 1931) LIBBERT 1931.

Figure 1. Aspect of the lake vegetation, before and after draining.
Figura 1. Aspect din vegetația lacului, înainte şi după desecare (original).

From those previously presented, it is noticed that the drainage works carried out in the area of Sânandrei reservoir have deep effects upon the aquatic and paludicolous flora and vegetation (Fig. 1). The aquatic flora and vegetation have completely disappeared. The species of pond smartweed, duckweed or arrowgrass, which used to represent the vegetation of aquatic macrophytes, because of the new environmental conditions (lack of water) could not survive. Also, the string course of paludicolous vegetation that used to be set around the lake, at the borderline between water and land, misses today. Even some common associations in the past, such as reed and sedge, that used to occupy considerable surfaces, are now rarely encountered and on insignificant areas, them too feeling the absence of water. The reed appears to continue to exist, though physiognomically there are some modifications. Nevertheless, we have noticed the increase of the areas occupied by the phytocoenoses edified of *Urtica dioica* L., *Cirsium arvense* (L.) SCOP., *Ambrosia artemisiifolia* L., *Galium aparine* L., *Kochia scoparia* (L.) SCHRADER, *Sonchus arvensis* L., *Polygonum lapathifolium* L., meaning a heavy ruderalization of the vegetal carpet. On the shore, the edified phytocoenoses of blackthorn, nettle, hemlock and danewort grow luxuriantly. Here we mention again that in the past, in the vicinity of the lake, it used to be animal farms and that waste discharge used to be performed in an uncontrolled manner. This explains the high presence of the above mentioned phytocoenoses, edified by species that grow well on soils rich in nitrogen. The evolution tendency of the vegetation is towards woody, pioneering associations, thus we mention the expansion of *Salix* species growing on the drained area.

CONCLUSIONS

Sânandrei reservoir was considered among the four largest water accumulations in Timiş County. It sheltered a characteristic flora and vegetation that, following drainage, have been severely affected.

Our research, carried out in the period 2005-2010, present aspects of the flora and vegetation of the lake, before and after the drainage. Thus we inventoried 119 species of plants and 13 vegetal associations.

We observed that the diversity of the aquatic flora and vegetation got reduced and we considered it the effect of the poor water quality. In addition, due to the lake drainage (in the spring of 2007) they disappeared completely. The paludicolous species have been affected as well by the lack of water, they withdrawing very much from their area and concentrating in certain water spots that preserved some humidity. For this reason the original flora and vegetation, which used to depend upon the humid environment, were replaced by other category of plants, mainly ruderal, adapted to the new conditions. On the area that used to be occupied by water, there have developed new plants and phytocoenoses. The reeds, sedge, even red plots that remained until today do not have the physiognomy from the past, the former have considerably reduced their area, only subsisting in some micro-depressions.

We deem it important to continue observing the evolution tendencies of the flora and vegetation, due to the radical modifications of the biotope and the fragmentation of the area of many species and phytocoenoses that used to be frequent before the drainage and that today appear only isolated, in small areas, with a reduced number of individuals.

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Neacşu Alina, Arsene G.- Gabriel, Stroia Ciprian, Stroia Marius
USAMVB, Timişoara, Botany Departement,
Calea Aradului 119, Timişoara, Romania
E-mail: alne76@yahoo.com

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