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Monitoring Gozna and Secu storage reservoirs in Semenic Mountains

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Abstract: Gozna and Secu storage reservoirs are developed in Semenic Mountains on Bârzava River with the scope to obtain electric energy, ensure industrial and drinking water needs for Resita City consumers. Around these lakes recreational areas were developed. In this paper the sampling and analysis method of water samples as well as monitoring program is presented in order to determine values of water quality parameters of those two lakes. The presented monitoring time is 9 years (2001-2009), water quality indicators in the reservoir have been water transparency, temperature, pH, dissolved oxygen, oxygen saturation, CBO_5, $CCOMn/O_2$, total nitrogen, total phophorous, phytoplankton density, phytoplankton biomass and clorophyll „a”.In the monitoring period, from a trophic point of view, the two reservoirs fall into mesotrophic category with eutrophication tendency, as a result of human activity in the area.

Keywords: storage reservoirs, Gozna, Secu, eutrophication, total nitrogen, total phosphorous, phytoplankton biomass.

1. INTRODUCTION - STORAGE RESERVOIRS FROM SEMENIC MOUNTAINS

Storage reservoirs are water management works formed after the execution of a dam on a water surface body. In the storage reservoir a certain water volume is retained which can be used with the purpose of modifying water flow time distribution [1].

In Semenic Mountains part of Banat hydrograph basin four storage reservoirs were developed, with specific characteristics presented in table 1 [2][3][4][5].

The catchment basin hillsides of Gozna reservoir are covered in most part with pine forests, and those of Secu reservoir with beech forests.

Water from the two reservoirs is used to produce electric energy and to ensure the needs of Resita City consumers. These sectors are also recreational areas.

2. MONITORING WATER QUALITY FROM GOZNA AND SECU STORAGE RESERVOIRS.

Water sampling from reservoir

The sampling techniques, handling, transport and storage of water samples for physico-chemical and biological trials are realised according to legal standards [6].

Choosing the sampling period is the first crucial element in analyzing phytoplankton communities. Setting a wrong sampling period during growth season or outside it can lead to errors when interpreting collected data, for example the lack of certain groups of algae.

Sampling is realised according to activity plan established by the Operation Manual. The Operation manual is established by the monitoring section according to provisions and requirements of Water Framework Directive (WFD) [7].

The recommended number of sampling campaigns in a year is 4 for reservoirs, with 3 campaigns in the growth and development season of phytoplankton, namely the period from May till October, including.

For reservoirs, the optimum periods of sampling should be established as follows:

- first campaign is at the end of winter, till the May, which is the period of mixing and corresponds with the first phase of phytoplankton growth, sometimes is the only period of growth in ultraoligotrophic environments;
- the second campaign starts at the middle of May till the end of June, this is the period when thermocline is stabilizing and corresponds to the spring season growth of phytoplankton;
- the third campaign must be set in July–August, in midsummer, when thermocline is well stabilised, this corresponds to the second growth of phytoplankton;
- the forth campaign is set between September and middle of October, at the end of summer stratiphication, but before the temperature drops and thermocline disappearance. This period corresponds to the maximum epilimnion.

Sampling section must be at a suffice distance from the shore, minimum 50 m, and for storage reservoirs outside the influence area of the dam, minimum 50m, 100 m, or 200 m, depending on the reservoir surface, in order to avoid contamination with

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periphyton algae or benthic, due to accumulation of floating algae in the bank area.

It is recommended that the number of sampling sections for phytoplankton, chlorophyll "a" and physico-chemical elements for natural reservoirs and storage reservoir be determined according to their surface:

- 0,5 km^2 – 1 km^2: one section at the middle of the reservoir;
- 1 km^2 – 10 km^2: two sections, namely: storage reservoir: one section at the dam, one section at the middle; natural reservoirs have two sections at the middle of the lake;
- > 100 km^2: four sections: storage reservoirs: one section at the dam, one section intermediate between the dam and the middle, one section at the middle of the lake, one section intermediate between the middle and the tale of the lake; natural reservoirs have four sections at the middle.

Once located, the GPS coordinates of the sampling points must be recorded so that the same place can be found in every campaign.

Sampling containers are chosen to eliminate as much as possible, interactions between water and other materials, glass for example.

The containers must protect the samples composition from absorption loss, evaporation, or contamination with foreign substances. It is recommended that the chosen container meet the following criteria: resistance to high temperatures, mechanical resistance, tight seal, the possibility of cleaning and reuse etc.

For organic compounds and biological species the use of glass bottles is recommended, but polyethylene can be also used.

Because light can influence aquatic organisms and may provoke unwanted chemical reactions, samples must be transported and kept in the dark until laboratory test are made. [8][9][10].

Parallel to sampling for analysis of phytoplankton and chlorophyll "a", samples are taken for analysis of support physico-chemical elements. Results from this analysis contribute to interpretation of biological data.

Analysis in the field will be made for physico-chemical elements, pH, dissolved oxygen, water transparency evaluated through Secchi disk (photo 1). Using Secchi disk to determine transparency allows us to calculate the depth to with the sample must be collected because photic area = 2.5*SD.

If pH, dissolved oxygen and conductivity determinations cannot be performed in the field they will be analysed in the laboratory.

Phytoplankton sample is taken during each campaign, from euphotic layer (God) corresponding layer of water between the surface and 2.5 times Secchi's disk depth. The sample characterises the entire photic area:

- when God is as reservoir depth, total transparency, integrated sample is taken at the surface till 1 meter from the lake bottom;
- if God < 3 m, a tube type sampling integrated system can be used;
- for God 3 – 5 m, a tube type sampling system can be used: device made from a silicon tube with a 10 – 15 m length, 18 -25 mm diameter, which presents a proper weight and is anchored by a rope;
- a deep reservoir, with God > 5 m, a Kemmerer type bathometer will be used with a graded rope or winch, samples will be taken from 0.5 – 0.5 m.

In all cases the sample volume is mixed into a larger collection container, for example a bucket, into which a small amount of all the samples, for phytoplankton, chlorophyll "a" and support physico-chemical elements analysis, will be included. For the integrated sample a suffice quantity of water will be taken, from which the analysis can be made: chlorophyll "a" – 1 litre of water; phytoplankton – 1 litre of water fixed with Lugol solution for determination of diatoms; 1 litre of water fixed with Lugol solution for the rest of taxonomic groups; physic-chemical support elements – 2 litres of water for general indicators analysis (oxygen regime, nutrients, organic load of water, etc.).

Sampling of phytoplankton, chlorophyll "a" and physico-chemical support elements from storage reservoirs and natural reservoirs are made according to N109/2008/04/15 Draft, "Guide for quality and quantity sampling of phytoplankton from inland waters [7]. Sampling device is craft made, as a silicone hose with a 10 – 15 m length, 18 – 25 mm diameter, which presents o proper weight, and achored by a rope. The end, which is not inserted in the water, presents a plug or valve. This integrate water sampling hose is showed in picture 2.

Fig. 1, Secchi disk

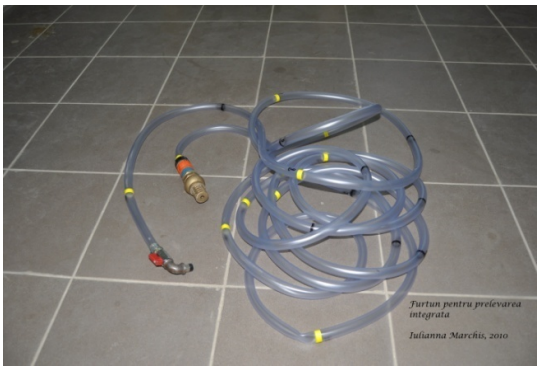

Fig. 2. Integrated water sampling hose

Bottles are filled completely with water and tightly sealed.

During and after each sampling, the sampling container does not have to be kept in direct sunlight or under rain, factors that can modify the sample. Contents of the container must be well shacked before sampling.

It is important that no matter what sampling technique was used, depth measurements must be precise.

In clear lakes, a sample from euphotic area must be collected. In turbid lakes, it is suffice to take a sample from the mix area (epilimnion).

During circulation phases, water sampling should be done till a depth of max 20 m, or 1 m above the sediment. In summer stagnation phase a distinction between two different states is made: turbid lakes: mixt sample from epilimnion and clear lakes: mix sample from euphotic area.

Phytoplankton samples are fixed in the field with alkaline solution of Lugol at a final concentration of 0.5%, ~5ml alkaline Lugol solution for 1 litre of sample, which will print a yellow brownish (whiskey) colour to the sample, Keeping the samples in the light leads to their discoloration. Samples will be checked periodically and if it is necessary fixing solution is added. The volume of fixing solution will not be taken into consideration in future calculations. A corresponding fixed sample can be stored up to four weeks, in the dark before analysis or twelve months if they are kept in the dark and cold (between 1 and 4°C). For longer storage periods, supplementary fixing solutions are added, for example formaldehyde.

Phytoplankton determination

Water sample bottles which must be analysed, after they have been fixed, can be stored until microscopic analyse a certain period without the sample quality being altered or modified.

Phytoplankton analysis is done by Utermohl method [11].

Phytoplankton analysis is accomplished through Utermohl method [11]. Take a bottle containing one litter of sample and mix the sample by slow circular motion for several minutes. After homogenization a volume of 50 ml is put in a settling chamber, which was previously cleaned and checked under a microscope to ensure that no traces of the previous sample are found.

Sedimentation chamber must be placed in a location away from vibration and rapid temperature variations. It is very important that before filling the settling chambers, you must achieve acclimatization, namely the samples will be kept 1-2 days in the same conditions, in the same place, both the sedimentation chamber and sample bottle to be analyzed, in order to have the same temperature. If the temperatures would be different the convection currents could cause movement in the small and very small algal mass of picoplanton respectively nanoplancton, and would jeopardize sedimentation and subsequently identification and correct calculations.

Depending on room volume of sedimentation, sedimentation takes between 1-3 days. For example, in a 50 ml sedimentation chamber, sedimentation takes 2 days.

During sedimentation, the chamber is covered with a slide and the table where is placed should be free of vibration. Species identification from algal mass is achieved with fixed preparations at the microscope and counting of algal objects will be done with an invertoscope. Fifty microscope fields will be counted respectively all objects found in these fields.
Counting results are entered into a software program for calculation of phytoplankton density and biovolume through Utermohl method, program called Comptage. Object identification is performed using algal expert determinations'. Measurement of algal objects without calculated biovolume will be done according to the biovolume Draft [12] [13]. Biovolume is calculated for all taxonomic units, by assigning appropriate shapes for each type: cell, filament, and colony and measuring corresponding dimensions.

If in the sample is identified algae whose biovolume are not calculated / included in Comptage program as well as for filamentous algae and colonies, the calculation is performed using the "Cell biovolume calculations", in electronic format, with the following cases: a) unicellular taxons. To calculate biovolume of a taxon the dimensions of a minimum 10 taxons are measured necessary, ideally from the same sample; b) filaments. To estimate filaments biovolume in a sample, all filaments in the fields are counted and divided by the number of filaments. Average biovolume obtained is used to calculate taxon biovolume by multiplying the number of filaments with the average biovolume; c) colonies. Vary depending on taxon. To calculate a colony bivolumului the required dimensions are measured. Phytoplankton biovolume expressed in cubic millimeters per liter (mm^3/ liter = mg/liter). Parameters reported following the phytoplankton samples analysis taken from the reservoir are: number of taxons, taxonomic composition (list of species), density and biovolume.
Algal density units per unit volume are calculated according to the formula:

$$N = \frac{X \times A \times d}{s \times a \times v} \qquad (1)$$

where:
N =number of algae units of X taxon/unit volume (ml);
X = total number of algae units of X taxon;
A = surface of counting chamber (mm^2);
d = dilution or concentration factor (final volume ml/initial volume ml);
s = number of fields used for counting (50 fields/600x);
a = surface of a microscopic field (mm^2);

v = counting chamber volume (ml); v is the sum of chamber volumes and tube, if using a chamber with sedimention tube.

Density calculation per unit volume will be made for each separate taxonomic unit. Density is expressed as number of algae units per milliliter. Calculations to determine values for algal density per unit volume will be made using the computer program Comptage. After entering your identified algae objects, their number, the volume values of sample taken into consideration and biovolume, the computer programs can provide accurate results on the total density of algal mass and total biovolume mm^3/l, values which indicates trophic status of the lake. These values (table no. 2), consistent with Order 161/2006 [14] [15] are:

Table 2. Trophic status of reservoir according to biovolume

Total Biovolume [mm^3/ l]	Trophic status of reservoir
0 – 1 mm^3/l	Ultraoligotrophic
1 – 3 mm^3/l	Oligotrophic
3 – 5 mm^3/l	Mesotrophic
5 – 10 mm^3/l	Eutrophic
10 < mm^3/l	Hypertrophic

It is very important to correlate these results with the values of chlorophyll "a", phosphorus and nitrogen, only after this correlation can we properly fit a particular reservoir into a certain quality group.

Chlorophyll „a" determination

Chlorophyll "a" is the essential photosynthetic pigment of green algae. The content of chlorophyll "a" in water is an indicator of their trophic status. It's determination provides information on biomass and potential photosynthetic activity of algae. The most important metabolites are phaeophytins and feoforbida chlorophyll and chlorophyll ratio "a" / feopigmenți is a physiological indicator of water.
Chlorophyll is sensitive to light and to oxygen action, especially in the extraction moment. To avoid oxidation and photochemical destruction, samples should not be exposed to bright light or in contact with air. In all cases, especially when a system for determining in situ chlorophyll "a" is not available, a sample from the integrated sample is required for analysis of chlorophyll "a" in the laboratory. Generally, one liter of sample is sufficient, regardless of lake trophic status. It is not recommended that the sample be filtered in the field. Sample containers are stored at 4 °C in the dark until analysis in the laboratory. The samples will be filtered in the laboratory as soon as possible after sampling, using a manual or electric vacuum pump through a glass fiber filter. Preservation until analysis is performed in a refrigerator in the dark and no longer than 8 hours. After filtering a liter of water the filter paper is placed in 20 ml of 90% ethanol and the tube is placed in a water bath for 5 minutes. Filter paper must retain more than 99% of particles with a diameter exceeding 1 mm (the diameter must be between 25 mm and 50 mm). In the water bath the extract level must be at the level of water in the bath. Allow to cool 15 minutes at room temperature. At this stage the extract can be stored in refrigerator before analysis for a maximum of 3 days. Transfer the extract into centrifugation containers at a speed of 2000 rpm for 5 minutes. Only now, using a spectrophotometer, will ca begin reading sample absorbance at different wavelengths, namely 665 nm and 750 nm. Spectrophotometric determination must be made on a clear supernatant. After reading it,the sample will acidification with 3M HCl, 0.01 ml hydrochloric acid for 10 ml extract, shake, allow 5 to 30 minutes and measure the absorbance again at 665 nm and at 750 nm. Following the results obtained by these readings at the 2 wavelengths and according to a formula will find the concentration of chlorophyll "a" expressed in micrograms per liter [mg / L]. The work method is according to legal standards SR ISO 10206/1996 Water quality - Measurement of biochemical parameters. Spectrophotometric determination of chlorophyll "a content [16].
The formula is as follows:

$$\rho_c = \left[\frac{(A - A_a)}{K_c}\right] \cdot \left[\frac{R}{(R - 1)}\right] \cdot \left[\frac{(10^3 \cdot V_e)}{(V_s \cdot d)}\right] \quad (2)$$

where:
$A = A_{665} - A_{750}$ extract absorbance before acidification;
$A_a = A_{665} - A_{750}$ extract absorbance after acidification;
V_e = extraction volume [ml];
V_s = water filtered sample volume [l];
K_c = 82 l/ µg * cm the value of specific coeficient of spectral absorbtion of chlorophyll „a";
R = 1,7 ratio A/ A_a for a solution of pure chorophyll „a" transformed by acidification in phaeophytins;
d = optical path of the cuvette [cm];
10^3 = dimensional factor which applied to V_e.

Determination of total Nitrogen

For determination of total nitrogen water samples are subject to a process of mineralization followed by distillation [17].

a) mineralization is achieved in dry digestion tubes (mineralization) where the following reagents are introduced: 0.2 g catalyst Devarda, 2.0 g potassium sulphate anhydrous, 50 ml sample of water, 10 ml sulphuric acid 98% d = 1.84. Mineralization tubes with samples and reagents are placed in the heating block and covered with a caps support related to a scrubber. In the device container is inserted sodium hydroxide solution 15%, but not more than 40% of the container volume. In the vacuum pump, double distilled water is added so that the water level is between the levels indicated within. The drain hose of cooling water is placed in the sink, open the water supply valve, connect the device to electric network, start the vacuum pump, the vacuum is adjusted by pressing to step 2-3. Start the plate where the tubes are placed in and so begin program P1 (T = 180°C, t = 60

min). After completing program P1, program P2 starts (T = 370°C, t = 120 min). With increasing amounts of gas during mineralization we can increase pump flow vacuum level 4-5. At the end of program P2 the plate stops, raise the tubes and put them on special support, leaving them to cool and absorb all vapors (during cooling vacuum pump is working 20 more min.). After the sample vials are cooled the vacuum pump stops, tap water is closed, the bubble tube from the container with sodium hydroxide solution 15% is raised. After mineralization in digestion tubes 50 ml of double distilled water is added by gentle swirling. At the end of mineralization the following procedures are required:

- Empty and wash the glass collectors of condensed matter;
- Unscrew and wash with running water the glass condenser (refrigerant);
- Unscrew and wash the stand with caps under running water.

b) Distillation requires adding the following reagents into the plastic containers: 4% boric acid, sodium hydroxide 30%, double distilled water. Use a container to remove residue. Place hoses in the containers with reagents, connect the device to the electric network, and open the valve for cooling water.

Separately in an Erlenmeyer glass it introduces 20 ml mixed indicator (boric acid + indicator).
Place the mineralized vial, close transparent protection of tube and start the machine. Distillation takes 5 minutes. Acoustic signal indicates completion of the distillation cycle. Collected distillate in Erlenmeyer glass is then titrate with hydrochloric acid 0.02 mol/l until the colour turns brownish and then calculates the total nitrogen content. After each trial cleaning is needed, using P2 program because samples that were subjected to distillation have different ammonium nitrogen content. Calculation of total nitrogen concentration expressed in mg/l is done using the formula:

$$\mathbf{C_N} = \frac{\left(\mathbf{V_1} - \mathbf{V_2}\right)}{\mathbf{V_0} \cdot \mathbf{C_{HCl}} \cdot \mathbf{14,01} \cdot \mathbf{1000}} \qquad (3)$$

where:
V_0 = analyzed sample volume [ml];
V_1 = volume of titrated HCl solution [ml];
V_2 =volume of titrated solution of HCl for blank solution[ml];
14,01 = atomic wieght of nitrogen [mg];
C_{HCl} = actual concentration of HCl (□0,02) [mol/ l].

Total phosphorous determination

Determination of total phosphorus conținutuli is done according to STAS SR EN 6878/2005 [18]. Necessary reagents are sulfuric acid 4.5 mol / l, peroxidisulfat, ascorbic acid 100 g / l acid molybdate II, double distilled water. Mode is as follows: take a maximum volume of 40 ml of sample stirred in 50 mL volumetric flask, dilute sample can also be used in double distilled water to 40ml, in parallel blank is prepared in 40 ml double distilled water 50 ml volumetric flask, add 0.4 ml of sulfuric acid, and 4 ml peroxidisulfat potassium boil moderately mineralized keeping the volume constant at 25 -35 ml by adding doubly distilled water for 90 minutes to cool; after mineralization of samples and their cooling at ambient verify that pH is between 3 and 10, and otherwise adjust the pH with sodium hydroxide solution 2 mol / l sulfuric acid or 2 mol / l stirring, add 1 ml ascorbic acid, and then 2 ml of acid molybdate II, dilute to the mark with double distilled water and mix, after 15 minutes read the absorbance of the sample analyzed by the blind, called the reference sample. The device used is a spectrophotometer that will do readings at a wavelength of 880 nm. For large curve using cuvettes with optical path lengths of 10 mm and the lower curve using cuvettes with optical path lengths of 50 mm. Depending on spectrophotometric readings will make different calculations for large curve and lower curve. Thus, between 0.200 mg P / L - 0.800 mg P / l curve is calculated between 0.010 mg high P / L - 0.200 mg P / l lower curve is calculated. Will perform calculations using the equations below:

$$\begin{aligned} \mathbf{y} &= \mathbf{bx} + \mathbf{a} \\ \mathbf{K_1} &= \frac{\mathbf{1}}{\mathbf{b}} \\ \mathbf{K_2} &= \frac{-\mathbf{a}}{b} \\ \mathbf{P_{Pt}} &= \left(\mathbf{A} \cdot \mathbf{K_1} + \mathbf{K_2}\right) \cdot \mathbf{D} \end{aligned} \qquad (4)$$

It is necessary that for the sample immediately analyzed after adding 0.4 ml of sulfuric acid 4.5 mol/l to check if pH is 1. If is not, correct with sodium hydroxide solution 2 mol/l or sulphurous acid 2 mol/l. If it is known or suspected arsenic in the sample, the interference appeared must be eliminated by treatment with 1 ml of sodium thiosulphate immediately after mineralization.

3. OBSERVED RESULTS

Table 3 and 4 present the minimum, average and maximum values of physico-chemical characteristics of the water in lakes Gozna and Secu, registered in sampling campaigns during the years 2001-2009. Sampling points were near the dam (B), the middle of the lake (M) and tail Lake (C).

Table 3. Physico-chemical characteristics registered in Gozna (2001-2009)

Secțiunea de recoltare	Val.	Trans-parența m	Temp ^{0}C	pH	OD (mg/l)	Sat. O_2 (%)	CBO_5 (mg/l)	$CCOMn/O_2$ (mg/l)	N_{tot}min (mg/l)	P_{tot} (mg/l)	Biomasa fito(mg/l)
B	min	0,40	1,00	6,34	6,90	54,70	0,85	1,20	0,40	0,010	0,61
	med	*2,23*	*7,94*	*7,26*	*9,00*	*73,34*	*1,57*	*2,46*	*0,64*	*0,030*	*3,07*
	max	4,80	18,50	8,74	11,5	103,30	2,45	3,85	1,13	0,075	4,68
M	min	0,30	1,00	6,39	7,30	54,60	0,90	1,20	0,38	0,014	0,72
	med	*2,01*	*8,43*	*7,29*	*8,95*	*73,40*	*1,62*	*2,52*	*0,63*	*0,040*	*3,2*
	max	4,10	18,50	8,85	11,65	103,30	3,00	4,35	1,10	0,225	4,63
C	min	0,30	1,00	6,15	7,10	53,10	0,80	1,20	0,29	0,010	1,22
	med	*1,80*	*9,17*	*7,25*	*8,94*	*74,73*	*1,60*	*2,52*	*0,68*	*0,040*	*3,87*
	max	3,60	21,00	8,82	11,70	104,33	2,80	4,10	1,42	0,090	6,32
Media lac		***2,01***	***8,51***	***7,26***	***8,96***	***73,82***	***1,60***	***2,50***	***0,65***	***0,038***	***3,38***

Tabelul nr. 4. **Caracteristici fizico-chimici înregistrați în lacul Secu (2001-2009)**

Secțiunea de recoltare	Val.	Trans-parența m	Temp ^{0}C	pH	OD (mg/l)	Sat. O_2 (%)	CBO_5 (mg/l)	$CCOMn/O_2$ (mg/l)	N_{tot}min (mg/l)	P_{tot} (mg/l)	Biomasa fito(mg/l)
B	min	0,45	1,00	6,61	7,35	54,70	1,00	1,40	0,31	0,010	0,81
	med	*2,06*	*9,52*	*7,21*	*9,07*	*77,53*	*1,60*	*2,49*	*0,67*	*0,032*	*3,51*
	max	3,50	23,00	8,86	12,40	112,90	2,70	3,90	1,13	0,060	4,98
M	min	0,30	1,00	6,50	5,80	54,60	0,90	1,33	0,31	0,010	0,44
	med	*1,87*	*8,50*	*7,15*	*8,71*	*72,36*	*1,59*	*2,50*	*0,68*	*0,034*	*3,28*
	max	2,90	17,60	8,21	11,70	91,30	2,70	4,00	1,10	0,060	4,67
C	min	0,25	1,00	6,66	7,40	58,70	0,80	1,20	0,30	0,010	2,11
	med	*1,65*	*9,53*	*7,16*	*8,95*	*76,30*	*1,61*	*2,57*	*0,71*	*0,034*	*4,01*
	max	2,80	22,00	8,77	11,90	100,70	2,40	4,10	1,42	0,050	5,90
Media lac		***1,86***	***9,18***	***7,17***	***8,91***	***75,40***	***1,60***	***2,52***	***0,69***	***0,033***	***3,60***

Looking at the average values of analyzed parameters in the two lakes it can observe that Lake Gozna has a greater transparency, while temperatures and biomass are higher in Lake Secu. Assessing trophic status of these lakes was based on phytoplankton biomass sampling campaigns set in the period of 2001-2009. Minimum and maximum values of phytoplankton biomass and trophic status of lakes Secu and Gozna are presented in Table. 5.

Tabelul nr. 5. **Starea trofică a lacurilor de acumulare Gozna şi Secu (2001-2009)**

Lacul GOZNA					Lacul SECU				
Luna		Biomasa fito(mg/l)	Starea trofică	Anul	Luna		Biomasa fito(mg/l)	Starea trofică	Anul
III	min	1,34	Oligotrof	2009	III	min	1,16	Oligotrof	2009
	max	3,72	Mezotrof	2002		max	4,14	Mezotrof	2005
V	min	1,11	*Oligotrof*	2009	V	min	2,99	*Oligotrof*	2007
	max	4,45	Mezotrof	2003		max	4,18	Mezotrof	2004
VII	min	3,44	Mezotrof	2004	VII	min	3,24	Mezotrof	2006
	max	4,88	Mezotrof	2007		max	5,10	*Eutrof*	2005
X	min	2,85	*Oligotrof*	2008	X	min	2,80	*Oligotrof*	2008
	max	3,47	Mezotrof	2009		max	4,06	Mezotrof	2003

Tabelul nr. 6.
Frecvențele stării de troficitate înregistrate în lacurile de acumulare Gozna şi Secu (2001-2009)

Lacul	Luna	Oligotrof	Mezotrof	Eutrof
GOZNA	III	4	5	-
	V	3	6	-
	VII	-	9	-
	X	2	7	-
SECU	III	4	5	-
	V	1	8	-
	VII	-	8	1
	X	1	8	-

4. INTERPRETING THE RESULTS AND CONCLUSIONS

In the first years after filling, Gozna and Secu reservoirs had a trophic ultraoligotrophic and oligotrophic status, later trophic status evolved to mezotrophic status and even eutrophic, according to date from the monitoring period of 2001-2009.

During the analysed period the parameter values were rated within the limits of mezotrophic reservoir (tables 3, 4, 5). Water quality degradation of these two reservoirs was caused by stagnant water, strong heatstroke, additional intake of nutrients (tree leaves, discharges of waste water), no refreshing water periods by lowering the water level.

Eutrophication was initially observed at Secu reservoir, but later at Gozna too. The analysis of quality indicators show that from a trophic point of view our reservoirs fall into a mezotrophic category with eutrophication tendencies, contamination being caused by natural and human activities. In the first years of use Gozna and Secu reservoirs had a balanced phytoplankton typical oligotrphic, but had suffered alteration in a relative short amount of time.

During the first sampling periods phytoplankton organisms were maintained at a relative low number, existing species were diversified, and mezotrophic character well defined. The number of organisms greatly increases during summer-autumn sampling campaigns, thereby reservoirs gaining a eutrophic character trend. Water quality alteration is also due to anaerobic decomposition of sludge off the bed, resulted from its own organic deposits especially those from hillside allochthonous deposits, leakage and seepage.

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