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Monitoring and Assessment of Nutrient Removal Capacity of Riverine Wetlands

Final Report

FEBRUARY 2007

C 309 DRP

DEMONSTRATION SITE: Romanian Lower Danube Floodplain Sector between Corabia (Km 630) and Turnu Magurele (Km 590)

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AND WATER MANAGEMENT

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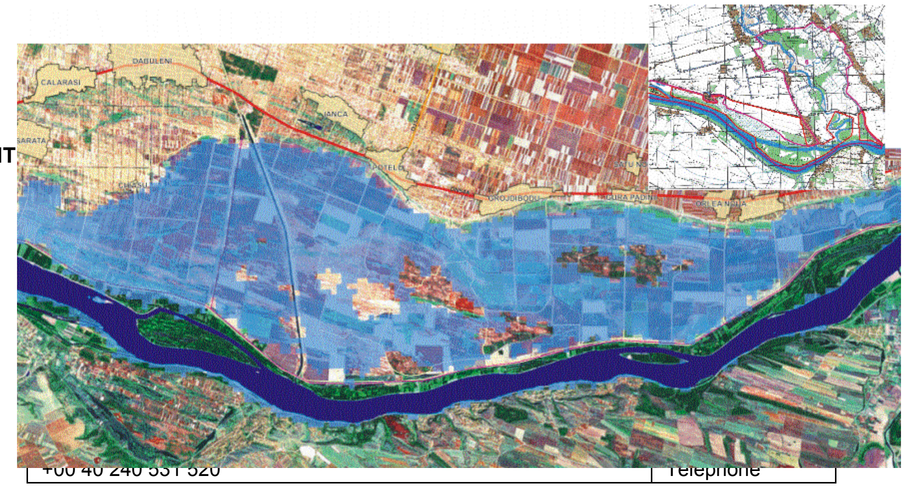

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CONTENTS

Introduction

The Danube River is one of the main rivers in Europe and the most important river in Romania. Therefore there are a lot of efforts to maintain its quality and even to improve it.

Research for nutrient removal from the Danube water and from its tributary rivers is one of the main objectives for the ICPDR (International Commission to Protect Danube River), in order to ensure a good Danube water quality that could support its biodiversity and also for human consumption as well. The Danube plays an important ecological role: on a local, regional and international scale, both for aquatic and terrestrial flora and fauna.

There were done a lot of researches regarding the capacity of wetlands to remove nutrients from a water course loaded with big amounts of nutrients. "Whole-ecosystem experiments, which have been carried out for terrestrial systems (Likens, 1977; Sullivan, 1993; Beier and Rasmunssen, 1994, cited by Mitsch et al., 2002), aquatic systems (Schindler, 1977; Schindler et al., 1997, cited by Mitsch et al., 2002), and wetlands (Odum et al.,1975; Mitsch et al., 1995, 1998, cited by Mitsch et al., 2002) can be less stochastic and thus more homeostatic and often allow for the demonstration of the ecosystem proprieties that otherwise would not appear in smaller scale experiments (Pomeroy et al., 1988; Odum, 1990, 1992; Beyers and Odum, 1993; Carpenter et al., 1995; Carpenter, 1998, cited by Mitsch et al., 2002)"(Mitsch et al., 2002). To study Danube whole system regarding nutrient removal capacity it is necessary first of all to have some focused points from its course, despite of the Mitsch et al. (2002) affirmations. It is good to mention that in this big project there are several pilot small projects regarding nutrient removal capacity (in Hungary, Bulgaria, Moldova and Ukraine).

This project is a demonstrative pilot project of the big Danube Regional Project of nutrient removal in the Lower Danube Floodplain. The Danube Regional Project (DRP) has been established to contribute to the sustainable human development in the Danube River Basin (DRB) through reinforcing the capacities in the basin to develop effective co-operation to ensure the protection of the Danube River. The objective of the DRP is to complement the activities of the International Commission for the Protection of the Danube River (ICPDR) to provide a regional approach to the development of national policies and legislation and the definition of actions for nutrient reduction and pollution control in the DRB.

"Recently, the value of the biological diversity and complexity which prevail in natural ecosystems has been recognized and attempts have been made to restore streams, rivers and wetlands, in order to regain their heterogeneity and thereby their self-purification capacity and buffering effects" (Brix and Schierup, 1989).

Site description

a. Studied area (Garcov Lake and Marsh)

The studied area is situated in the south part of Romania (fig.1) on the left shore of the Danube River downstream, but near, the Corabia locality (fig.2). The name of the Lake and Marsh came from the nearest locality of the area named also Garcov (fig. 2).

Fig.1 – The studied area location in Romania

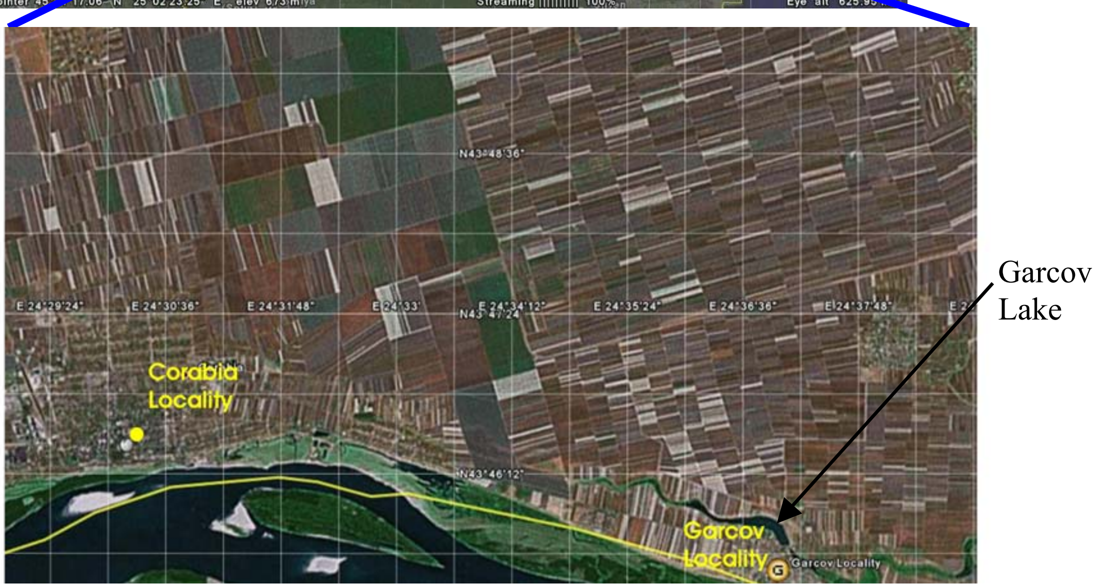


Fig.2 – The location of the Garcov Lake (GoogleEarth satellite images)

This lake is a fluvial coast lake. This means that this lake is formed most "as the result of the river action, but they have a different position than the usual set of floodplain lakes" (Gastescu, 1971).

A main role in this lake formation was played by eustatic movements (negative and positive ones) and also the epeirogenesis movements, which induced the transformation of the small water courses, especial in lower part of fluvial coast and thus the section of fluvial coast was enlarged at the confluence area. In old periods a main role was played also by the flooding waters, which before the general damming have penetrated these small valleys (especial in lower course of the Danube River), rising the water level with 2-3 m (after Gastescu, 1971).

Also in the formation of these types of lakes were implied neotectonical movements (negative), which transformed some small valleys with small relief energy in lower lake area. The fluvial coasts between Garla Mare and Giurgiu are formed on the tight valleys with low altitudes and low slopes with the main formatting process flooding (Ciobarnacu-Negoiu, Cilieni-Bistret, **Garcov-Islaz**, Parapanca-Malu Valleys) (after Gastescu, 1971).

The average temperature for one year of the air in the area registers a slight decrease from west to east (11.5 ºC at Calafat to 11.1 ºC at Corabia) (Posea, 2005). The average temperature for the January (period 1931-1960) for the studied area is 2 ºC (after **, 1969). The average temperature for the July (period 1931-1960) for the studied area is about 23 ºC (after **, 1969). The wind blows moderately to low predominant from tow direction east and west (after **, 1969). The precipitations register a decrease from the west to the east, in the same way with the continental clime proprieties degree increase: 560 mm at Calafat and 530 mm at Corabia (after Posea, 2002).

Normally these kinds of lakes have water in the flooding periods (water from the Danube River) and the water stays as log the level of the Danube River are high. In the periods when the Danube River has low water levels the water of the lake couldn't stay there to much unless there is an obstacle (natural or artificial) in the way of the water to flow back to the Danube River. In the case of the Garcov Lake the obstacle is an artificial one, a bridge that blocks the water flowing out from the lake (fig. 3). The water can pass only through a hydraulic ram that was made under the bridge. The water from the lake can be also from precipitation and from the groundwater.

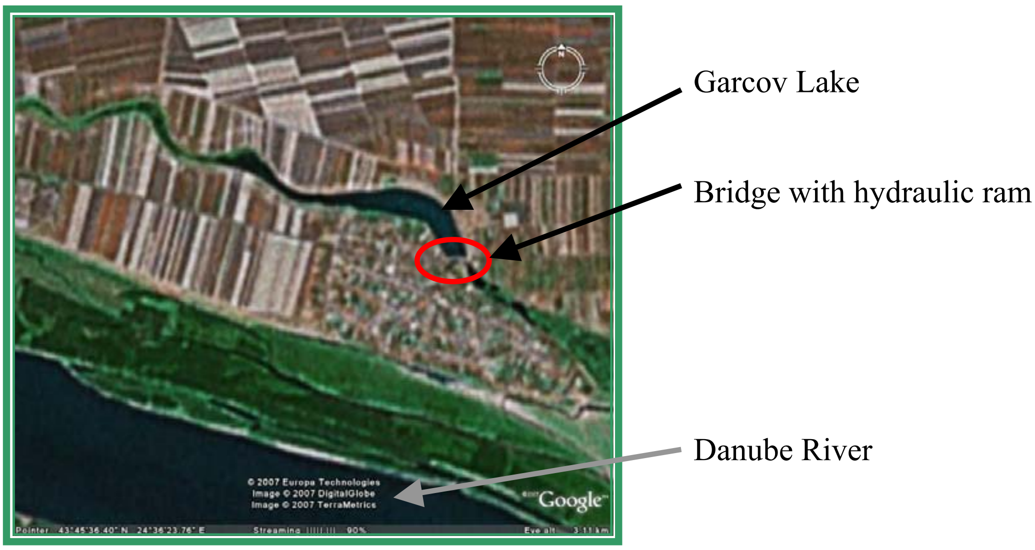


Fig. 3 – Hydraulic ram on the Garcov Lake (image source: GoogleEarth)

b. Tributary rivers to the Danube River in the area (Olt and Saiu rivers)

Olt River is one of the most important rivers from Romania. Its course is full with artificial lakes and there are a lot of industries that use its waters and then discharge all wastewaters into this river. The Olt River mouth is situated downstream the Garcov locality near the Islaz locality (fig. 4).

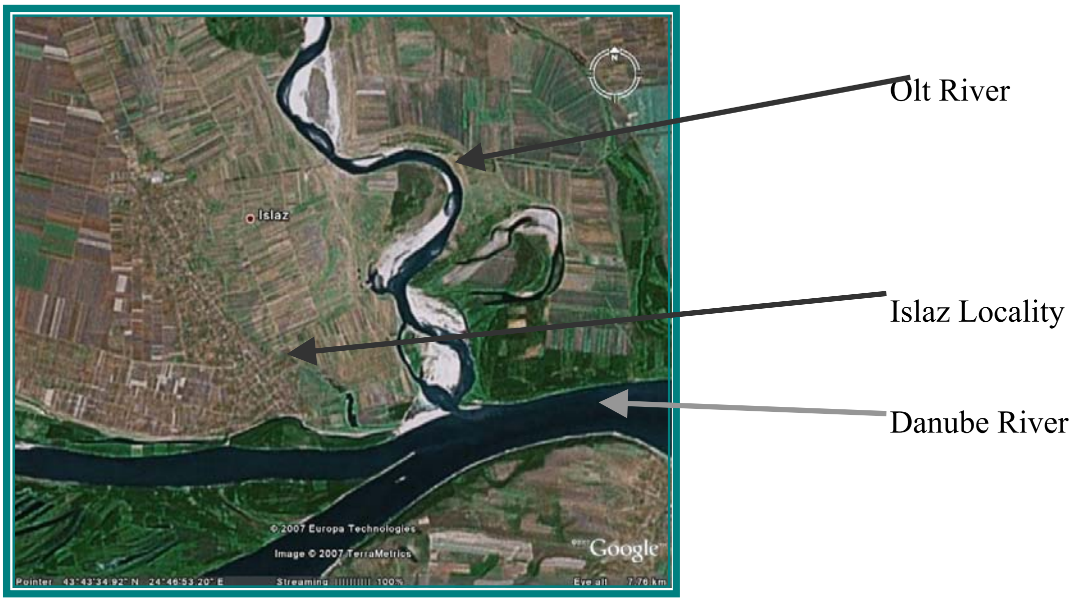


Fig. 4 – The confluence of Olt River with Danune River (image source: GoogleEarth)

The Olt River is one of the biggest rivers from the Campia Romana Field and it has a flow capacity over 170 m^3/s and an energetically potential used at maximal with through the many artificial lakes (after Posea, 2002).

Saiu River is a former course of the Olt River. It is situated in the east side of the Olt River (fig.5). It flows into Danube River downstream the Olt mouth. The main source of the water of Saiu River is probably the water from the Olt River, to this in plus there are waters from precipitation and from the infiltration from the adjacent terrains. The velocity of the water is not high and also the liquid volume is smaller then the one of Olt River.

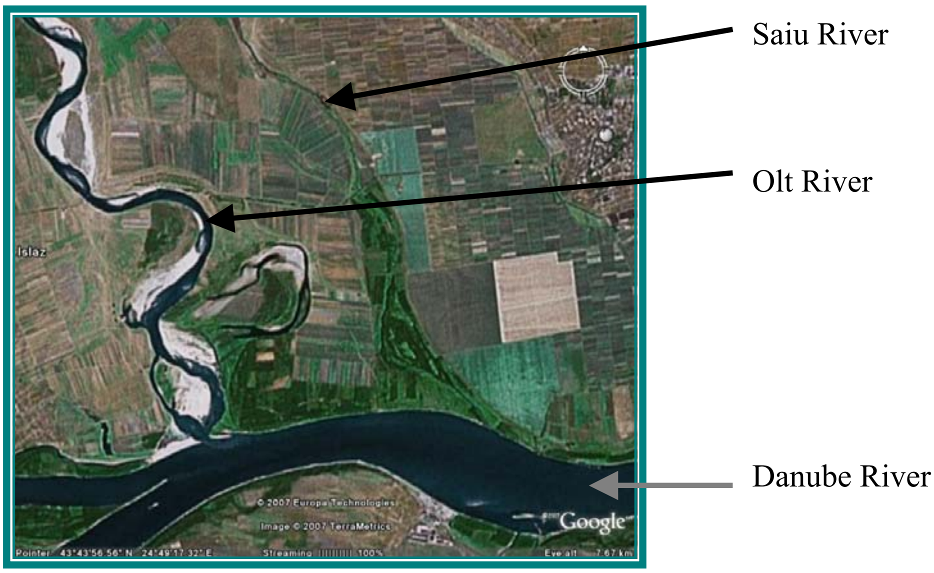


Fig. 5 – The confluence of Saiu River with Danune River (image source: GoogleEarth)

c. Adjacent area (former Potelu Lake now flooded arable dammed land)

The adjacent area is represented by a former lake that was transformed into an agriculture land. “Many floodplains lakes, especially those from the Danube River Floodplains have been desiccated as the result of the embankment process of the flooding areas” (after Gastescu, 1971). Due the exceptional high Danube River water levels the adjacent area was flooded in the year 2006. The defending dykes against flooding were broken beside the Calarasi-Dabuleni and Celei-Corabia localities. This area is situated on the place of Potelu Lake (fig. 6).

The adjacent area - former Potelu Lake

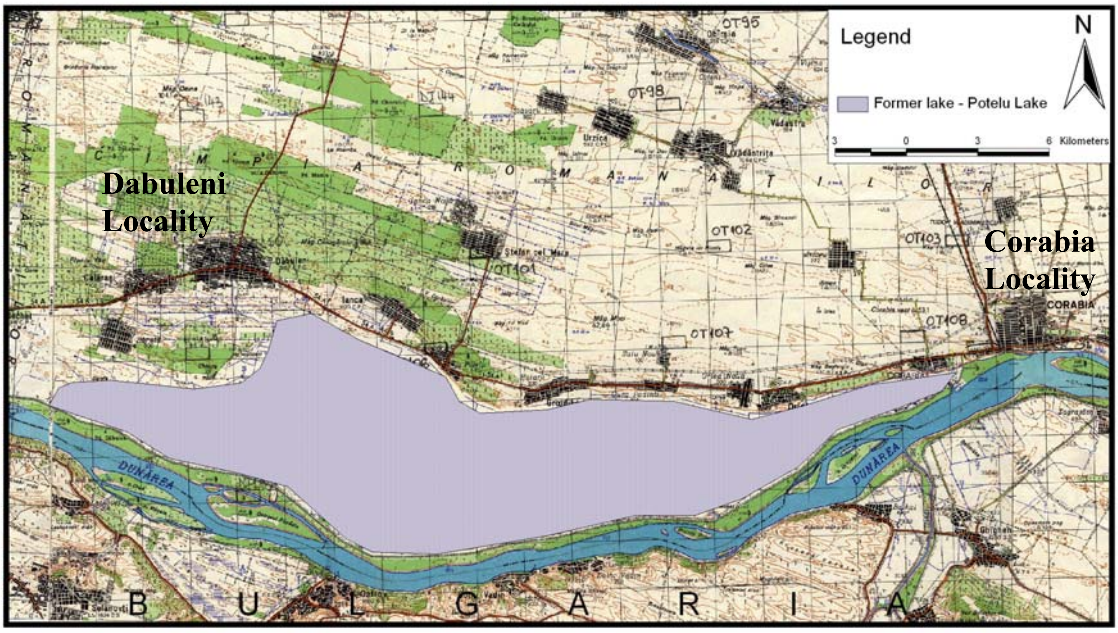


Fig.6 – The adjacent area on the former Potelu Lake (map source: Harta topografica 1:50000, 1985)

Working hypothesis

a. Studied area (Garcov Lake and Marsh)

Ecosystems dominated by aquatic macrophytes are among the most productive in the world. Aquatic plants posses an outstanding ability for assimilating nutrients and creating favorable conditions for microbial decomposition of organic matter. This ability can be exploited in the restoration process of natural streams, lakes and wetlands… (Brix and Schierup, 1989).

The sediments from wetlands populated with vegetation have an important role to retain nutrients especially nitrogen under different forms. Phosphorous forms in specific conditions could adhere to the sediment particles being adsorbed at the particles surface. "Phosphorus discharged into the water column of lakes, streams, reservoirs, and ponds is either assimilated by algae or retained by the sediment" (Reddy and Redd, 1993)

We expect that due the fact of vegetation activity the water from the marsh should have lower concentration in nutrients than the lake. The simple presence of the vegetation influences the water velocity.

A riverine wetland nutrient removal capacity is demonstrated by the simultaneous validity of the following three statements:

1. phytoplankton of inflowing waters (inputs) is **more diverse** than phytoplankton of out-flowing waters (out-puts), and
2. phytoplankton of inflowing waters (inputs) is **more abundant** than phytoplankton out-flowing waters (out-puts), and
3. phytoplankton species present in the inflowing waters (in-puts) belong to categories with **higher saprobity values**, in comparison with the species present in out-flowing waters (outputs).

Zooplankton is an inseparable part of the aquatic ecosystems, and it fulfils a great variety of important functions. First of all, feeding on phytoplankton and microorganisms, it purifies water. Based on the species dominant on zooplankton communities, we may evaluate the quality of water. Hence, zooplankton can be used as an indicator of saprobity.

Oligochaetes and chironomids are reliable indicators of eutrophication for freshwaters even if they neither feed nor reproduce in the same way Firstly, chironomid larvae feed on algae and detritus freshly deposited on the sediment, while oligochaetes feed on bacteria within the sediment. Secondly, chironomids have winged adults which lay eggs on the water surface, whereas oligochaetes reproduce within the sediment. In summary, chironomids are more mobile and they depend less on the inner sediment for their food and reproduction than the oligochaetes. These differences could explain why, in some cases, chironomids react more rapidly than oligochaetes to the improvement or a decrease of water qulity. Most species are indicators especially for nutrient conditions of the water body thus the community composition can reflect the trophic state.

b. Tributary rivers to the Danube River in the area (Olt and Saiu rivers)

The Olt and Saiu Rivers waters have their inputs with nutrients into the Danube River waters. For a good understanding of the nutrients load of the Danube River water it is good to measure the nutrients concentration in the tributary waters from the area.

The sediments of the rivers could contain nutrients adsorbed to the particle surfaces or deposited between the particles. These sediments loaded with nutrients can be a source of nutrients for the tributaries waters which flows into Danube River.

The quality of the tributaries waters influences the quality of the Danube River waters. To get an impression of the quality of the water there will be taken some water samples for the saprobity analyses taken into account the phytoplankton, zooplankton and bentos.

c. Adjacent area (former Potelu Lake now flooded arable dammed land)

The adjacent area was flooded with Danube River waters for a big surface. The soil of the area will stay for a long time under these waters. The content of these soils in nutrients could influence the water nutrient concentration in sense of load it. There is another hypothesis that the nutrient concentration from the flooding water could decrease due the fact of different chemical and biochemical processes.

It is possible that in some circumstances the flooding water due the water nutrient big concentration to have a poor quality. The quality of this water can be partial determinated by data on phytoplankton, zooplankton and benthos.

Materials and methods

The water samples were taken an analyzed revering the Normative 161/2006 regulation regarding water quality classification.

To take sediment samples from underwater in the studied area there was used a proof stick with transparent pipe. That pipe is 1 m length, 6 cm external diameter and 5 cm internal diameter.

To measure the depth of the sampling point there was used a measuring tape with minimal division of 1 mm. All the samples were taken in small bags of plastic and all the characteristics were written down into a notebook. The method that was used is in concordances with the Methodology of making Pedological and Agrochemical Studies (1986). The samples were taken to the chemistry laboratory and there were made the following analyzes: amount and type of salts, pH, the amount of humus, the amount of organic carbon, the amount of P_2O_5, of K_2O, the amount of NO_3 and also the amount of $CaCO_3$.

The phytoplankton-sampling sites were: the Turnu Măgurele – Corabia – Potelu sector of the Danube river and its floodplain.

The samples were submitted to the taxonomical analyses.

Abundance of the phytoplankton was calculated according to the standard methods [**3**].

For establishment of the phytoplankton **diversity** there was calculated the Shannon-Weaver index [**1**].

The results of the analyses were used (according to the methodology proposed by Van Dam et al., 1994) for the establishment of the **saprobic status** of the target sites, taking into account recommendations of the national legislation [**2**].

Beyond the above-mentioned factors necessary for testing the working hypothesis, there were performed analyses of the trophic status of the target sites.

Results

A. Sediment chemical analyses

a. Studied area (Garcov Lake and Marsh)

There were 2 sampling points for the studied area: one from the Garcov Lake and the other one from the Garcov Marsh. The period of the sampling expedition of the sediments was September 2006. The sampling points position from the studied area can be seen in the figure 7.

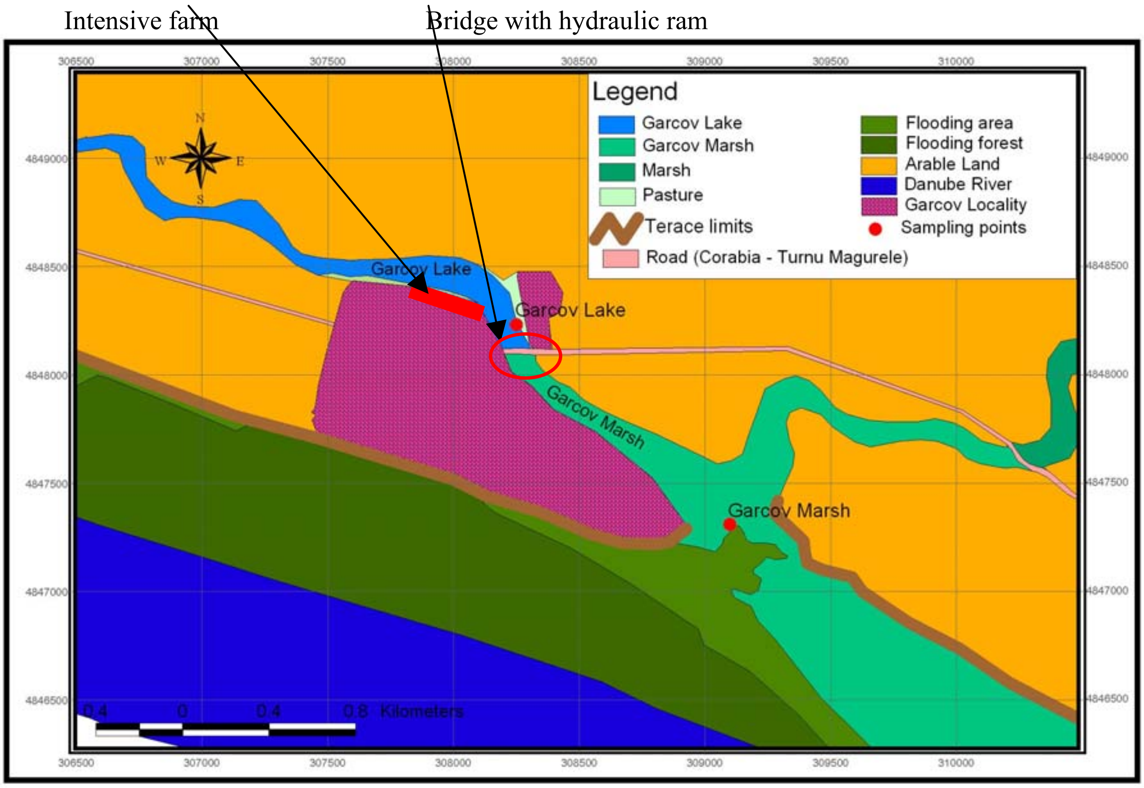


Fig. 7 – Studied area, Garcov Lake and Marsh

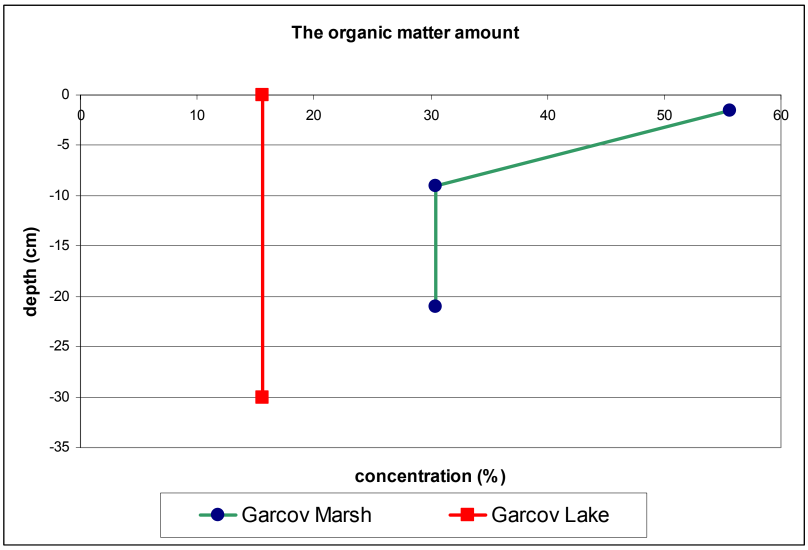
On the right side of the Garcov lake it was identified an intensive farm with ducks and gooses and also there are greenhouses. This farm is very close to the shore of the lake.

The sediment samples from the Garcov Lake were taken for 30 cm depth and the analyses were done for the whole sample as one. For the Garcov Marsh the there were 3 samples at different depth: 0-3 cm, 3-15 cm and 15-21 cm.

In the Garcov Lake the sediments from the top were rich in sand. The water had green color. The pH of the water was about 9,5 measured in the same time of sampling process. The temperature of the water was about 24 ºC.

In the Garcov Marsh the sediments from the top were rich in clay, except the layer between 0-3 cm where the sand is present. The color of the water was very light green. The pH of the water was about 7,75 measured in the same time of sampling process. The temperature of the water was about 23 ºC.

The organic matter is in bigger amounts in Garcov Marsh than in Garcov Lake. This can be seen on the graph 1.



Graph 1 – The organic matter in the top layers of the sediments in the studied area

The organic matter accumulation rates were highest in the SA (reed swamp) phase (1.12 kg m^{-2} y^{-1} on a dry weight basis), intermediate in the BM (brownmoss quaking fen) and CF (carr forest) phases (0.49 and 0.58 kg m^{-2} y^{-1}), and lowest in the Aq (open water) phase (0.26 kg m^{-2} y^{-1}) (Bakker et al., 1997).

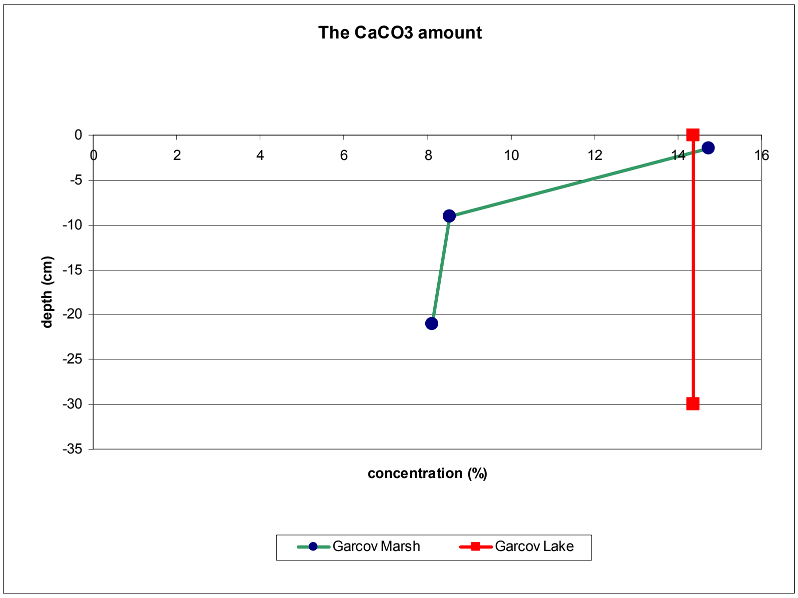
The similarity of the studied case (Garcov site) with the experiment of Bakker is that in both cases the open water ecosystems have a lower rate of organic matter accumulation than for the wetland ecosystems (marshes in our case).

This demonstrates why the organic matter is in bigger amounts in Garcov Marsh sediments than in Garcov Lake sediments.

Another fact that made this difference can be due the different types of sediment texture for the both sampling points.

The difference between pH values of the marsh and of the lake waters can be due the fact of organic anaerobe organic matter decomposition that have through the intermediate substances organic acids. This made the pH value to decrease from the 9.5 in the Garcov Lake to 7,75 in Garcov Marsh. The presence of $CaCO_3$ is the factor that limited the pH decreasing and let the reaction of the marsh water to be low alkaline.

The graph 2 shows the difference of the $CaCO_3$ amount in sediments for the two sampling points (for mars and lake).



Graph 2 - The $CaCO_3$ concentration in the top layers of the sediments in the studied area

The bigger concentration with $CaCO_3$ of the surface layer from the marsh can be due to the sand sediments that came from the lake loaded with $CaCO_3$.

The values (graph 3) of concentration regarding the nitric nitrogen are at small scales for Garcov Lake and also Marsh. These small amounts of nitrogen (from NO_3^-) can be explained through two main class processes: biological processes and chemical processes.

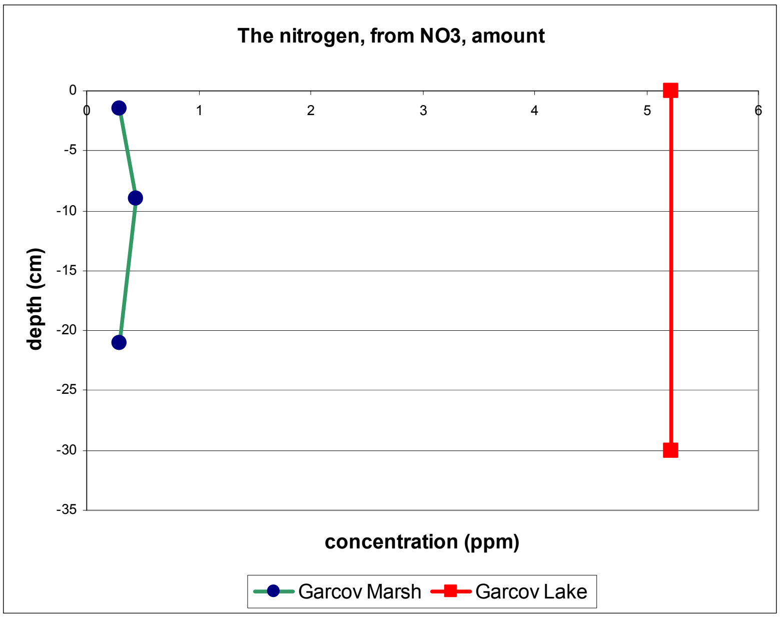
Microbial processes of significance to the removal and transformation of nitrogen are ammonification, nitrification and denitrification. Ammonification is a decomposition process whereby dead organic matter (proteins) is converted to amino acids and then ammonia. Ammonification occurs under both aerobic and anaerobic conditions. (Greenway, 2000) In this case the ammonification occurred under the anaerobic conditions. The final result of this process (ammonium ion) can be easily assimilated also by photosynthetic micro-organisms.

Another microbiological process that could occur in this case might be the denitrification. The dentrification process occurs under anaerobic conditions, usually in deeper sediments. Nitrates and nitrites are reduced to gaseous nitrous oxide and nitrogen which diffuse into the water and ultimately lost to the atmosphere. (Greenway, 2000)

A biological process is also the plant uptake of the nitrogen from the sediments.

The potential rate of nutrient uptake by plant is limited by its net productivity (growth rate) and the concentration of nutrients in the plant tissue. Therefore, desiderable traits of a plant used for nutrient assimilation and storage would include rapid growth, high tissue nutrient content, and the capability to attain a high standing crop (biomass per unit area) (Reddy and DeBusk, 1987 cited by Vymazal et al., 1998).

In our case is about the vegetation that is in the marsh (reed and mace) which could uptake serious nitrogen amounts. This can be also an explanation to the difference between the nitrogen (NO_3^-) concentration between the lake and marsh sediments (graph 3).



Graph 3 - The NO_3^- nitrogen concentration in the top layers of the sediments in the studied area

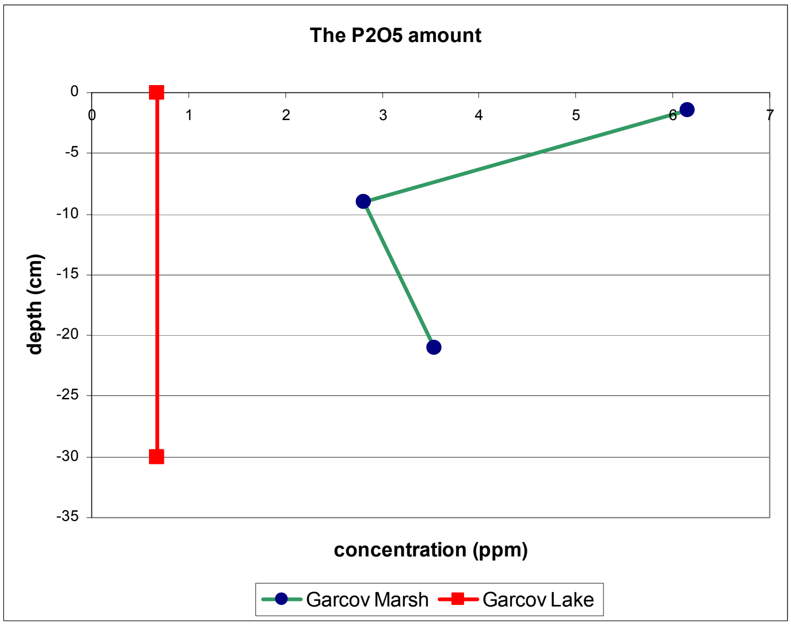
The chemical processes facilitate sediment redox conditions changing as well as facilitating aerobic microbial processes including nitrification (Greenway, 2000).

The physical process (sediment adsorption of the nitrogen) is not to be taken into account. "In a reduced state amoniacal N is stable and can be adsorbed onto active sites of the bed matrix. However, the ion exchange of NH_4^+ N on cation exchange site of the matrix is not considered to be a long term of sink for NH_4^+ N removal" (Cooper et al., 1996 cited by Vymazal, 1998).

The chemical processes facilitate adsorption and desportion of phosphorus onto and from sediment particles. Phosphorus may be in the form of insoluble iron or aluminium phosphates on clay particles. Phosphorus can be immobilised through sorption and precipitation by ferric oxyhydroxide and the formation of ferric phosphate in oxidised zones. Thus alternating drying and flooding releases phosphate by this mechanism. (Greenway, 2000)

The smaller values of P_2O_5 (available phosphorous for plants) from sediments in Garcov Lake, shown in the graph 4, than from Garcov Marsh sediments can be due the fact that most of the water phosphorous was accumulated into sediments much more then nitrogen. "Fine-textured, mineral soil on the bottom of the wetland (subsoil of the former arable land) seemed to be very efficient in retaining P from agricultural runoff" (Liikanen, 2004)

Phosphorous removal occurs mainly as a consequence of adsorption, complexation and precipitation reactions with aluminium, iron, calcium and clay particles and by accumulation of undecomposed fractions of plant litter (peat accretion). Peat accretion is a very slow process but also the most sustainable removal process for phosphorous (Brix, 1998).



Graph 3 - The P_2O_5 concentration in the top layers of the sediments in the studied area

It can be seen very easily that the nitrogen is in smaller concentration in the sediments of the Marsh than the Lake and the phosphorous is in bigger concentration in Marsh sediments in comparison with sediments concentration of Lake.

b. Tributary rivers to the Danube River in the area (Olt and Saiu rivers)

Olt and Saiu Rivers are tributary rivers to the Danube River. Taking samples from these 2 rivers is to establish the load of these rivers in nutrients to the Danube River. The sampling points were taken as it is shown in figure 8. As it can bee observed also from this figure the Olt River is a bigger river then the Saiu. The nutrient load will be bigger in case of Olt River then the Saiu River.

For the Olt River there was no sediment sampling point, just water sampling point. This was done due the fact that the velocity of the water was too high to use the tool for sediment sampling and also the depth of the river was taken into account.

Later in this material will be presented the situation of Saiu River sediments load with nutrients. The nutrients from sediments are potential nutrient load to the water.

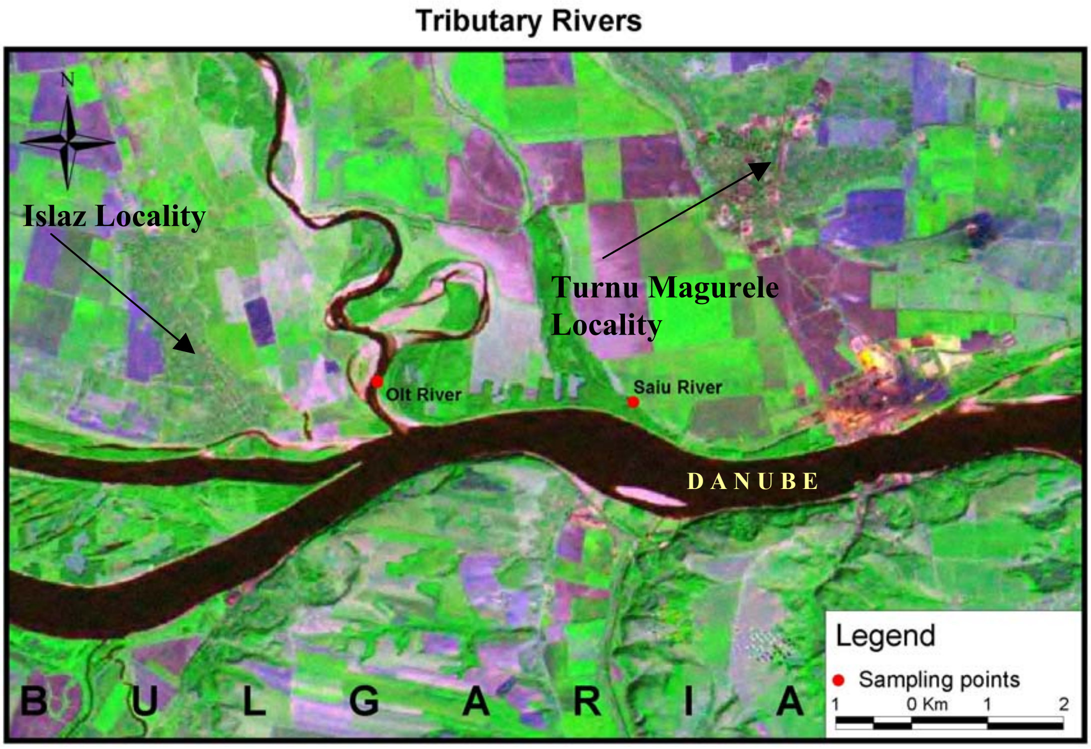
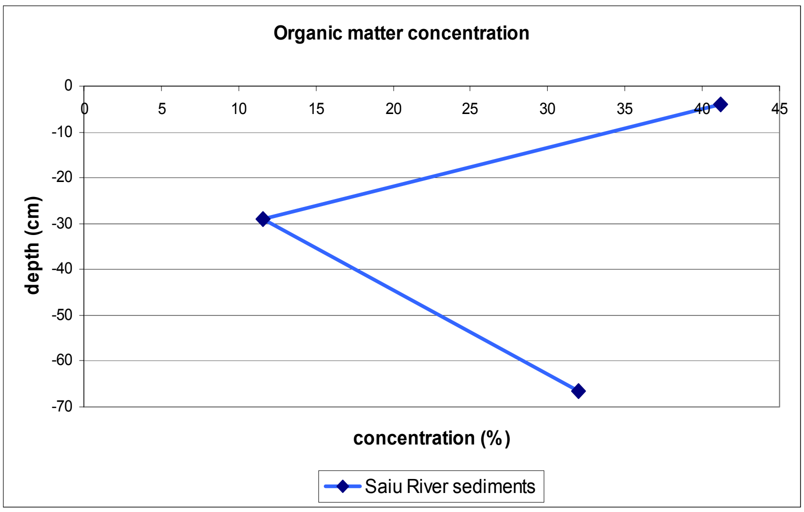


Fig. 8 – Tributary rivers to the Danube River, sampling points (IRS satellite image)

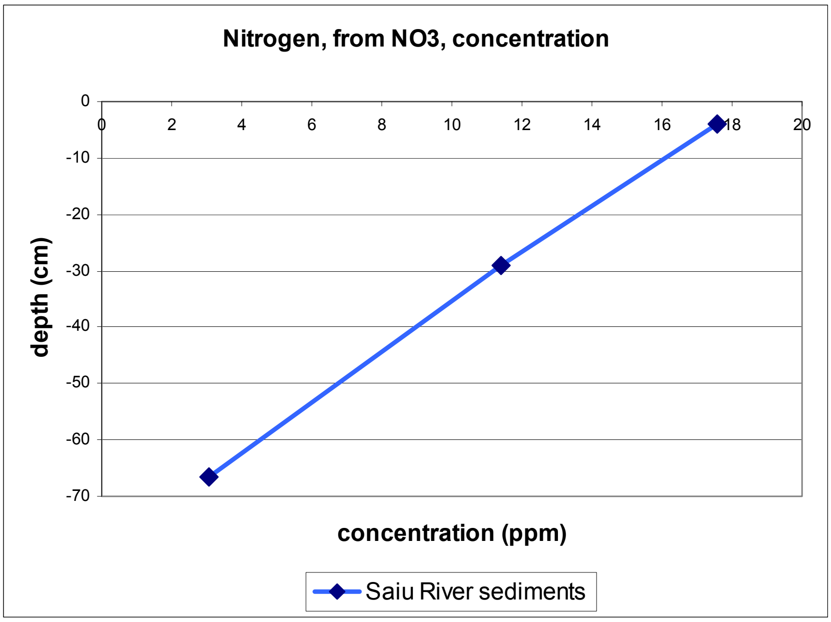
The samples of the Saiu River sediments were taken from 3 different layers: 0-16 cm, 16-42 cm and 42-66.5 cm. The pH of these samples was between 6.25 and 6.75, fact that proves a very low acidity in the sediments.

Organic matter concentration is very fluctuating (graph 4) from the first layer of sediment were the concentration is bigger than for the second layer, then the concentration is increasing in the third layer.



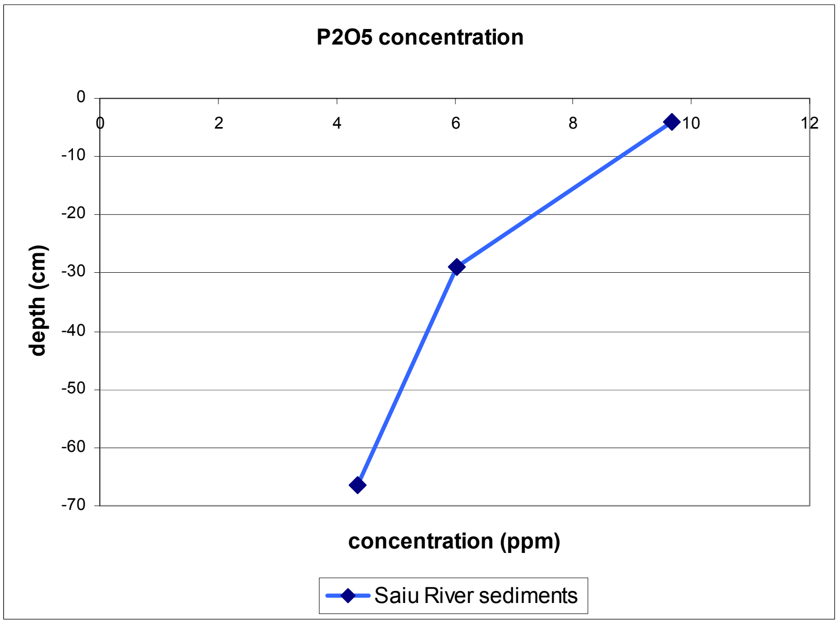
Graph 4 – Organic matter concentration in Saiu River sediments

Regarding nitrogen from NO_3^- it can be told that the concentration of this is high in the sediments (graph 5) at the top of the drillings and it decrease as much as the depth increases.



Graph 5 – Nitrogen from NO_3^- concentration in Saiu River sediments

The variation of the mobile P (P_2O_5) in the sediments of the Saiu River is almost the same as for nitric nitrogen (graph 6). The high concentration is registered at the surface of the sediments then the concentration decreases in the same time with the depth increasing.



Graph 6 – Mobile P (P_2O_5) concentration in Saiu River sediments

c. Adjacent area (former Potelu Lake now flooded arable dammed land)

The area is situated on a former lake named Potelu. Now the area is used for agriculture, exactly arable land. Due the high levels of Danube waters the defending dyke was broken in two places: near the Dabuleni – Calarasi locality and the second near the Celei locality. The area between the dyke and terrace was flooded (figure 9).

There were taken samples from 6 sampling points: near Potelu, Orlea, Celei, Corabia localities. All the sediment samples have low to medium alkaline reaction, due the presence of the $CaCO_3$ in the water and also in the sediments.

Adjacent area

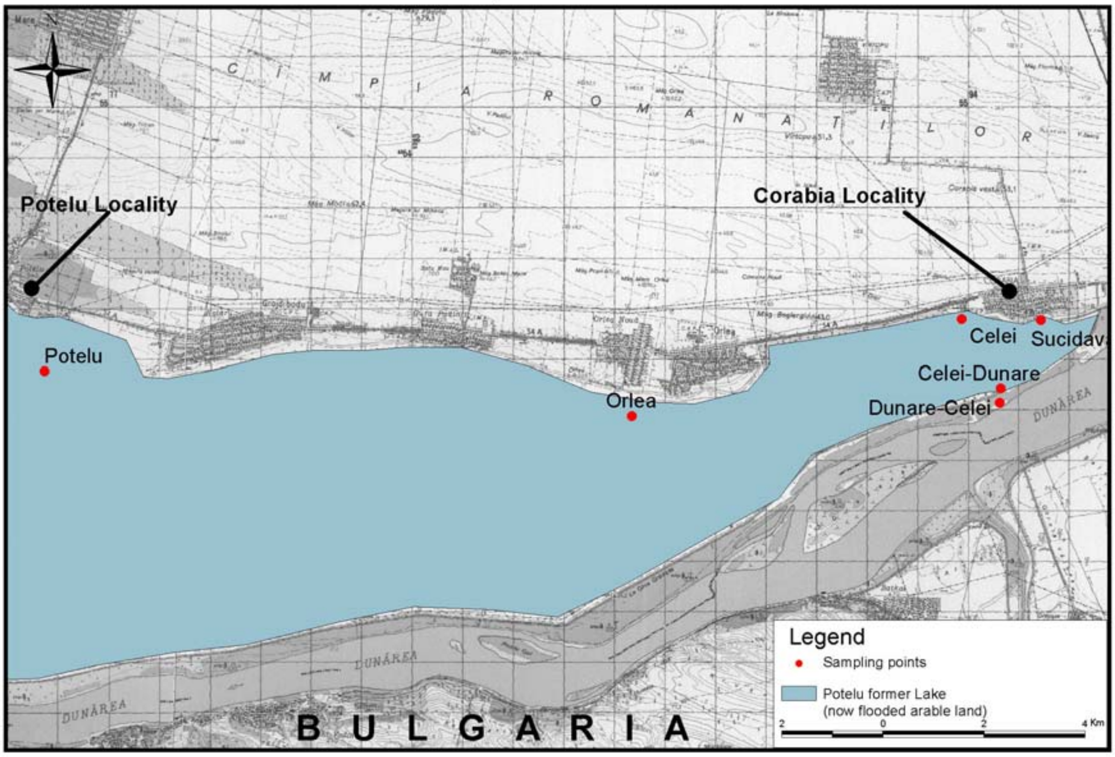
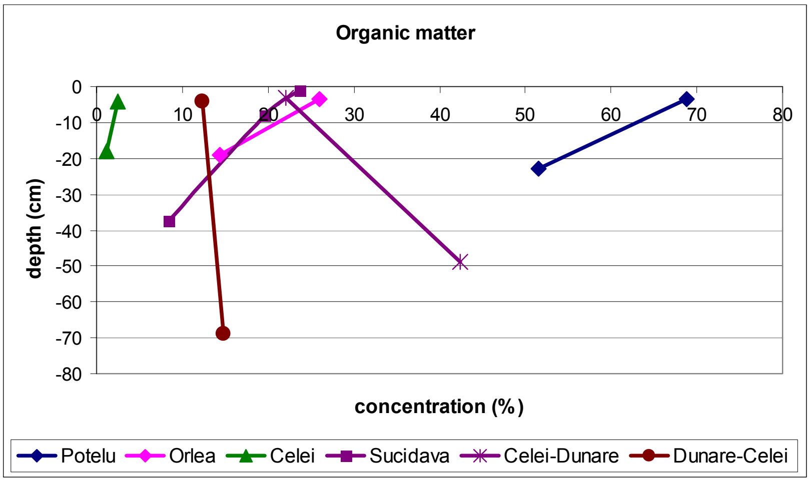


Fig. 9 – Adjacent area with sampling points (Source of map: Topographical Map, 1987, 1:50000)

The organic matter for all the 6 points varies a lot (graph 7). First of all we have to mention the very big amount for the Potelu drilling. All the sampling present a decrease of Organic Matter (OM) from the top of the sediments after that the decreasing slope is very high on the profile.

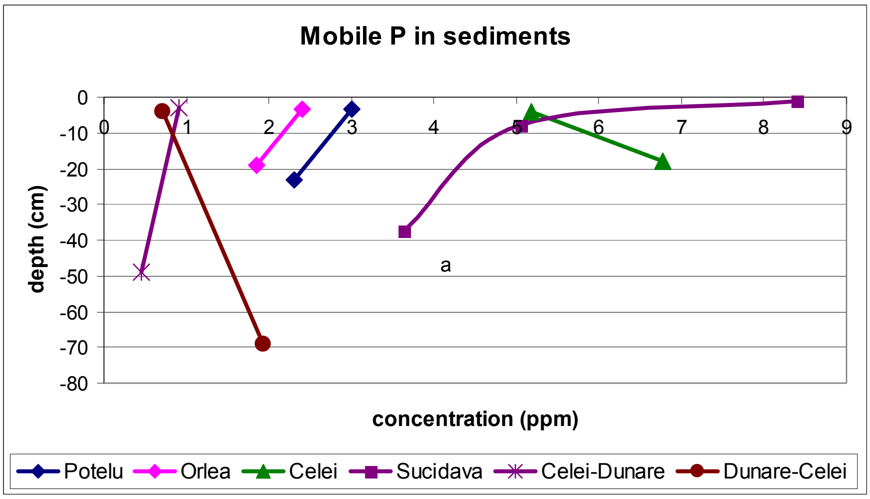
The smallest OM concentration values had been found for the Celei sampling point. For the Celei-Dunare and Dunare-Celei the concentration of OM is smaller at the top of the sediments and it increases to the base of the drilling. This fact is due the new sediments brought be Danube flooding waters.



Graph 7 – Organic Matter concentration for adjacent area

Mobile P in sediments varies very much. The situation of the mobile P concentration is shown in the graph 8.

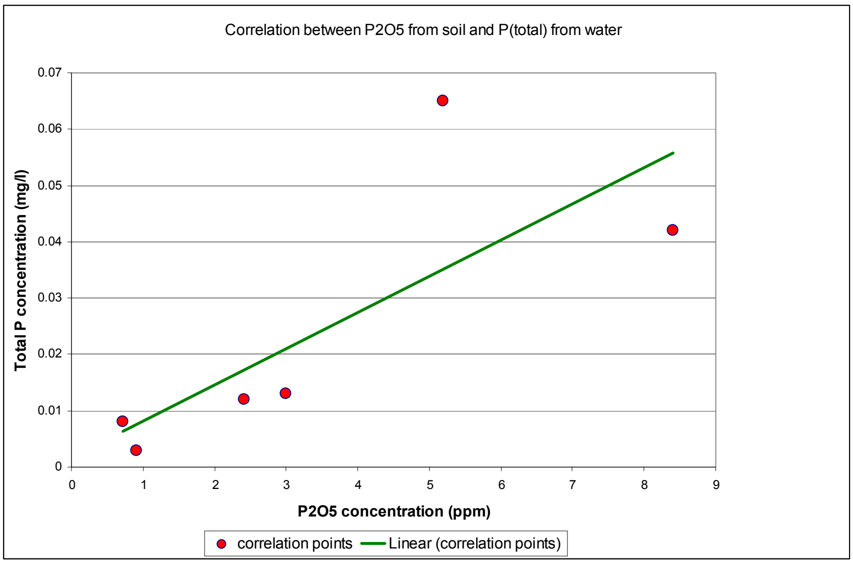
The biggest concentration of mobile P was registered to Sucidava sampling point and the smallest was registered to Celei-Dunare. In most of the cases the concentration decreases from the top to the bottom of the drilling, except the Celei-Dunare and Dunare-Celei sampling points.



Graph 8 – Mobile P concentration for adjacent area

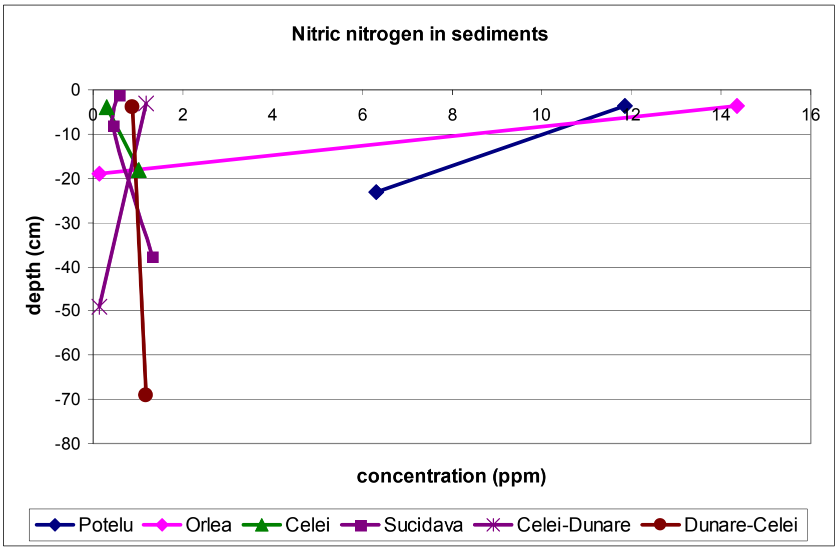
The graph 9 shows a medium correlation coefficient between P_2O_5 from the top of sediments (September) and P total from the water (August). The phosphorous need some special conditions to be adsorbed to the sediment particles.

The correlation coefficient is 0.772 fact that means a good correlation between two parameters that had been taken into account. This mean that a part of the total P from the water one month later is located in sediments ready to be uptake by the plants.



Graph 9 – Correlation between total P (water, August samples) and mobile P (sediments, September)

Nitric nitrogen in sediments is not so different from a drill to another (graph 10). The biggest concentrations were found in Orlea and Potelu sampling points. All the other sampling points vary in short limits.



Graph 10 – Nitric nitrogen concentration for adjacent area

Correlation between nitric nitrogen from water (August) and from sediments (September) is very poor. This means that the nitric nitrogen from the sediments is very low linked with the one from the water samples.

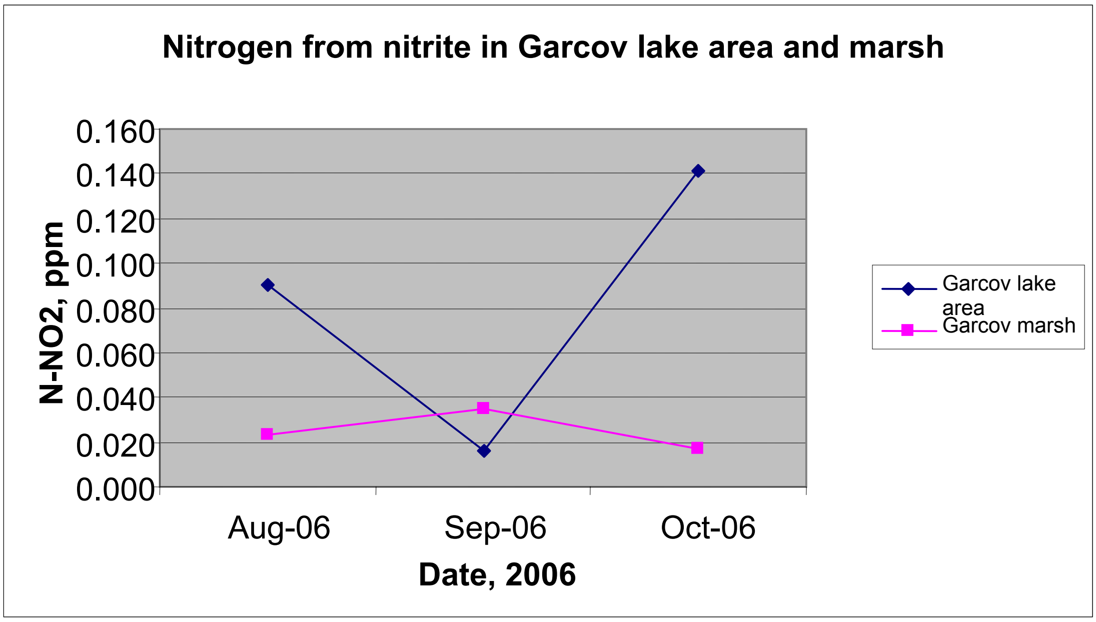
The same situation is for correlating data regarding nitric nitrogen from water of adjacent area (September) with nitric nitrogen from sediments (September).

B. Water chemistry analyses

a..Garcov area removal/retention capacity

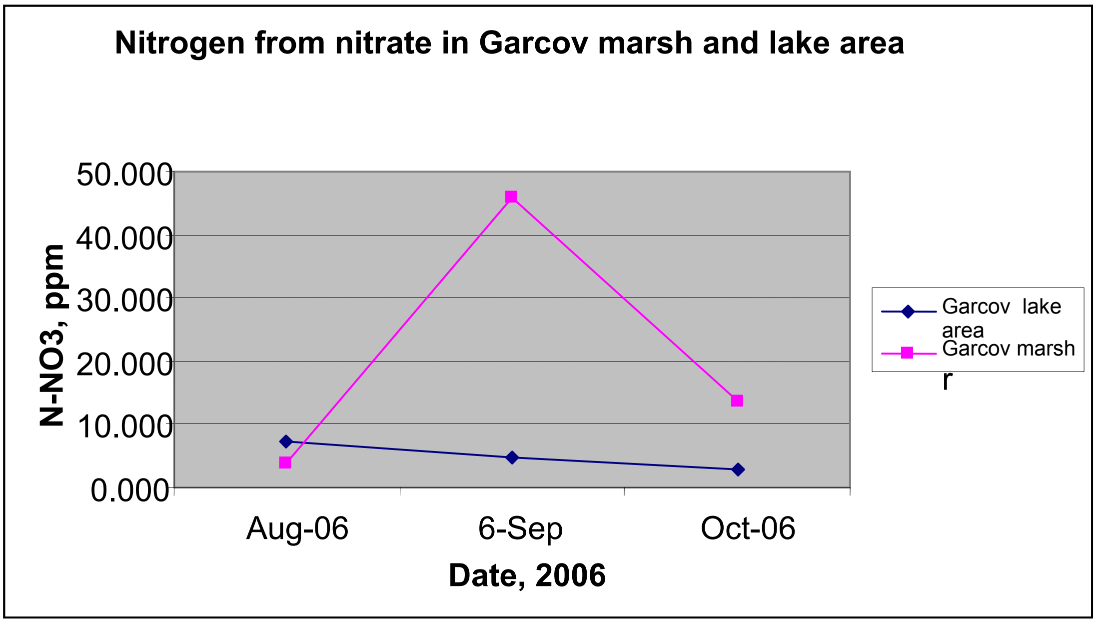
In order to establish the filtering/retention capacity of Garcov reservoir, we take into account, the measurements in 2006, of nutrients concentrations in lake comparing to downstream marsh areas. The water samples were collected in august, September and October 2006. All the results are expressed in ppm (mg/l).

- The nitrogen from nitrite has higher concentrations in the lake area comparing to marsh (except in september)



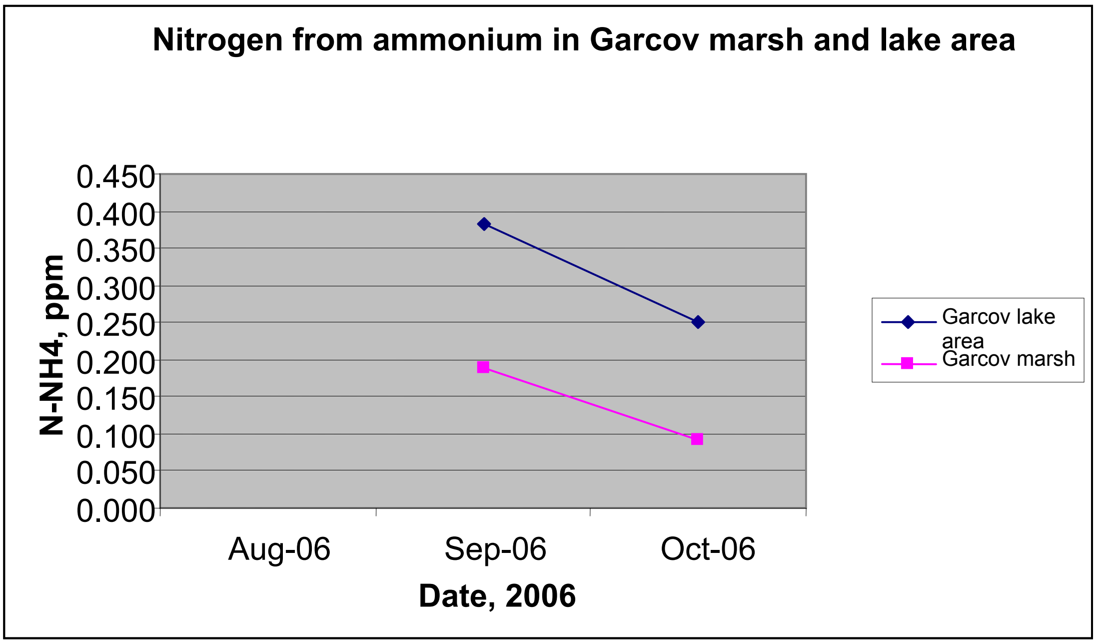
Graph 11 – Nitrogen from nitrite in studied area water

- The nitrogen form nitrate, has a different dynamic (with higher values in marsh, comparing to lake area. The high values found in September, are probably due to the direct input by partial treated and untreated waste water in the area.



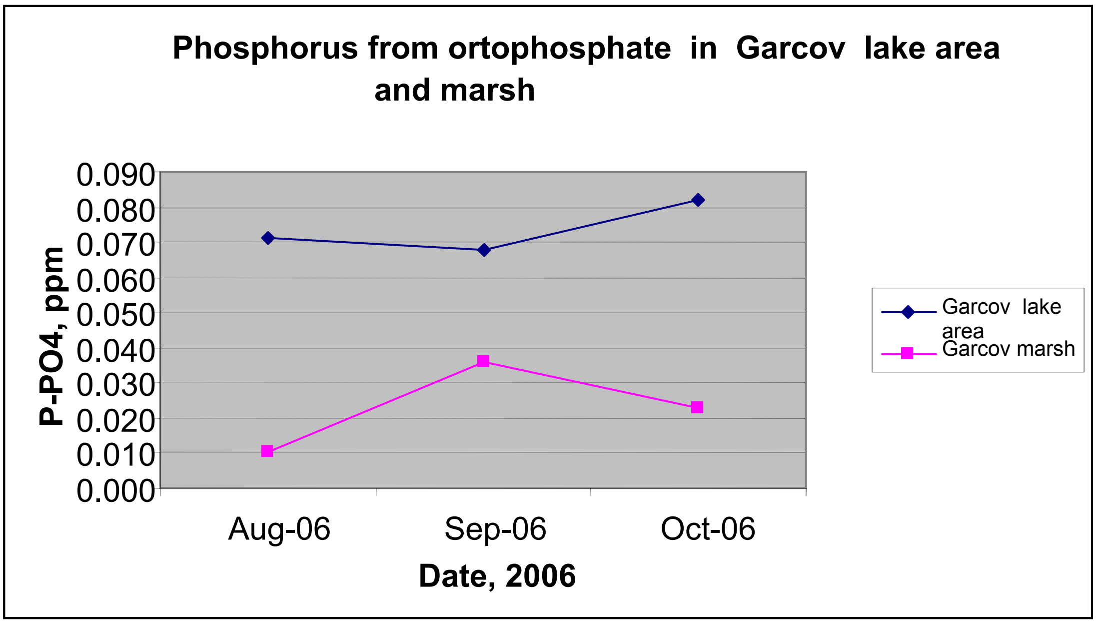
Graph 12 – Nitrogen from nitrate in studied area water

- The nitrogen from ammonium, was analysed only in september and october 2006; The general dynamic respects the assumption of filtering capacity, with smaller concencetrations, in marsh comparing to lake area.



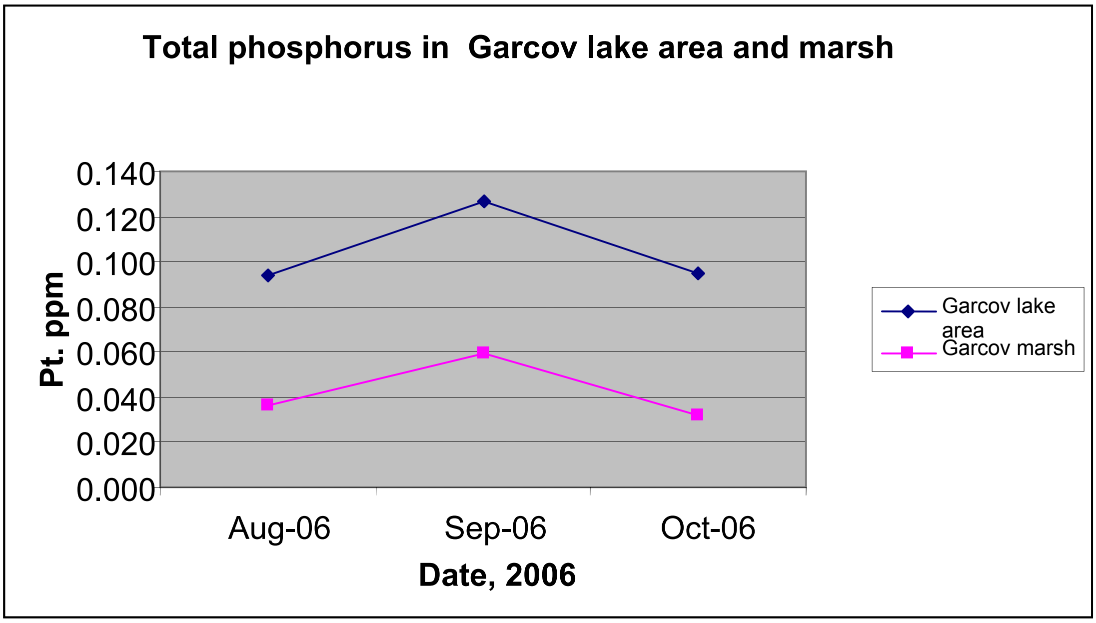
Graph 13 – Nitrogen from ammonium in studied area water

- The concentrations of inorganic phosphorus, expressed as phosphorus from ortophosphate, respect the asssumption of Garcov filter, in all the sampling periods.



Graph 14 – Phosphorous from othophosphate in studied area water

- The total phosphorus, that included the inorganic and organic phosphorus, indicate lower values in marsh area as a result of active sedimentation processes in lake area.



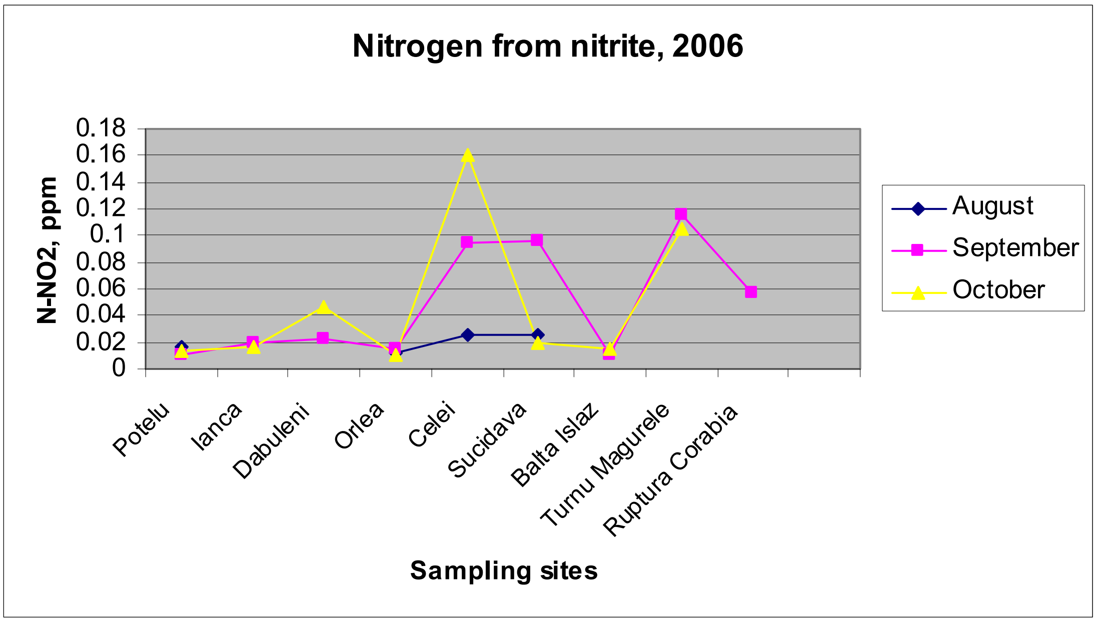
Graph 15 – Total phosphorous in studied area water

Even if the analyses are made only in one year, from three sampling times, looking to the nutrients concentrations, expressed in nitrite, nitrate, ammonia, ortophosphate, total phosphorus, we can conclude that the Garcov lake, has a filter/retention function, with a decreasing gradient of phosphorus concentration from lake to marsh area, as well as of nitrogen forms of nitrite, nitrogen in form of nitrate, except September. The nitrogen from nitrate form, dominates as a results of good oxygenated environment in both area.

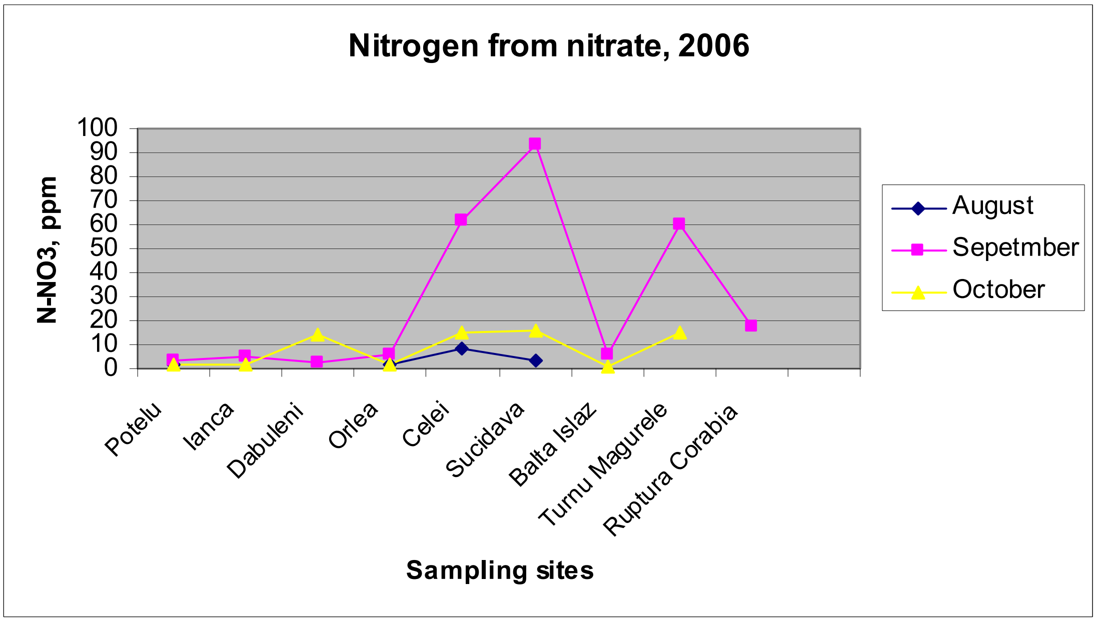
b. Nutrient monitoring in adiacent area

In this section we compare the next sampling sites: Potelu, Ianca, Dabuleni, Orlea, Celei, Sucidava, Balta Islaz, Turnu Magurele, Ruptura Corabia. For these points, we take into account the nutrients concentration from august, September, October 2006.

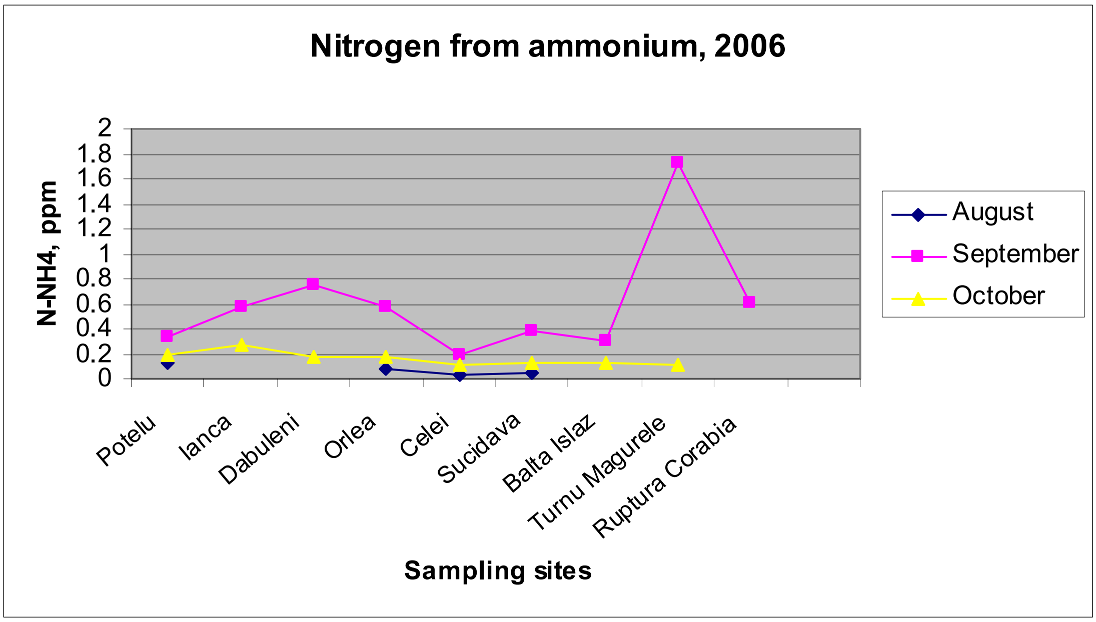
We represent the general dynamic of nutrients concentrations, in the sampling sites, in three months.



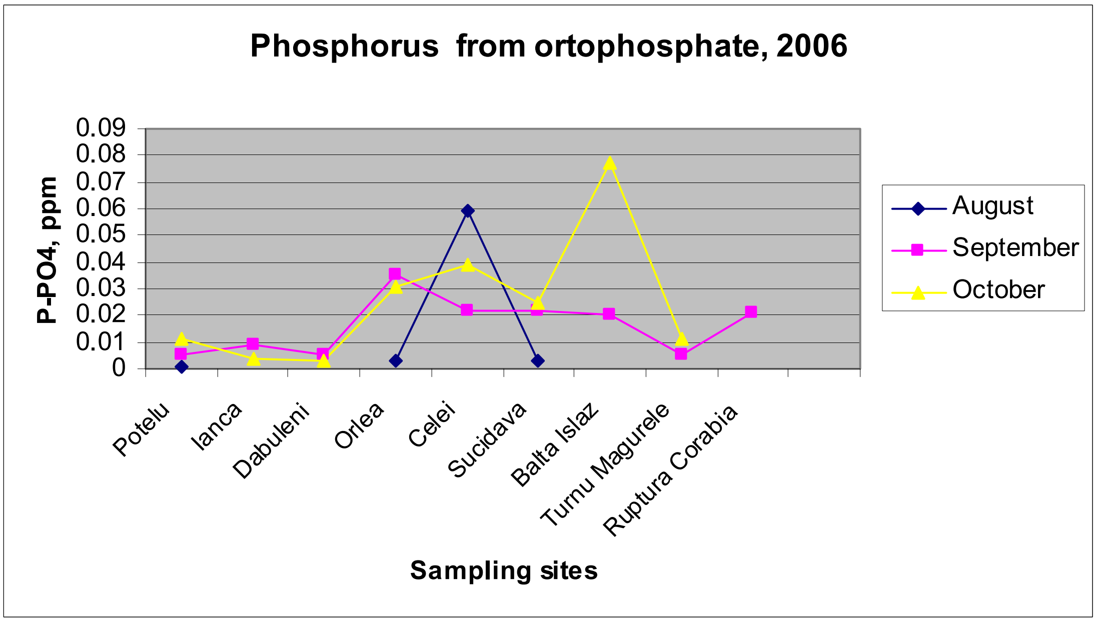
Graph 16 – Nitrogen from nitrite in adjacent area water



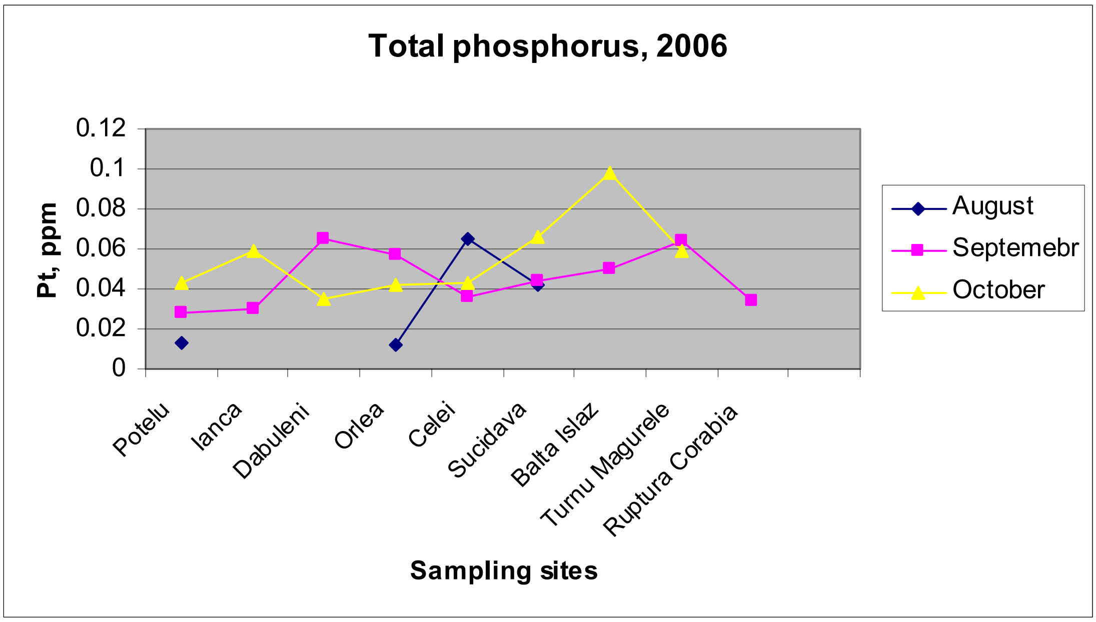
Graph 17 – Nitrogen from nitrate in adjacent area water



Graph 18 – Nitrogen from ammonium in adjacent area water



Graph 19 – Phosphorous from orthophosphate in adjacent area water



Graph 20 – Total phosphorous in adjacent area water

As we expect, in Celei, we obtain high concentrations in nitrite and nitrate, due to the general characteristics at this site - the surface water passes the agricultural land, and an old zootechnical farm, which determine high levels of nutrients.

The existence of Donauchem, near Turnu Magurele, explains the high concentrations of nitrite, nitrate and ammonia.

Some high concentrations in Sucidava (nitrate in september), can be linked with the village domestic used water.

The phoshorus, expresses as inorganic phosphorus and total phosphorus, has maximum concentrations in Celei, explain by the water characteristics (agricultural and zootechnical input), and also in Balta Islaz, an underground water, which has a Danube input

If we compare the monthly general dymanic, we observe maximum concentrations in September (example: ammonia, all sampling sites), with small exceptions.

The land charactersitics, overpasses by surface water (our sampling sites), determine the input of nutrients.

Also, the used water of Donauchem near Turnu Magurele in an other input in the surface water.

2006, was a particular year, when we were measured small concentrations of total phosphorus, bellow 0.1ppm, due to the high dillution factor, result may be of relatively constant overflow in volumes in Danube.

c. Contribution of tributaries Olt and Saiu to Danube nutrients load

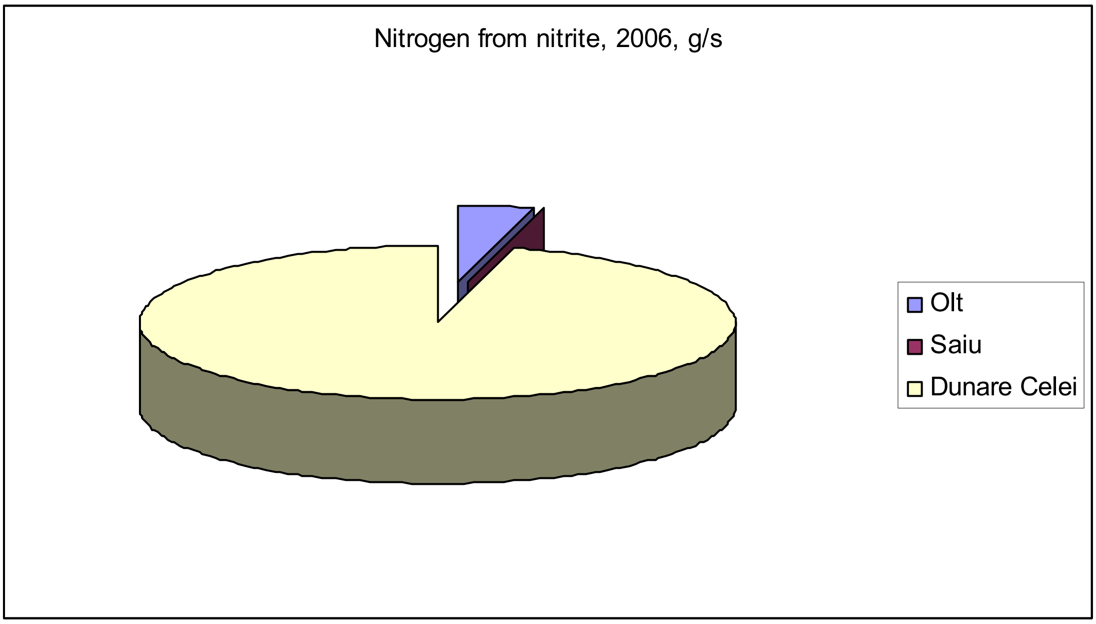
During 2006, in august, september and october, it were taken samples from Olt, Saiu and Danube Celei.

To make the correlation between nutrients input of Olt and Saiu in the Danube, we use the mass flow, in g/s , (expressed as the media concentration, in mg/l, in 2006 in different nutrients, multiplied by multi-yearly media water flow, in m^3/s)

Nitrogen from nitrite

Sampling sites	Water flow, m^3/s	$N\text{-}NO_2$, mg/l	Mass flow, g/s
Olt	160	0.030	4.800
Saiu	3	0.048	0.144
Dunare Celei	5825	0.019	110.675

As we can see in the table and also in the graph, the nitrogen from nitrite in Olt, represents 4.34% from the Danube concentration, and in Saiu, 0.13%.

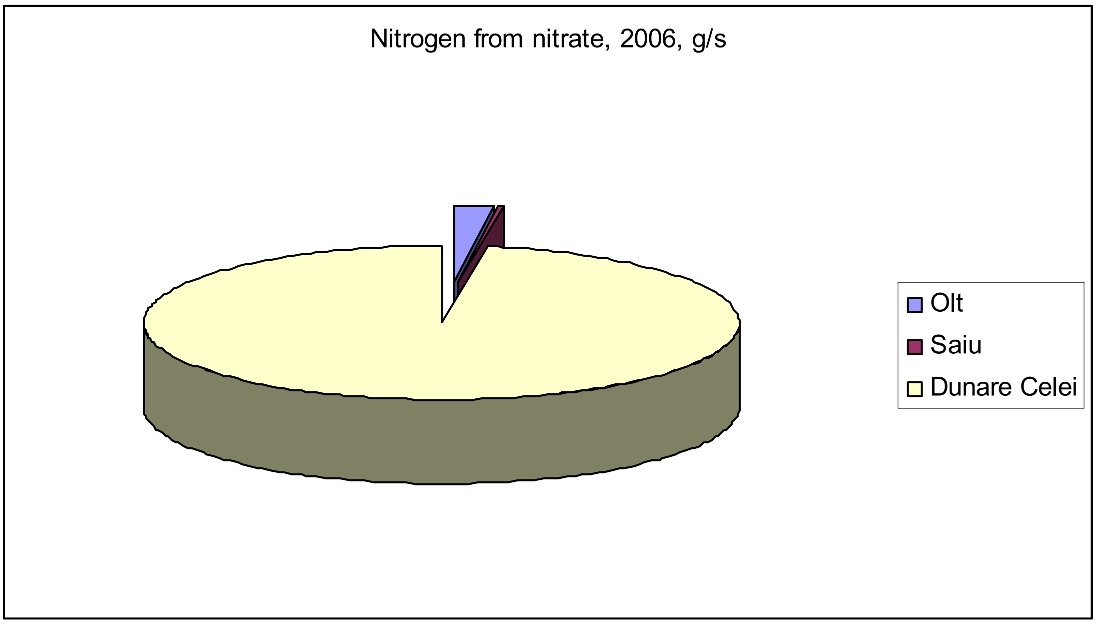


Graph 21 – Nitrogen from nitrite in tributary rivers water

Nitrogen from nitrate

Sampling sites	Water flow, m^3/s	$N\text{-}NO_3$, mg/l	Mass flow, g/s
Olt	160	5.709	913.440
Saiu	3	12.806	38.418
Dunare Celei	5825	6.644	38701.300

The contribution of nitrogen from nitrate in the Danube river, represents 2.36% from Olt, and 0.1% from Saiu, in mass flow.

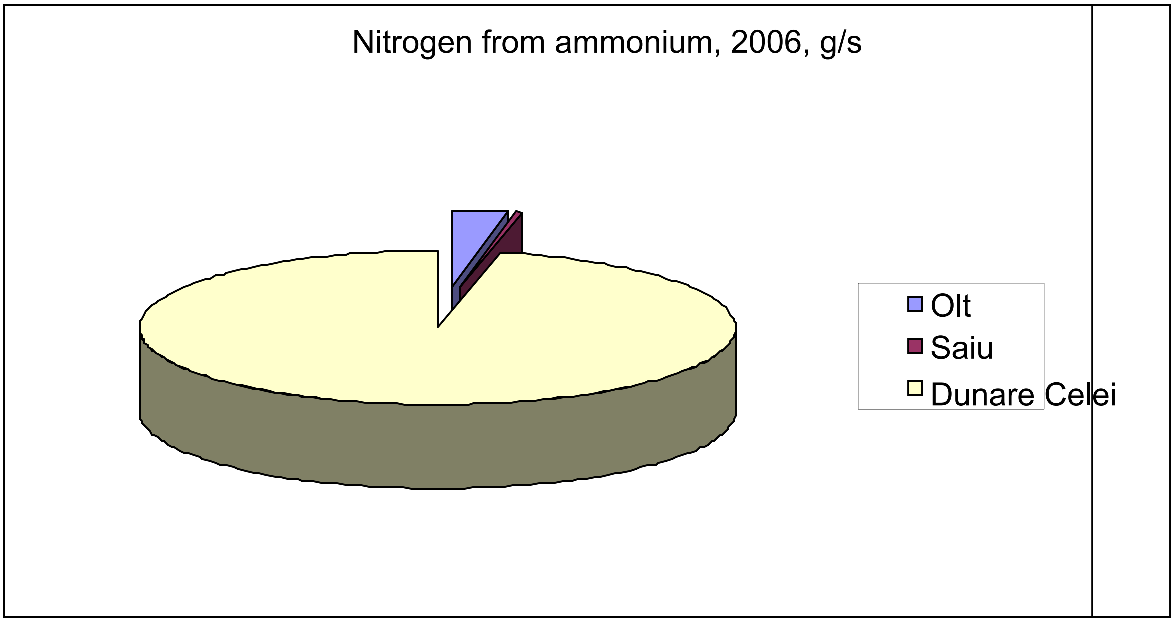


Graph 22 – Nitrogen from nitrate in tributary rivers water

Nitrogen from ammonium

Sampling sites	Water flow, m^3/s	N-NH_4, mg/l	Mass flow, g/s
Olt	160	**0.144**	**23.040**
Saiu	3	**0.351**	**1.053**
Dunare Celei	5825	**0.121**	**704.825**

In the Danube, the contribution of ammonium nitrogen, in mass flow, of Olt, represents 3.27%, and Saiu 0.15%.

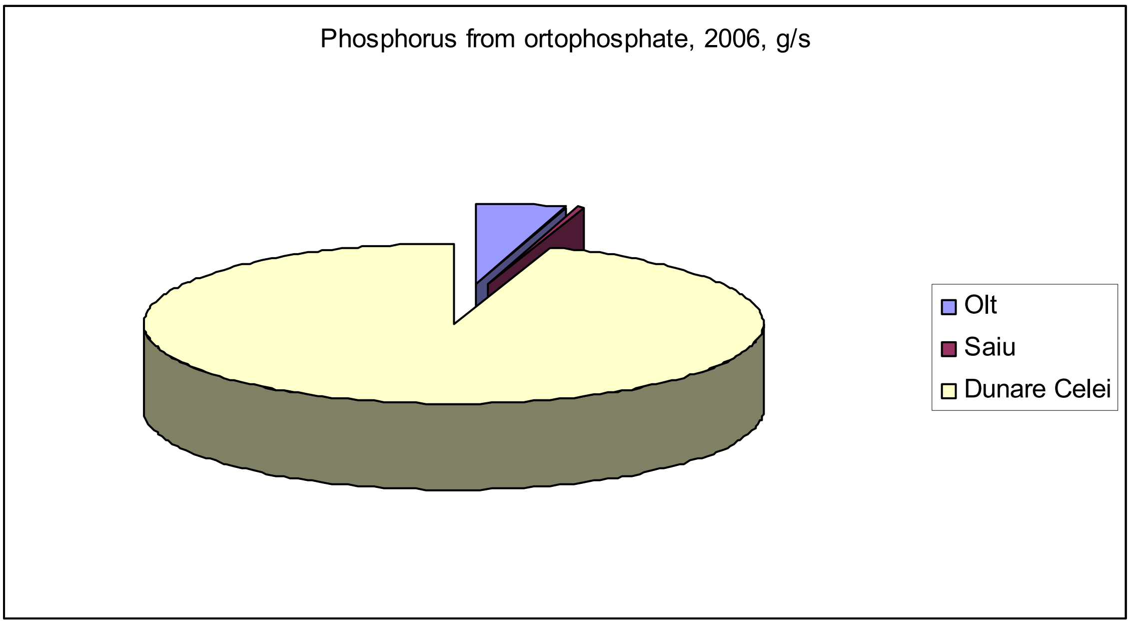


Graph 23 – Nitrogen from ammonium in tributary rivers water

Inorganic phosphorus from ortophosphate

Sampling sites	Water flow, m^3/s	$P\text{-}PO_4$, mg/l	Mass flow, g/s
Olt	160	0.010	1.600
Saiu	3	0.028	0.084
Dunare Celei	5825	0.005	29.125

The contribution of Olt, in inorganic phosphorus from orthophosphate, at the Danube concentration, represents 5.49%, and Saiu 0.29%.

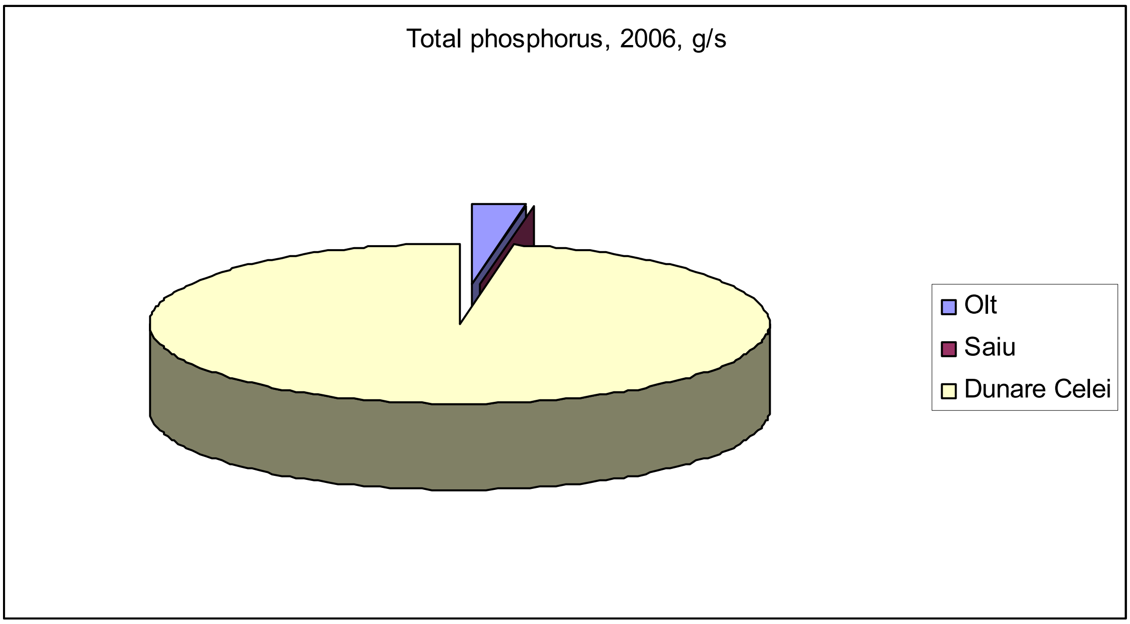


Graph 24 – Phosphorous from orthophosphate in tributary rivers water

Total phosphorus

Sampling sites	Water flow, m^3/s	Pt, mg/l	Mass flow, g/s
Olt	160	0.017	2.720
Saiu	3	0.049	0.147
Dunare Celei	5825	0.017	99.025

The total phosphorus contribution of Olt , in mass flow, represents 2.747%, from the Danube mass flow, and Saiu 0.148%.



Graph 25 – Total phosphorous in tributary rivers water

- The nutrients contributions of Saiu, represents 0.1%inorganic nitrogen and 0.148% total phosphorus from the Danube nutrients concentrations
- The nutrients contributions of Olt, represent 2.38% inorganic nitrogen and 2.74% total phosphorus from the Danube nutrients concentrations

C. Phytoplankton

1. Diversity of phytoplankton

According to the results of the qualitative analyses, diatoms (Fillum Bacillariophyta) are the dominant algal group occurring during the late summer period in the riverine wetlands of the lower Danube valley (see Table No. 1).

Table No. 1. Number of species recorded in various sampling-sites.

No.	Name of sampling site	No. of species belonging to the systematical group						
		BACI	CHLO	CYAN	CRYP	EUGL	DINO	CHRY
1	Celei	32	14	2	0	5	1	0
2	„Celei – Dunăre”	25	7	6	0	2	1	0
3	„Dunăre – Celei”	49	2	4	0	1	0	0
4	„Gârcov Marsh”	38	8	2	0	0	0	0
5	„Gura Oltului”	27	3	1	0	0	0	1
6	lake Gârcov	28	7	2	0	0	0	0
7	Orlea	30	8	4	1	3	0	0
8	Potelu	24	3	3	1	4	0	2
9	Sâiu	32	3	1	0	0	0	1
10	Sucidava	31	14	1	0	5	0	1

Abbreviations: BACI – Bacillariophyta; CHLO – Chlorophyta; CYAN – Cyanophyta; CRYP – Cryptophyta; EUGL – Euglenophyta; DINO – Dinophyta; CHRY – Chrysophyta.

The results of the qualitative analyses show that the most diverse sites are the ones located up-stream areas (e.g. Potelu – the value of Shannon-Wiever index is: 2.93), and the minimal values of the diversity index were registered in sites located down-stream areas (e.g. Sucidava – the value of Shannon-Wiever index is: 1.212) (see Table No. 2).

Table No. 2. Total number of species and values of diversity indexes recorded in sampling-sites.

No.	Name of sampling site	No. of species	Shannon-Weaver index
1	Celei	54	2.7
2	„Celei – Dunăre”	41	2.571
3	„Dunăre – Celei”	56	2.8
4	„Gârcov Marsh”	48	2.22
5	„Gura Oltului”	32	1.991
6	lake Gârcov	37	1.482
7	Orlea	46	2.259
8	Potelu	37	2.93
9	Sâiu	38	2.668
10	Sucidava	52	1.212

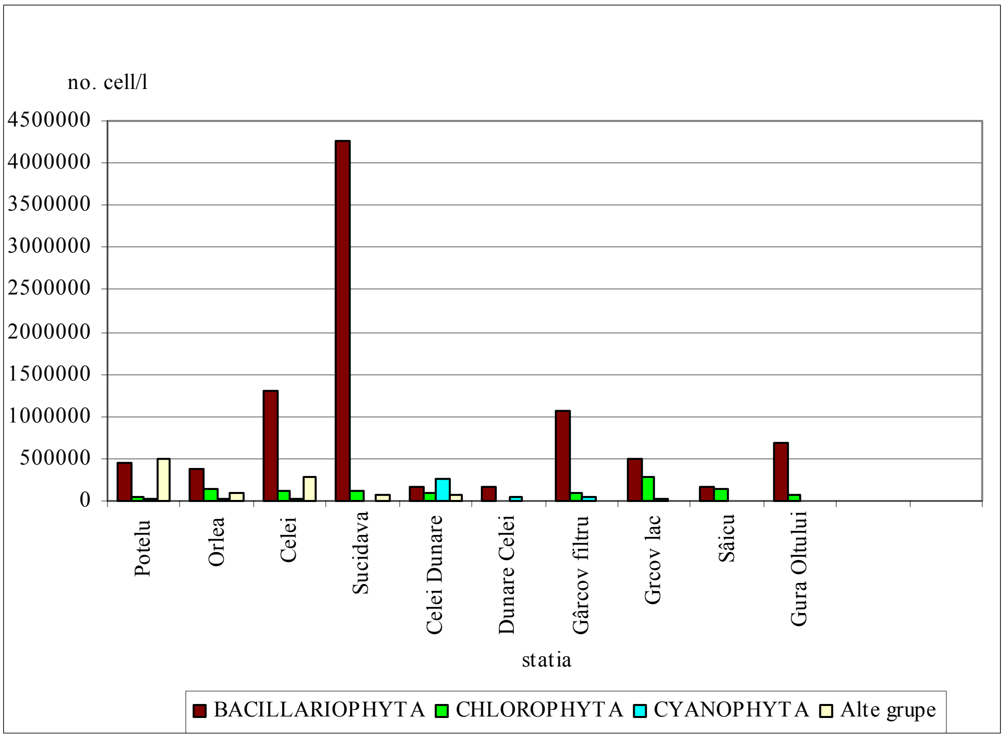
Furthermore, analyses of suplementary samples (taken from Turnu Măgurele and ”Islaz-ruptură”) show that values of Shannon-Weaver indexes ranges between wider limits, depending on the location of the sampling-site and the sampling period. For example, in case of the samples taken in September from Turnu Măgurele, the total number of species is 60, and the value of the Shannon-Weaver index is 3.95; in case of the samples taken in September from ”Islaz ruptură” area (close to Turnu Măgurele), the total number of species is 55, and the value of the Shannon-Weaver index is 3.445.

Measures of diversity is considered as indicators of the wellbeing of ecological systems (Magurran, 1988). The Shannon-Weaver index is one of the most frequently used index to calculate the diversity of a system. The value of the Shannon-Weaver index is usually ranging between 1.5 and 3.5. The values of Shannon-Weaver index calculated for the phytoplankton samples taken from the riverine wetlands of the lower Danube valley fall between 1.5 and 3.5 (with the only exception represented by the sample from Turnu Măgurele, taken in September 2006).

2. Abundance of phytoplankton

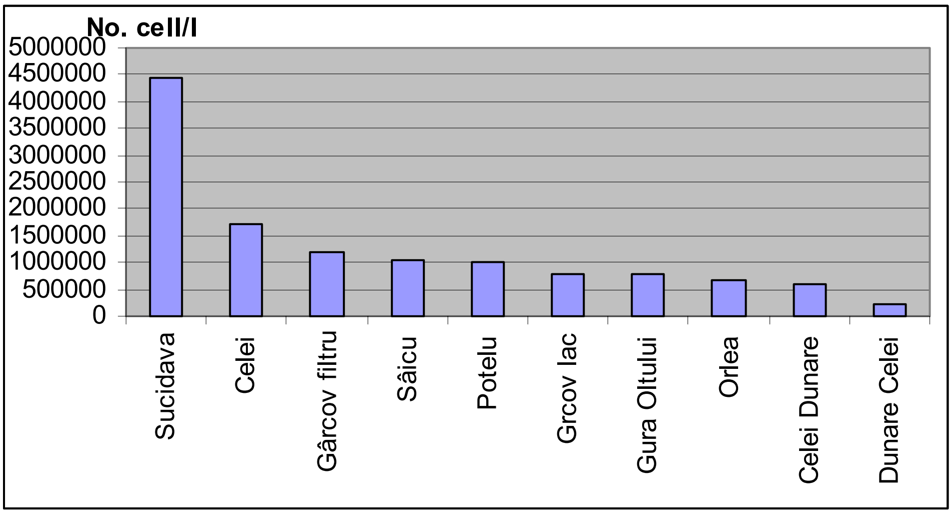
According to the results of the quantitative analyses, diatoms (Fillum Bacillariophyta) are the most abundant algal group (see Graph26).

Graph 26 – The abundance of algal groups



The highest values of algal abundance were recorded at Sucidava (see Graph 27).

Graph 27 – The total abundance of phytoplankton



The value recorded in case of the sample from Sucidava shows the nutrient removal capacity of the riverine wetland system from Turnu Măgurele – Corabia – Potelu sector.

Furthermore, the cluster analysis (see Graph 28) and the ANOVA statistical test performed with the available data shows the homogenity of the recorded values of abundance of phytoplankton and of nutrients concentration (see Table No. 3 and Table No. 4).

Graph 28 – The similarity analyses from the sampling points based on the species densities of identified phytoplankton.

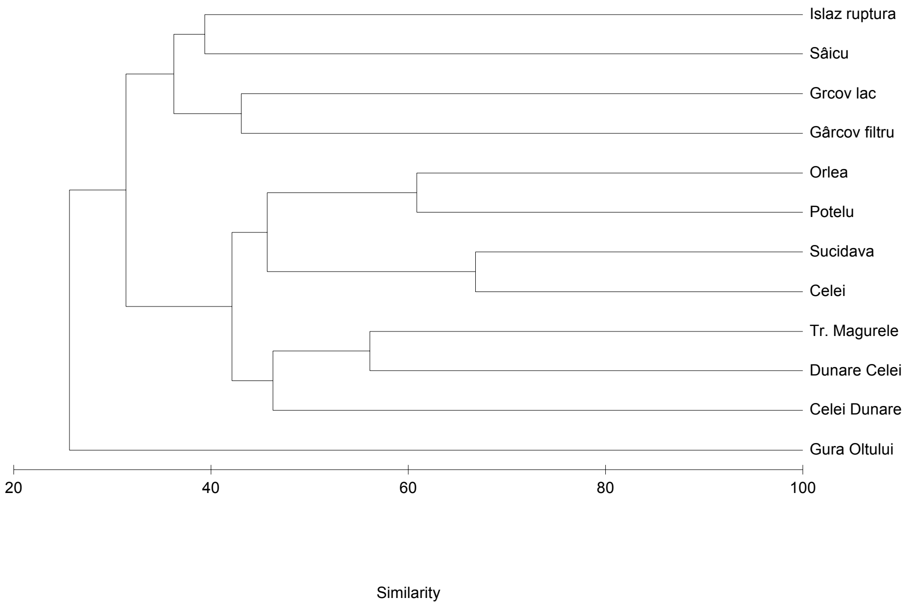


Table no. 3 – ANOVA test

Crt.No.	*Station*	*Variable No.*	*Average*	*Variance*	*Fmax*
1	Dunare Celei	4	1,169	107,251	
2	Sucidava	4	2,362	106,086	
3	Potelu	4	1,286	103,622	
4	Orlea	4	1,630	99,966	
5	Celei Dunare	4	1,121	94,149	
6	Celei	4	3,388	87,694	
7	Garcov lake	4	2,296	86,865	
8	Gura Olt	4	1,094	79,399	
9	Garcov pool	4	3,087	71,330	**1,579**

Table No.4

ANOVA

Variabilities source	*Degree of freedom (df)*	*Mean square MS*	*F*	*P-value*	*Fcrit*
Between stations	9	2,877	0,031	0,999	2,210
Inside stations	30	90,427			
Total	**39**				

3. Saprobity of the target area

The ecological status of the target area was estabished taking into account the category of saprobity and trophicity to which the recorded species belong to.

The species were included into classes ranging between oligo to mesosaprobe and to oligotraphentic to hipereutraphentic classes (Table No. 5 and Table No. 6).

Table no. 5 – species number and the saprobity class

	A	B	C	D	E	F	G	H	I	J	K	L
Oligo-saprobe	0	0	0	1	0	1	1	0	0	1	1	0
oligo/β-meso-saprobe	1	1	2	1	3	2	0	0	0	1	1	2
β-meso -saprobe	4	7	10	9	6	5	8	5	2	1	3	5
oligo/α-meso -saprobe	20	24	24	22	18	32	23	18	20	17	25	29
β/α-meso -saprobe	3	2	3	6	6	7	5	6	2	2	6	8
α-meso -saprobe	1	3	3	2	3	6	5	2	6	3	5	5
oligo-poli -saprobe					1							
β-meso / poli -saprobe												
α-meso/poli -saprobe												
Poli -saprobe	1	1	1	1	1		1	1	1	1	1	1
unknown	7	8	11	10	3	3	5	5	7	6	13	10

Where: A = Potelu; B = Orlea; C = Celei; D = Sucidava; E = Celei Dunare; F = Dunare Celei; G = Garcov Marsh; H= Garcov Lac; I = Saiu; J = Gura Oltului; K = Islaz Ruptura; L = Tr. Magurele

Table No.6 species number and their troficity categorie

Troficity class	A	B	C	D	E	F	G	H	I	J	K	L
ultraoligotraphentic												
oligotraphentic												
oligo-mezotraphentic								1				
mezotraphentic	1	1	1	1	1	1	1	1	1	1	1	1
ultra/oligotraphentic-eutraphentic	0	2	0	0	1	2	1	0	1	2	2	1
mezo-eutraphentic												
eutraphentic						1	0	0	1	1	0	0
ultra/oligo la hiperutraphentic	20	24	25	25	16	36	32	24	26	20	34	37
hipereutraphentic			1	1	0	0	1	0	0	1	0	2
unknown	16	19	27	25	23	14	13	11	9	7	18	19

Where: A = Potelu; B = Orlea; C = Celei; D = Sucidava; E = Celei Dunare; F = Dunare Celei; G = Garcov Marsh; H= Garcov Lac; I = Saiu; J = Gura Oltului; K = Islaz Ruptura; L = Tr. Magurele

Even if the limits of ecological status are large, the dominant phytoplankton species that occure in the riverine wetlands of the lower Danube river are mesosaprobe and eutraphentic species.

D. Zooplankton

Zooplakton is an inseparable part of the aquatic ecosystems, and it fulfils a great variety of important functions. First of all, feeding on phytoplankton and microorganisms, it purifies water. Based on the species dominant on zooplankton communities, we may evaluate the quality of water. Hence, zooplankton can be used as an indicator of saprobity.

On the other hand, zooplankton is a source of food for some species of fish. In addition, species diversity, abundance and biomass of zooplankton determine production of fish in the aquatic ecosystems.

Water chemistry, temperature, and zoogeography may determine the general morphology of zooplankton species in all Corabia – Turnu Magurele Sector of Danube Floodplain.

The species list (ANNEX) and graphics of abundance (Graph 29) and biomass (Graph 30).

The zooplankton assemblage of 2006 comprised 29 species representing 17 genera from the Calanoida, Cyclopoida, Cladocera and the Rotifera.

The Rotifera possessed the largest number of species 12 followed by cladocera and Calanoida. The nauplius stage of the copepoda accounted for 15.2% of the total zooplankton abundance. On a biomass basis, the importance of the rotifera dropped 10% of the zooplankton biomass because of their small size in all the stations and Copepoda contributed 56% of the biomass (Graph 30).

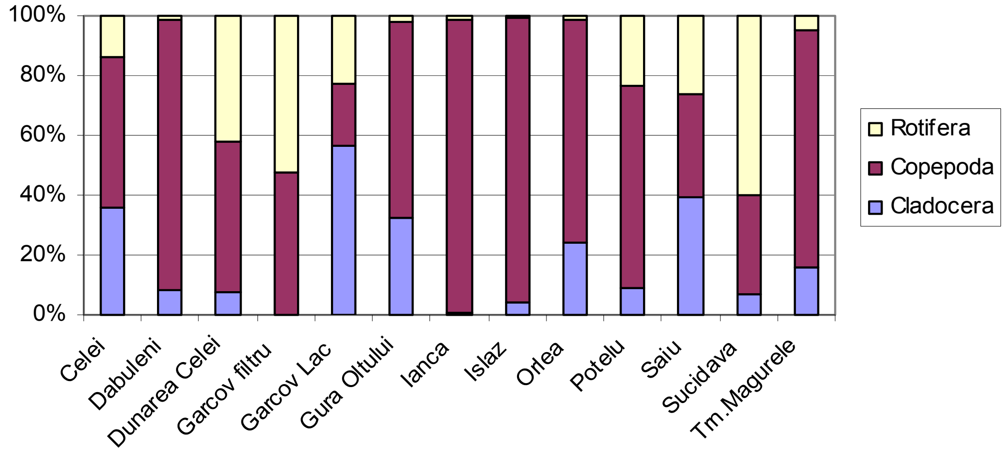
Studies revealed that the percentage abundance and biomass of zooplankton in the Corabia-Turnu Magurele sector are high.

Average biomass was higher in the Dabuleni station, dominated by copepoda 690 indiv/l, with high biomass: 62.7 mg/l ww). The low biomass was in Galcov Marsh station 1 indiv/l, with 0.002 mg/l, nauplius stage of the copepoda.

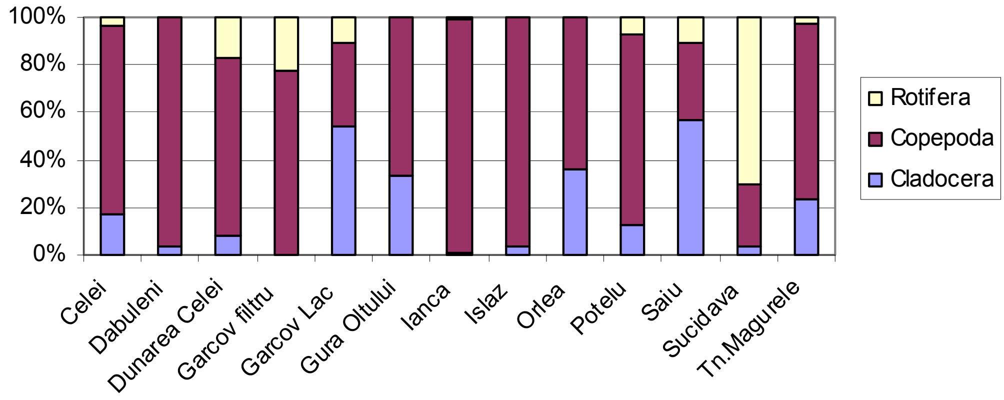
A group, such as rotifers, that typically have a short lifespan and explosive population growth over a short period would have different species succeeding each other very quickly and result not all rotifer species being observed in period study.

The eutrophic indicators *Brachionus calyciflorus*, *B. angularis*, *Filinia longiseta,* cyclopoid copepods, had abundances restricted to or significantly higher in all the stations.

Graph 29 - Abundance of zooplankton in different parts of the Corabia-Turnu Măgurele Sector in 2006,%



Graph 30 - Biomass of zooplankton in different parts of the Corabia-Turnu Măgurele sector, in 2006,%



Abundance no.indiv/l	Cladocera	Copepoda	Rotifera
Celei	74.7	105.9	28.9
Dabuleni	64.0	690.0	9.3
Dunarea Celei	2.9	19.1	15.8
Garcov Marsh	-	26.0	28.8
Garcov Lac	143.1	52.1	57.7
Gura Oltului	7.0	14.3	0.5
Ianca	1.1	210.7	2.5
Islaz	2.7	65.9	0.7
Orlea	50.6	156.5	2.5
Potelu	9.7	71.5	24.8
Saiu	1.6	1.4	1.1
Sucidava	14.3	67.8	123.9
Trn.Magurele	4.8	23.5	1.5

Biomass mg/l ww	Cladocera	Copepoda	Rotifera
Celei	3.72	17.47	0.71
Dabuleni	2.29	62.74	0.27
Dunarea Celei	0.14	1.22	0.29
Garcov Marsh	-	2.23	0.65
Garcov Lac	6.75	4.45	1.30
Gura Oltului	0.95	1.88	0.00
Ianca	0.05	9.36	0.08
Islaz	0.16	4.59	0.01
Orlea	5.89	10.30	0.03
Potelu	0.46	2.88	0.27
Saiu	0.08	0.04	0.01
Sucidava	0.70	4.81	13.08
Tn.Magurele	0.23	0.72	0.02

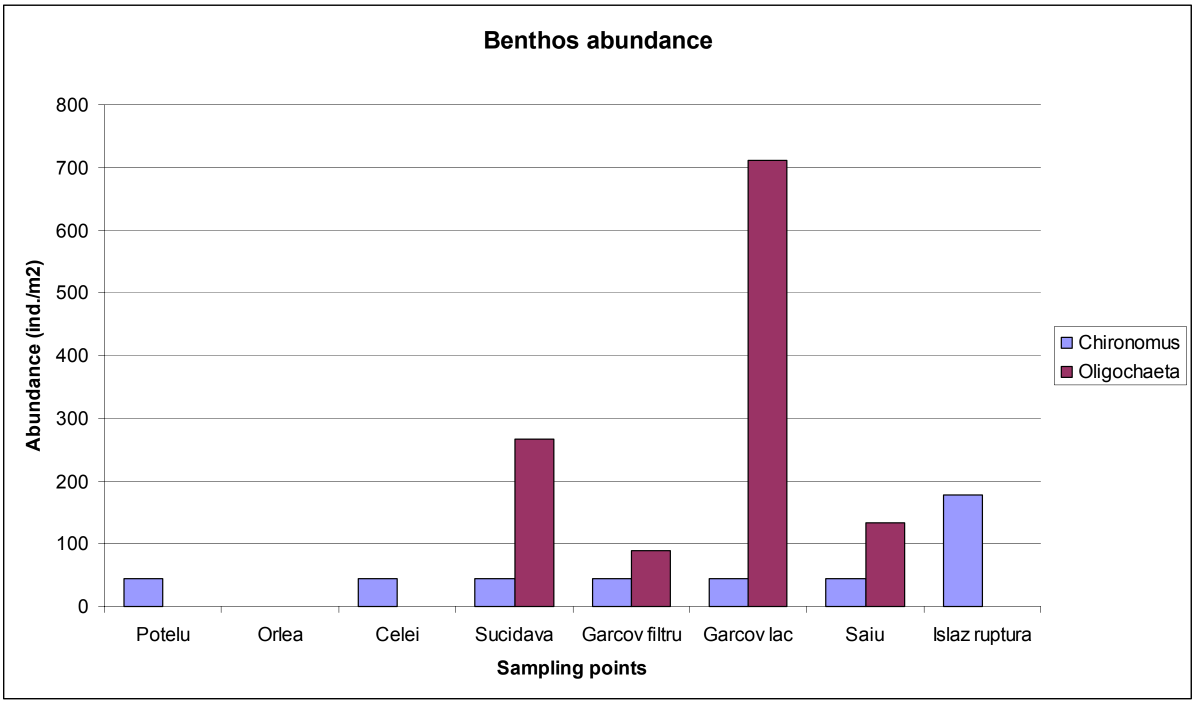
E. Benthos

August Sampling

Only two groups of organisms have been reported from the studied locations namely Oligochaeta – represented by 2 species, *Eiseniella tetraedra* and *Tubifex tubifex* and Chironomidae, represented by genus *Chironomus*.

By the total number of 8 sampled location for benthic macroinvertebrates, the communities has represented only by chironomids in Potelu, Islaz ruptura and Celei and no organisms was found in Orlea. The other stations communities were clearly dominated by oligochaets. Oligochaete worms are diverse, and occur in a spectrum of fresh waters, from unproductive to extremely eutrophic lakes and rivers some of the species determined living also in wet soils being semi-aquatic.

Considering the data collected in August 2006 oligocheta/chironomidae ratio was applied in order to determine the ecological quality of the analysed sites. 50 % of the sampling points can be characterized as in very bad ecological status (Potelu, Orlea, Celei and Islaz ruptura) and the rest of 50 % in bad ecological status.



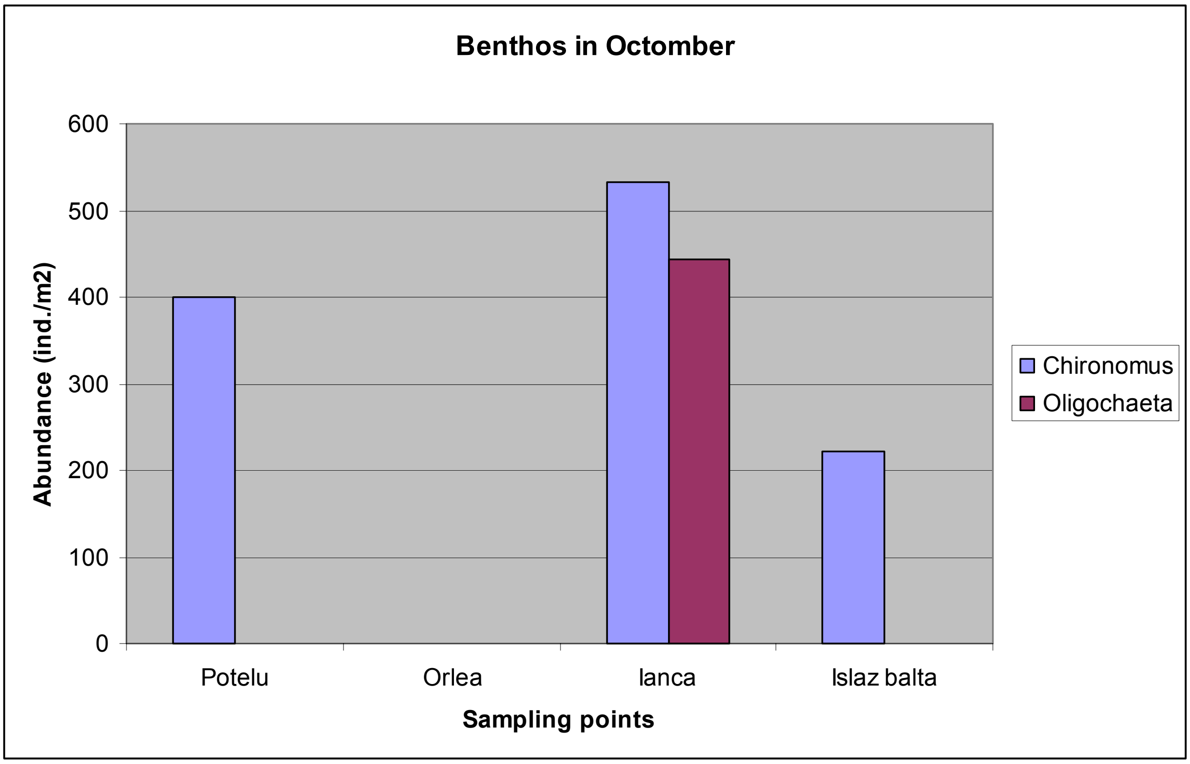
Graph 31 – Benthos abundance studied area, tributary rivers and adjacent area (September)

Octomber Sampling

In October 4 stations were sampled: Potelu, Orlea, Ianca and Balta Islaz. Like in September, Potelu has no benthic invertebrate. Chironomid abundances are higher this time (~550 individuals/m2).

Determined chironomids are represented by *Chironomus plumosus* and *Microtendipes pedellus.* The last one appears only in Islaz Balta and has an abundance of 44.4 ind/m2.

Oligocheta is represented only by *Tubifex tubifex.* All specii found in the sample are insensitive taxa. They appear in all types of water even in those with high amounts of organic substances and nutrients.



Graph 32 – Benthos abundance studied area, tributary rivers and adjacent area (October)

CONCLUSIONS

a. Studied area (Garcov Lake and Marsh)

- The sediments of Garcov Marsh are more loaded with organic matter and phosphorous than the sediments from the Garcov Lake,
- The sediments of Garcov Lake is more loaded with nitric nitrogen than the sediments of Garcov Marsh,
- The nitrogen from nitrite has higher concentrations in the lake area comparing to marsh (except in September).
- The nitrogen form nitrate has a different dynamic (with higher values in marsh, comparing to lake area. The high values found in September, are probably due to the direct input by partial treated and untreated waste water in the area,
- The nitrogen from ammonium, was analyzed only in September and October 2006; the general dynamic respects the assumption of filtering capacity, with smaller concentrations, in marsh comparing to lake area,
- The concentrations of inorganic phosphorus, expressed as phosphorus from orthophosphate, respect the assumption of Garcov filter, in all the sampling periods,
- The total phosphorus, that included the inorganic and organic phosphorus, indicate lower values in marsh area as a result of active sedimentation processes in lake area,
- The nutrient removal capacity of the wetlands located in the studied area of the lower Danube river valley is demonstrated by the more diverse and more abundant phytoplankton recorded in the inflowing waters (in comparison with the outflowing waters),
- In case of the samples taken in the late summer – early autumn period, the saprobity values recorded for input and output waters are not sufficient for quantification of the nutrient removal capacity of the floodplains occurring along the lower Danube valley,
- Studies revealed that the percentage abundance and biomass of zooplankton in the studied area are high,
- The low biomass was in Galcov Marsh station 1 indiv/l, with 0.002 mg/l, nauplius stage of the copepoda,
- A group, such as rotifers, that typically have a short lifespan and explosive population growth over a short period would have different species succeeding each other very quickly and result not all rotifer species being observed in period study,
- The eutrophic indicators *Brachionus calyciflorus*, *B. angularis*, *Filinia longiseta,* cyclopoid copepods, had abundances restricted to or significantly higher in all the stations,
- In August only two groups of organisms have been reported from the studied locations namely Oligochaeta – represented by 2 species, *Eiseniella tetraedra* and *Tubifex tubifex* and Chironomidae, represented by genus *Chironomus,*
- In Octomber like in September there were no benthinc invertebrate. Chironomid abundances are higher this time (~550 individuals/m2).;

b. Tributary rivers to the Danube River in the area (Olt and Saiu rivers)

- The sediments of Saiu River are highly loaded with organic matter,
- The sediments of Danube River tributary (Saiu River) are highly loaded with mobile phosphorous at the top of the layers,
- The nitric nitrogen is in relative big amounts in sediments of Saiu River,
- The contribution of nitrogen from nitrate in the Danube river, represents 2.36% from Olt, and 0.1% from Saiu, in mass flow,
- In the Danube, the contribution of ammonium nitrogen, in mass flow, of Olt, represents 3.27%, and Saiu 0.15%,
- The contribution of Olt, in inorganic phosphorus from orthophosphate, at the Danube concentration , represent 5.49%, and Saiu 0.29%,
- The nutrients contributions of Saiu, represents 0.1%inorganic nitrogen and 0.148% total phosphorus from the Danube nutrients concentrations,
- The nutrients contributions of Olt, represent 2.38% inorganic nitrogen and 2.74% total phosphorus from the Danube nutrients concentrations,

c. Adjacent area (former Potelu Lake now flooded arable dammed land)

- The organic matter was found in the sediments of adjacent area in big concentration except two points that are close and directly linked with the Danube River waters,
- There is a medium correlation coefficient between P_2O_5 from the top of sediments (September) and P total from the water (August), fact that proves the link between the mobile phosphorous from sediments and total P from flooding water,
- The nitric nitrogen from sediments and the one from water have no correlation fact due the nitrogen accessibility for micro-organisms and the chemical easy mobility
- Average biomass was higher in the former Potelu Lake, dominated by copepoda 690 indiv/l, with high biomass: 62.7 mg/l ww)..

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The correspondence between drillings codes and sampling point names

Sampling points	GPS Code	Drilling Code
Potelu	139	F1
Orlea	162	F2
Celei	165	F3
Sucidava	166	F4
Dunare Celei	167	F5
Celei Dunare	168	F6
Garcov pool	152	F7
Garcov lake	169	F8
Turnu Magurele	171	F9
Islaz Balta	156	F11
Saiu	189	F12

List of the algae species identified in 2006

Bacillariophyta		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Achanthidium	*minutissimum*	x		x			x	x	x	x		x	x
Achnanthes	*clevei*			x									x
Achnanthes	*conspicua*									x			
Achnanthes	*hungarica*							x					
Achnanthes	*lanceolata*			x	x			x					x
Achnanthes	*lanceolata var. rostrata*									x			
Achnanthes	*polenensis*				x								
Achnanthes	*saccula*					x							
Achnanthes	*sp.*		x				x	x		x	x	x	x
Actynociclus	*normanii*				x		x		x				x
Amphora	*ovalis*						x				x	x	
Amphora	*pediculus*			x				x		x		x	
Amphora	*veneta*	x	x	x									
Anomoeoneis	*sphaerophora*								x				
Aulacoseira	*ambigua*						x						
Aulacoseira	*distans*		x			x		x					
Aulacoseira	*granulata*	x	x	x	x	x	x			x	x	x	x
Aulacoseira	*italica*		x	x	x	x	x					x	x
Aulacoseira	*sp.*		x				x						
Cocconeis	*pediculus*				x							x	x
Cocconeis	*placentula*	x	x	x			x	x	x	x	x	x	x
Cyclostephanos	*dubius*												x
Cyclotella	*atomus*	x	x	x	x	x	x	x	x	x	x	x	x
Cyclotella	*meneghiniana*	x	x	x	x	x	x	x	x	x	x	x	x

Cyclotella	*steligera*				x		x						x
Cyclotella	*sp.*					x							
Cymatopleura	*solea*						x						
Cymbella	*cistula*												x
Cymbella	*cymbiformis*											x	
Cymbella	*silesiaca*					x			x				x
Cymbella	*tumida*										x	x	x
Cymbella	*sp.*									x			
Diatoma	*elongatum*										x		x
Diatoma	*tenuis*						x						
Diatoma	*vulgaris*										x		x
Epithemia	*adnata*									x		x	
Epithemia	*sorex*											x	
Eunotia	*bilunaris*							x					
Fallacia	*pygmaea*	x						x	x	x			
Fragillaria	*beroliensis*		x									x	x
Fragillaria	*bidens*		x										
Fragillaria	*capucina*	x	x		x			x					
Fragillaria	*capucina var. mesolepta*							x	x	x	x	x	
Fragillaria	*construens*	x	x	x				x	x	x	x	x	x
Fragillaria	*ulna*	x	x	x	x	x	x	x	x		x	x	x
Fragillaria	*ulna var. acus*	x	x	x	x		x	x				x	x
Fragilaria	*sp.*	x			x	x							
Gomphonema	*angustatum*				x					x		x	
Gomphonema	*augur*									x			
Gomphonema	*gracile*								x				
Gomphonema	*olivaceum*							x	x				x
Gomphonema	*parvulum*	x		x	x		x	x	x	x		x	x
Gomphonema	*truncatum*		x	x									
Gomphonema	*sp.*			x	x		x				x		
Gyrosigma	*accuminatum*		x				x				x		x
Gyrosigma	*scalproides*						x						
Hippodonta	*capitata*			x	x		x		x				
Melosira	*varians*	x	x		x	x	x	x				x	x
Navicula	*capitatoradiata*			x			x			x			
Navicula	*clementis*						x						
Navicula	*cryptocephalla*			x	x	x	x	x		x		x	x
Navicula	*cryptotenella*		x	x	x		x				x	x	
Navicula	*decussis*												x
Navicula	*gastrum*						x						
Navicula	*gregaria*					x	x	x					
Navicula	*halophila*				x			x				x	
Navicula	*menisculus*									x			
Navicula	*pupula*						x			x			
Navicula	*radiosa*						x					x	
Navicula	*tripunctata*									x			
Navicula	*trivialis*							x			x		

Navicula	*viridula*					x							
Navicula	*viridula var. rostellata*						x				x		
Navicula	*sp.*						x	x				x	x
Nitzschia	*acicularis*	x	x	x	x	x	x		x	x			
Nitzschia	*capitellata*	x	x	x	x	x	x	x	x	x	x		x
Nitzschia	*constricta*							x					
Nitzschia	*dissipata*						x	x				x	x
Nitzschia	*frustulum*	x		x	x	x	x	x	x	x	x		x
Nitzschia	*gracilis*	x	x	x	x	x	x		x	x	x	x	x
Nitzschia	*inconspicua*									x	x		
Nitzschia	*intermedia*											x	
Nitzschia	*levidensis*						x						
Nitzschia	*linearis*		x			x	x	x	x	x		x	x
Nitzschia	*obtusa*												x
Nitzschia	*palea*	x	x	x	x	x	x	x	x	x	x	x	x
Nitzschia	*paleacea*		x		x	x	x	x	x			x	x
Nitzschia	*recta*											x	
Nitzschia	*reversa*							x	x	x			
Nitzschia	*rostellata*			x									
Nitzschia	*sigmoidea*						x						
Nitzschia	*sp.*	x	x			x	x	x		x		x	
Puncticulata	*comta*	x	x	x	x	x	x					x	x
Rhoicosphaenia	*abbreviata*			x				x	x		x		x
Stephanodiscus	*binderanus*					x	x	x			x	x	x
Stephanodiscus	*hantzschii*	x	x	x	x	x	x	x	x		x	x	x
Stephanodiscus	*minutulus*										x	x	
Stephanodiscus	*neoastrea*						x						x
Stephanodiscus	*parvus*	x	x	x	x		x		x			x	x
Stephanodiscus	*sp.*	x	x						x				x
Surirella	*brebissonii*										x		
Thalassiosira	*hyperborea*						x						
Thalassiosira	*lacustris*												x
Thalassiosira	*weissfolgii*			x	x			x	x	x			
Thalassiosira	*sp.*			x				x					x
Chlorophyta													
Actinastrum	*hantzschii*					x	x						x
Amphikrikos	*minutissimus*												x
Chlamydomonas	*sp.*		x							x	x		
Chlamydomonas	*ehrenbergi*		x										
Chlamydomonas	*reinhardi*												x
Chlorella	*vulgaris*	x	x	x	x	x		x	x	x	x	x	x
Chlorella	*ellipsoidea*										x		
Chlorochoocum	*sp.*							x					
Chlorogonium	*sp.*											x	x
Chodatella	*longiseta*		x										
Closterium	*lunaris*			x	x								
Coelastrum	*sphaericum*		x										

Coelastrum	*microporum*				x	x							
Coenocystis	*reniformis*											x	
Cosmarium	*sp.*			x					x	x			
Crucigenia	*quadrata*	x	x	x				x					
Crucigenia	*tetrapedia*											x	x
Dictyosphaerium	*pulchellum*			x	x							x	
Eutetramorus	*planctonicum*											x	
Monoraphidium	*arcuatum*											x	
Monoraphidium	*contortum*		x	x								x	
Monoraphidium	*minutum*											x	
Oocystis	*elliptica*												x
Oocystis	*sp.*				x								
Pediastrum	*clathratum*			x	x								
Pediastrum	*duplex*			x	x								
Pediastrum	*boryanum*							x					
Scenedesmus	*acuminatus*			x									
Scenedesmus	*bicaudatus*				x								
Scenedesmus	*carinatus*			x									
Scenedesmus	*ecornis*			x		x		x					
Scenedesmus	*obliquus*						x						
Scenedesmus	*ovalternus*				x								
Scenedesmus	*protuberans*			x	x								
Scenedesmus	*quadricauda*		x	x	x	x		x	x				
Scenedesmus	*quadricauda var. longispina f. capricornus*				x								
Scenedesmus	*spinosus*	x		x	x							x	
Siderocelis	*ornata*							x	x				
Tetraedron	*caudatum*					x							
Tetraedron	*minimum*							x	x				
Tetraedron	*muticum*								x				
Tetraedron	*trigonum*								x				
Tetrastrum	*glabrum*					x							
Treubaria	*triappendiculata*				x								
Cyanophyta													
Anabaena	*affinis*		x			x							
Anabaena	*circinalis*		x			x	x						
Anabaena	*sp.*	x										x	
Aphanizomenon	*flos-aquae*					x	x						
Aphanothece	*minutissima*							x	x	x			
Chroococcus	*limneticus*					x							
Chroococcus	*microscopicus*	x	x					x	x		x		x
Coelosphaerium	*kuetzingianum*												x
Lyngbya	*limnetica*	x											
Microcystis	*viridis*		x										
Microcystis	*aeruginosa*				x								
Oscillatoria	*limnetica*			x		x	x						
Oscillatoria	*tenuis*			x		x	x						

Oscillatoria	*sp.*												x
Cryptophyta													
Cryptomonas	*ovata*												x
Cryptomonas	*sp.*		x									x	
Rhodomonas	*lacustris*	x										x	x
Euglenophyta													
Euglena	*sp.*			x								x	
Phacus	*acuminatus*												x
Phacus	*curvicauda*				x								
Trachelomonas	*hispida*	x	x	x	x	x							
Trachelomonas	*hispida var. coronata*	x		x	x								
Trachelomonas	*oblonga*	x	x	x	x		x						x
Trachelomonas	*volvocina*	x	x	x	x	x							
Dinophyta													
Gymnodinium	*sp.*					x							
Peridinium	*sp.*			x									
Chrysophyta													
Kephyrion	*ovum*	x			x					x	x	x	
Kephyrion	*spirale*	x											

Note: 1=Potelu; 2=Orlea; 3=Celei; 4=Sucidava; 5=Celei Dunare; 6=Dunare Celei; 7=Garcov Marsh; 8=Garcov lac; 9=Saiu; 1=Gura Oltului; 11=Islaz Ruptura; 12=Tr. Magurele

Species diversity of zooplankton in the in Corabia-Turnu Magurele sector of Danube Floodplain -2006

Species composition	Celei	Dunarea Celei	Orlea	Potelu	Ruptura Corabia	Sucidava	Gura Oltului	Saiu	Tr. Magurele	Islaz	Galcov (lac)	Galcov (Marsh)	Dabuleni	Ianca
Copepoda														
Cyclops sp.	+	+	+	+	+	+	+	+	+	+		+	+	+
Eucyclops sp.	+	+												+
Macrocyclops sp.				+	+	+							+	
Heterocope sp.	+									+			+	+
Diaptomus sp.			+							+				
Cladocera														
Disparalona rostrata (Koch)				+		+	+							
Ceriodaphnia reticulata (Jurine)			+	+	+	+	+						+	
Chydorus sphaericus (O.F. Muller)	+			+										
Moina micrura (Kurz)							+							+
Moina brachiata (Jurine)										+	+		+	
Daphnia cucullata (Sars)	+		+		+									
Daphnia longispina (O.F.Muller)			+						+					
Bosmina coregoni (Baird)														
Bosmina longirostris (O.F.Muller)	+		+											
Diaphanosoma brachyurum	+	+	+				+	+		+	+		+	+
Holopedium gibberum Zaddach			+											
Leptodora kindti (Focke)			+		+		+							
Rotatoria														
Asplanchna priodonta Gosse	+	+			+		+	+			+		+	
Anureopsis fissa							+							
Ascomorpha ecaudis	+	+												
Brachionus angularis Gosse								+						
Brachionus calyciflorus Pallas	+	+					+	+			+			+
Brachionus diversicornis (Daday)			+			+	+		+					
Brachionus forficula Wierzejski	+	+				+							+	
Euchlanis dilatata Ehrenberg						+						+		+
Fillinia longiseta (Kellicott)							+	+						
Keratella cochlerais (Gosse)				+			+							
Polyarthra vulgaris Carlin	+						+							
Squatinella tridentata.							+							