Report

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1. Introduction

Lake Durowskie is an important part of the Wągrowiec city landscape.

We are supposed to take care of it, not only because of the beauty it gives but also for economic reasons. So the quality of the water has to be as good as possible to be more atractive for tourism activities.

Earlier water of Lake Durowskie was in very good condition. During last years it got much worse. To make an improvement recultivation work has started. Three years ago the University of Adama Mickiewicz in Poznań joined this process with students not only from Poland, but also from other countries.

This year for the first time a group for hydrological balances appeared. The aim of our work was to measure the discharge of water wich comes in and goes out from the lake. We were focused on the outflow and inflow of Durowskie but also an inflow of Lake Kobyleckie. Thanks to this measurements we have a picture of nutrients which are coming into the ecosystem and have an influence on the water state. So if we want to straighten the condition of Lake Durowskie we have to supervise the water that comes from other lakes or rivers as well..

2. Study area

The Durowskie and Kobyleckie lakes are located in the northwestern Poland, 50 km from both Poznań and Bydgoszcz. Lake Durowskie is located in Wągrowiec municipality with geografical coordinates of N 52°49’6’’ and E 17°12’1’’.

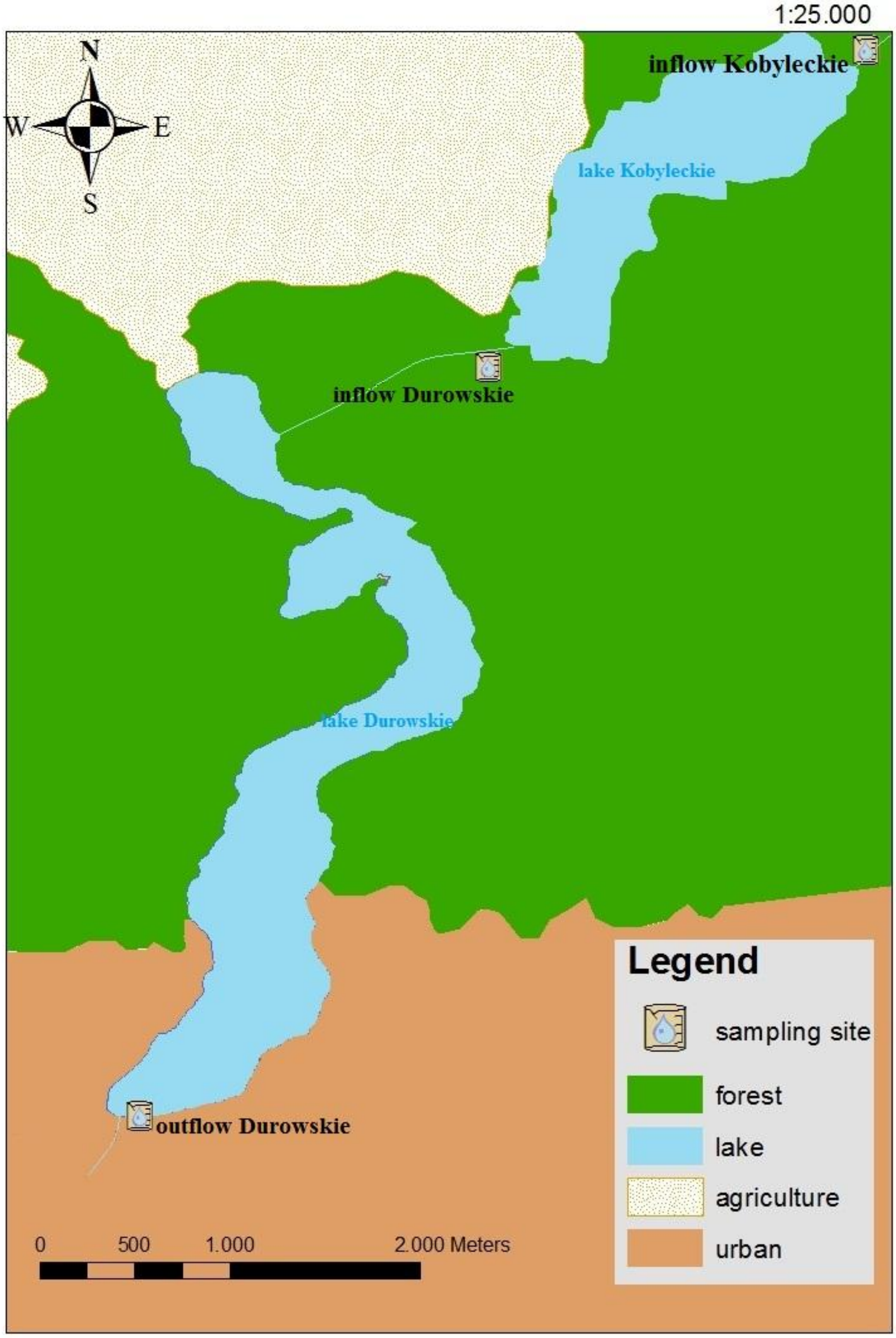

figure 1: Sampling sites map

We choosed three sampling sites for our survey and on 4-9th of July 2011, our teams took water samples and measured the water discharge in this areas. In correlation with their position, the sampling sites were named as it follows:

1. Inflow Kobyleckie – N 52°51’25’’; E 17°13’35’’.
2. Inflow Durowskie – N 52°50’40’’; E 17°12’30’’.
3. Outflow Durowskie – N 52°48’29’’; E 17°11’30’’

The inflow Kobyleckie sampling site, as it is shown on the above map, is located very close to the lake Kobyleckie, in the northern part. The surrounding consist of large vegetation, like a forestry environment. The bottom of the stream is irregular and it has muddy parts at the shoreline, but also has hard and stable areas especilly in the middle, covered with muscles.

The second sampling site – inflow Durowskie – is located on the stream Gołaniecka, under the bridge of 190 county road. The approximate distance from the sampling site to the lake Durowskie is 850m. The area of the stream where measurements were done has a rocky bottom and the shorelines are covered by small grass.

The third sampling site – outflow Durowskie – is located in the south part of the lake Durowskie, under a railway bridge. We choosed this location because there are regular anthropic shorelines and the water discharge measurements can be done more accurate. The sampling area has a rocky bottom formed of large stones as well as medium size stones.

3. Parameters analyzed

We studied: temperature, pH, oxygen, conductivity, nitrate and phosphate concentration and the amount of chlorophyll-a.

- **Temperature:**

It is an important water parameter, it influences on organism living in water, physical, chemical, biological processes which happen in this environment.

An increase in temperature causes a decrees in dissolved oxygen amounts, what leads to bigger need of it for organisms and conducts acceleration of chemical and microbiological processes.

Temperature of surface waters depends on: its origin, climate zone, seasons, infloats of sewage.

- **pH:**

The pH of water determines the solubility and biological availability of chemical compounds such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). For naturals waters it reaches from 4 to 9.

Pollution can change a water's pH, which can harm animals and plants living in the water. We take a pH measurement whenever water is studied. The pH not only affects the organisms living in the water, a changing pH in a stream can be an indicator of increasing pollution or some other environmental factor.

- **Oxygen:**

Oxygen is a very important factor. Aquatic plants are producing oxygen by photosynthesis during daylight hours but they also use oxygen for respiration.

Both plants and animals depend on dissolved oxygen for survival. Measuring dissolved oxygen is the most important water quality test to determine the suitability of stream for many aquatic organisms, each one of them has different needs. Under oxygen free conditions, phosphorus may be released from the bottom sediments into the overlying water.

We measured this parameter in two units. The first one is a weight in mg/l and the second one is presented as oxygenation in %.

- **Conductivity:**

It measures the ability of water to conduct an electrical current. It is often used as the first ratio of mineralization and pollution of water. It highly depends on the amount of dissolved solids (such as salt) in the water. Most of surface waters in Poland reaches a conductivity from 100 to 500 mS/cm.

Nitrate and phosphate concentration will be closer presented in chapters about them.

- **Chlorophyll a:**

It is a green pigment. Chlorophyll a is located in chloroplasts. It absorbs light energy needed in photosynthesis process, that is made by autotrophs. Basing on its amount we can estimate development conditions of algae.

4. Sampling procedure

Lake Durowskie is a shallow lake (14,6m depth) with the whole catchment area of 236,1km. Water samples and data were taken from indicated locations: Inflow Durowskie, Inflow Kobylechie and Outflow Durowskie. Temperature, conductivity, dissolved oxygen (DO) and pH was measured in situ by a multiparameter measurements device (HI 991300).

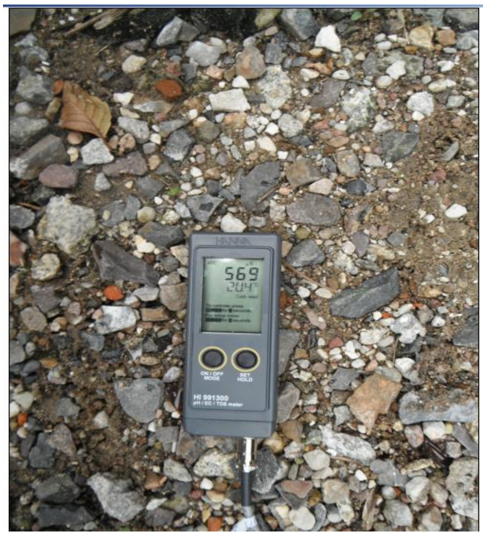

figure 2: Multiparameter measure HI 991300

Flow velocity was measured with a flow rate meter at different depths and different points of width. It's important to measure flow velocity to know how much water inflow or outflow.

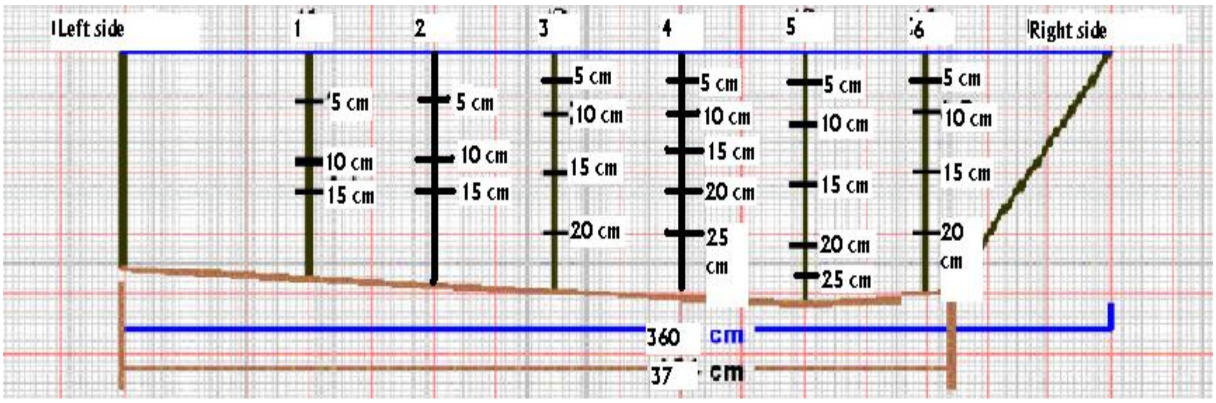

figure 3: Calculation discharge by area and velocity_ Outflow Durowskie

We also took samples of water from each location for chemical analyses: nitrate, phosphate, nitrites, ammonium and chlorophyll-a and was analyzed in laboratory by Spectrophotometer.

5. Analysis

We took one liter of water samples at every sampling point. The analysis took place in the laboratories of the AMU faculty of biology in Poznań.

5.1. Total Phosphorous (TP)

Phosphorous can be divided into organic and inorganic P. Organic phosphorous is commonly found as adenosine phosphate or in DNA and RNA. The addition and removal of phosphate from the cells is an important process of metabolism. Inorganic phosphates in form of phosphorous are mainly used as a fertilizer in the agricultural industry. Beside Nitrogen, phosphate is the most limiting nutrient for plant growth. If it occurs in higher concentrations, it can lead to eutrophication of aquatic ecosystems. The quantity found in the lake is a mayor indicator for water quality.

By analyzing the concentration of total phosphorous the soluble and indissoluble parts will be considered. We developed the analysis for 18 samples taken from three different sampling points during the week.

Procedure:

We filled 50 ml of each water sample into different test tubes. After that we added 1-2 drops of phenolphthalein into each sample. The reaction leads to a pink color as an indicator for alkalinity. As a next step we added 1ml of sulfuric acid into each test tube. In a last step 10 ml of sulfate potassium has to be put into the sample.

To start the mineralization and convert all phosphate compounds into orthophosphate (PO_4^{3-}) we have to put the test tubes for 40 minutes into a 220 ° C heater. After that, the samples have be cooled down and mixed up again. The detection of P_{total} in mg/l will be done with a photometer, using a wavelength of 880nm.

5.2. Nitrate (NO3-)

Nitrate is the conjugate base of nitric acid with a positive charge (+1). Under aerobic conditions, nitrification takes place. NO_3^- is formed by microbacteria (nitrosomonas/- bacter) in two steps out of ammonia ($NH_{3)}$ and nitrite (NO_2^-).

NH_3 + Nitrosomonas → NO_2^-

NO_2^- + Nitrobacter → $\mathbf{NO_3^-}$

Under anoxic conditions denitrification takes place. Through a series of steps, nitrate will be reduced into laughing gas (N_2)

$NO_3^- \rightarrow NO_2^- \rightarrow NO + N_2O \rightarrow N_2$ (g)

Procedure:

100 ml of all samples have to be filled into test tubes. 1 ml of a sulfonic acid ($C_6H_7NO_3S$) is added before the sample will be mixed by shaking it slightly. After a reaction time of 5 minutes, the color of the liquid changed into pink, depending on the concentration of nitrate. Now, 1 ml of naphthalene ($C_{10}H_9N$) and 1 ml of acidic buffer has to be added. The concentration will be measured photometrically with a wavelength of 520 nm.

5.3. Ammonia (NH_4)

Ammonia is a colorless gas and contributes essentially to the nutrition of terrestrial organisms, both as food and as a fertilizer. More than 80% of ammonia is used as fertilizers either as its salts or as solutions. Consuming more than 1% of all man-made power, the production of ammonia is a significant component of the world energy budget. As we have seen in chapter 5.2, it will be transformed into nitrate and nitrite by microbiological organisms.

Procedure:

Ammonia and ammonium salts can be detected by the addition of Nessler's solution, which gives a distinct yellow coloration. We filled 50 ml of the sample into a test tube and added 1 ml of sodio potassium and 1 ml of the Nessler solution. Before the measurement we have to mix the samples and wait 10 minutes until the reaction had finished. The concentration will be measured with a wavelength of 410 nm.

5.4. Nitrite (NO_2^-)

Nitrite or Nitrogen dioxide (NO_2) is the salts of nitrous acid. It is a intermediate product in the microbial degradation of organical Nitrogen compounds to Nitrate. It can be used as an indicator for the water quality. Nitrite is toxic for dissimilating organism because of it blocks the binding of oxygen to hemoglobin.

Procedure:

Nitrate reacts with sulfanilic acid ($C_6H_7NO_3S$) and naphthyl composition by changing colour into a purple red. The concentration will be detected with a photometer and a wavelength of 436 nm.

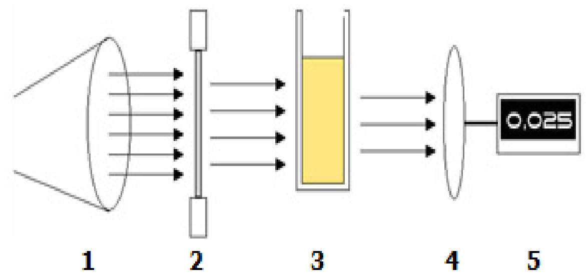	1. light emitted 2. filter where only light with a defined wavelength passes 3. cuvette with colored water sample 4. diode measuring the light transmitted 5. difference between radiated and received light 6. Display, where the extinction of light is shown

figure 4: Schematic draw of the functionality of a photometer

5.5. Total Nitrogen

In the total nitrogen concentration there are all compounds included, irrespective their chemical structure. It is important to carry the analysis out as fast as possible to avoid the transformation from one into another compound. It is the Sum of Ammonium-N and organic nitrogen.

The nitrogen analysis is based on the Kjedahl method. The method consists of heating a substance with sulfuric acid, which decomposes the organic substance by oxidation to liberate the reduced nitrogen as ammonium sulfate. In this step potassium sulfate is added to increase the boiling point of the medium Chemical decomposition of the sample is complete when the medium has become clear and colorless.

Summing up the Nitrogen compounds Nitrate, Ammonia and Nitrite we will get the total amount of mineral nitrogen. The organic Nitrogen can be calculated as followed: Kjehldal - NH4. Suming up N_{org} and N_{min} leads to the total amount of nitrogen in the water sample.

5.6. Chlorophyll a

We can measure a concentration of chlorophyll a basing on condense of seston, thanks to usage of filter made of fiberglass. When we put water using filtration device we gather work material remembering the volume of sample.

Then we put used filter into the mortal, prepare extract and then measure absorbation at specific wavelengths(before and after adding acid). The amount of chlorophyll a is counted by special formula.

Execution mark:

1. Filtration of water samples.
2. Removing of filter and foldeting it on a half.
3. Grating a filter in mortar and adding acetone(not to many, about 2ml).
4. Transferring the extract into tubes and adding the acetone till reaching the same volumes in each one of them(7-8 ml).
5. Putting tubes into a mix shaker.
6. Putting of the samples info fridge for 24 hours.

The next day:

1. Placing tubes in centrifuge and swirling for 10 minutes.
2. Adding mixed extract to cuvettes.
3. Measuring the absorbance in wavelengths 663 nm and 750 nm.
4. Adding to each cuvette o,1 ml of HCl.
5. Mixing of the content and performing the asorbance again after 10 min, wavelength 665 nm and 750 nm.
6. Putting data into computer using special formula.

6. Results:

In the following chapter we present the results obtained from the measurements and analysis described earlier. Due to the fact that there have been many people, with different background knowledge and different ways of taking samples and doing the analyses contributing to the results, they contain a high error probability. Until now, there hasn`t been a group dealing with hydrological balances, so that a comparism with former data is not possible. Besides that, it has to be mentioned that we do not consider the concentrations for dissolved oxygen because of technical problems with the measurement device. Another point which has to be taken in mind is the lack of data for Evaporation and Precipitation which should have been used for the discharge calculation.

6.1. Discharge

After the measurements from the three location: Inflow Kobylechie, Inflow Durowskie and Outflow Durowskie, a decrease in water flow during the seven days was observed. At the beginning of the week the water flow was highest at the Inflow Kobylechie and decreased considerably until the end of the week.

To Inflow Durowskie the water flow was not so high and the decrease was not so significant during the week.

At the Outflow Durowskie is not seen so much difference as at the inflows and the lake gain on average about 17,031 l/day.

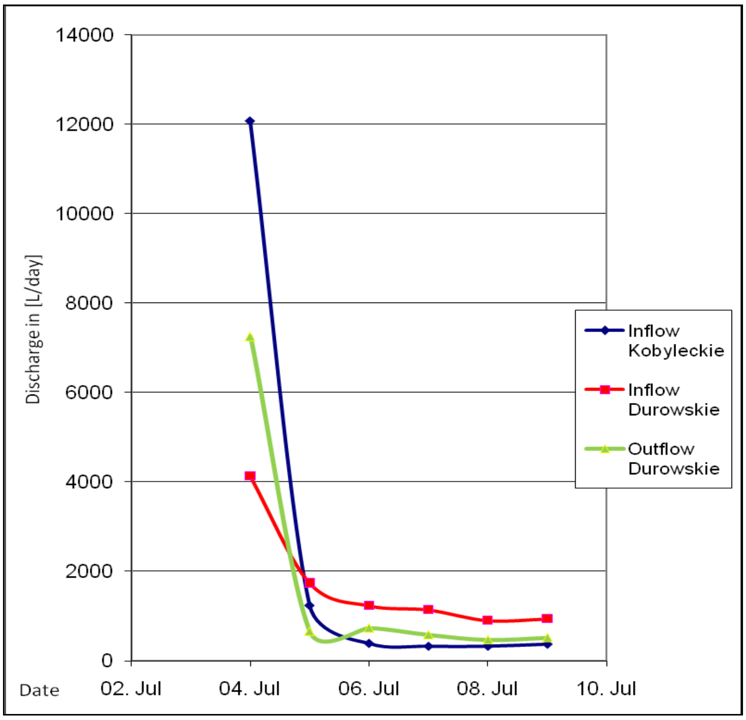

figure 5: Discharge [l/day]

6.2. Rainfall

The amount and intensity of precipitation influences the reactions taken place in a water body very much. That's why we searched for the closest weather station and added the graph of the rain events including the day before we arrived. As you can see, there have been quite heavy rains. People from further north also spoke about extremely heavy rains. Taken these volumes in mind, it is more easy to follow the graphs describing the discharge and the loads.

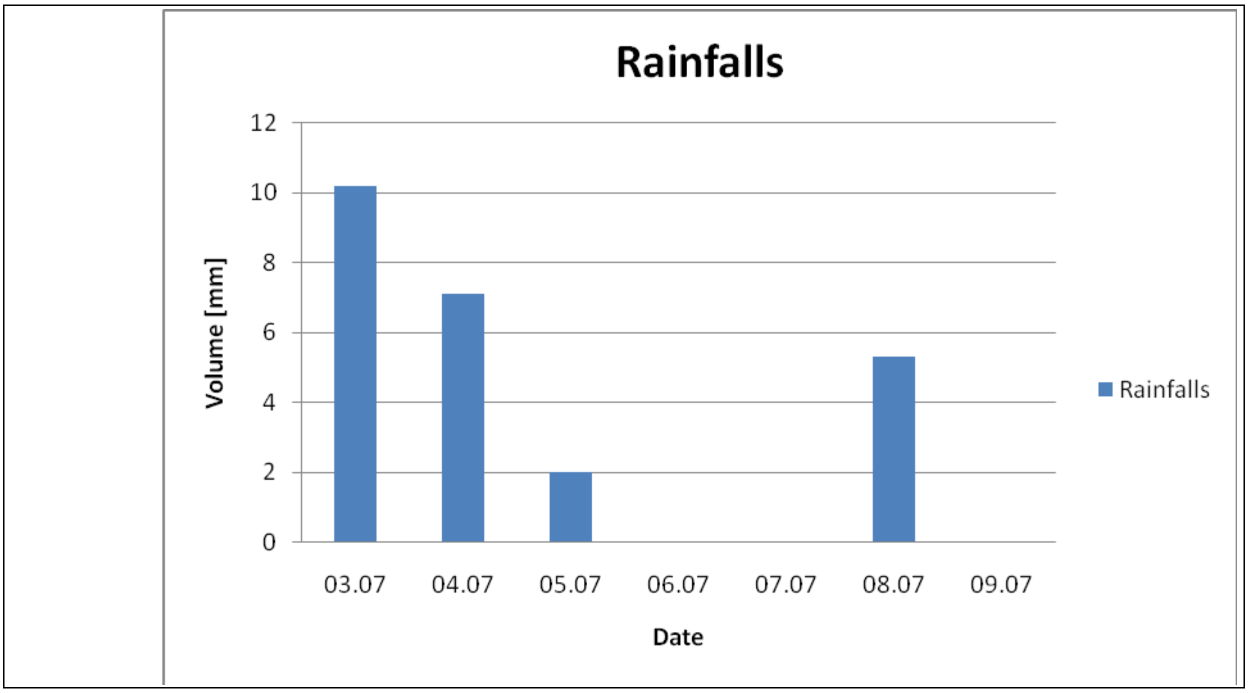

figure 6: Rainfalls

6.3. Loads

6.3.1. Total Nitrogen

In the following diagram you can see how the concentration of total nitrogen varies during the week at different stations. On Monday, we measured the highest concentration at all, especially high was it at the most northern located sampling point: Inflow Kobeleckie. It can be seen that the total load of Nitrogen transported into lake Durowskie is always higher than the amount going out of the lake. The amounts decrease from Monday to Thursday constantly and seem to increase after that again. By the end of the week, the total load at all three stations is still less than 10 % of the amount detected on Monday.

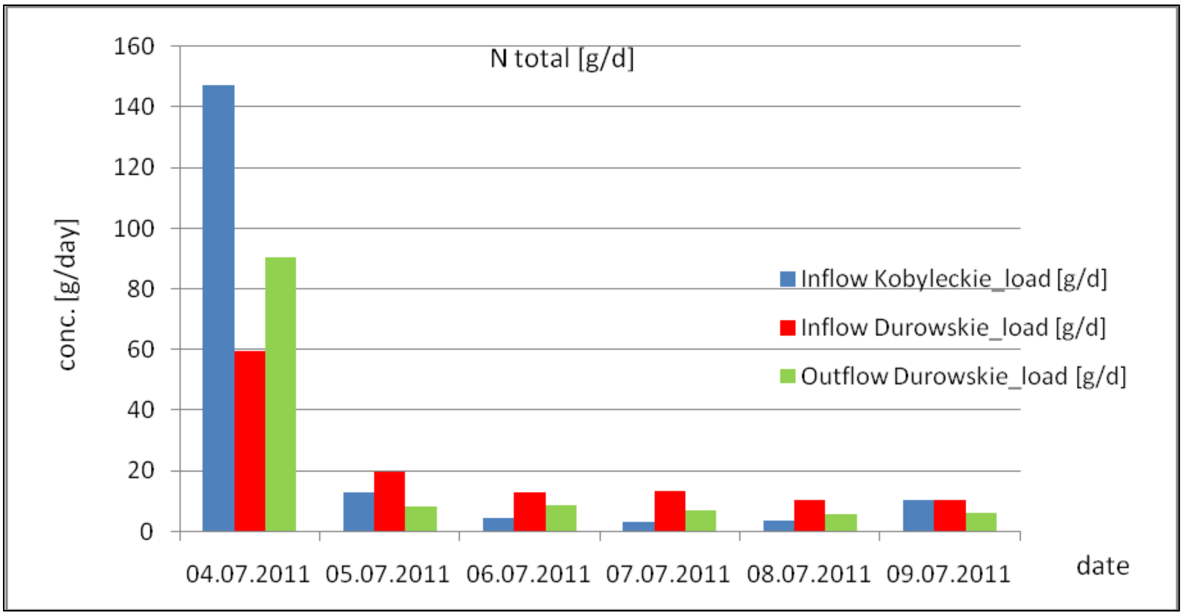

figure 7: Nitrogen load at different sampling point over time

6.3.2. Total Phosphorous [mg/ day]

The following graph shows the total amount of phosphorous entering and leaving the lake in mg/day. On Friday, the load at Inflow Kobyleckie is only 1,8 % of the load from Monday, it decreases from 471 mg/day to 8,6 mg/day. For the Inflow Durowskie the load on Friday is about 20% the load calculated on Monday. In the case of the Outflow it decreases of 93%. The concentration of total Phosphorous at the Inflow to lake Durowskie is always higher that at the outflow.

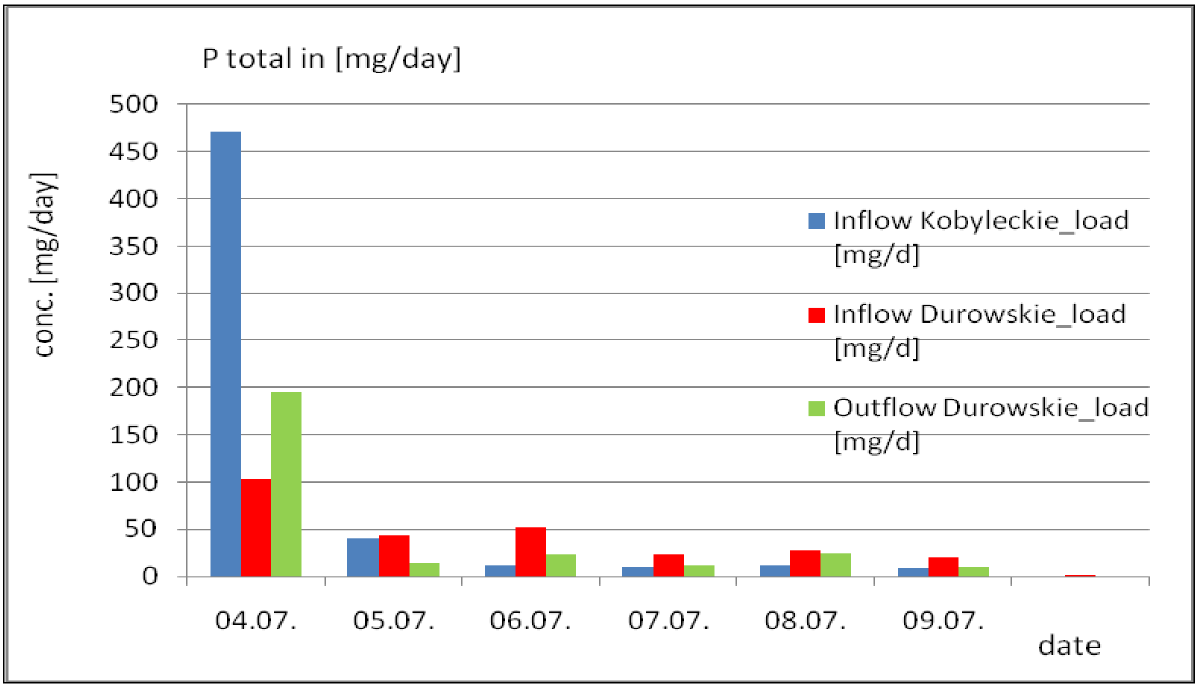

figure 8: Total Phosphorous load at different sampling point over time

6.3.3. Ammonia (NH4- N [mg/day])

The amount of Ammonia input decreases during the sampling period similar to the load of the other nutrients. At the inflow to lake Kobyleckie is decreases by 98%. The changes between the sampling points are also comparable. On the first sampling day, the amount at the most north situated point is more than twice as big as at the most southern point. At the other four days, the transport at Inflow to lake Durowskie is higher than at the other two points. On Friday there is an increase in load at all station compared to Wednesday. The concentration drops again on Saturday.

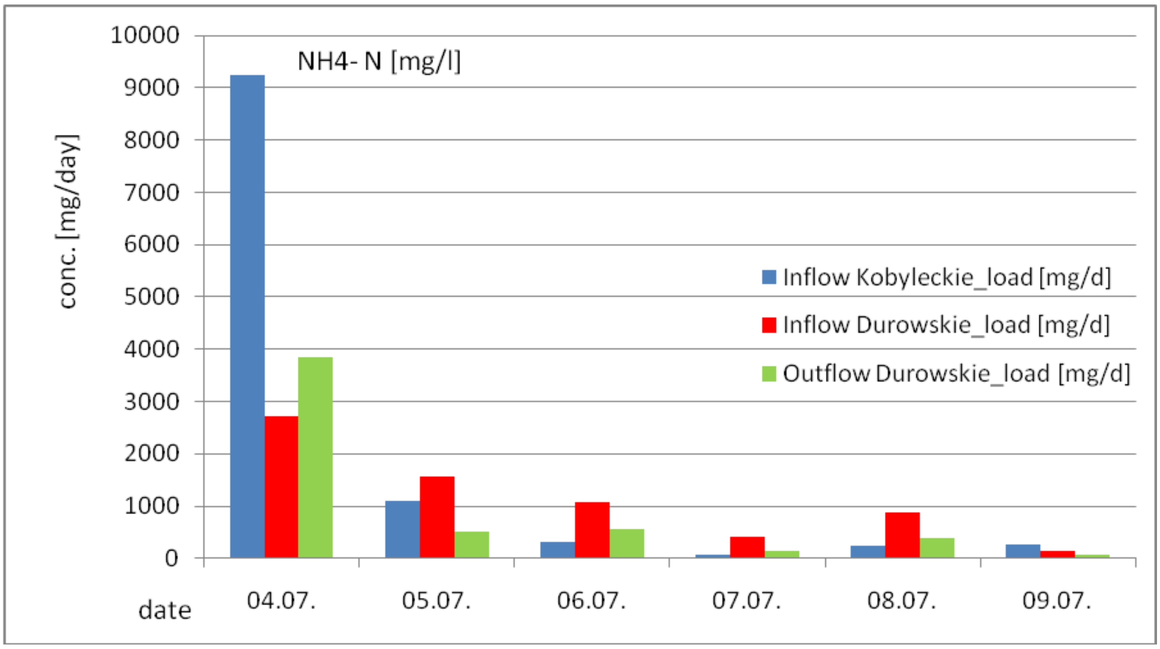

figure 9: Ammonia load at different sampling point over time

6.3.4. Nitrate (NO3- [g/day])

The concentration for Nitrate is given in g/day. In this case the development is similar to the ones of the other nutrient parameters. It decreases from Monday to Friday and the relation between the concentration of the inflow to lake Kobyleckie and the inflow to lake Durowskie changes. First, it is higher at the first location and than the load is higher at the inflo to lake Durowskie. During the whole week, the concentration of Nitrate transported into lake Durowskie is at least double that high than the amount leaving the lake.

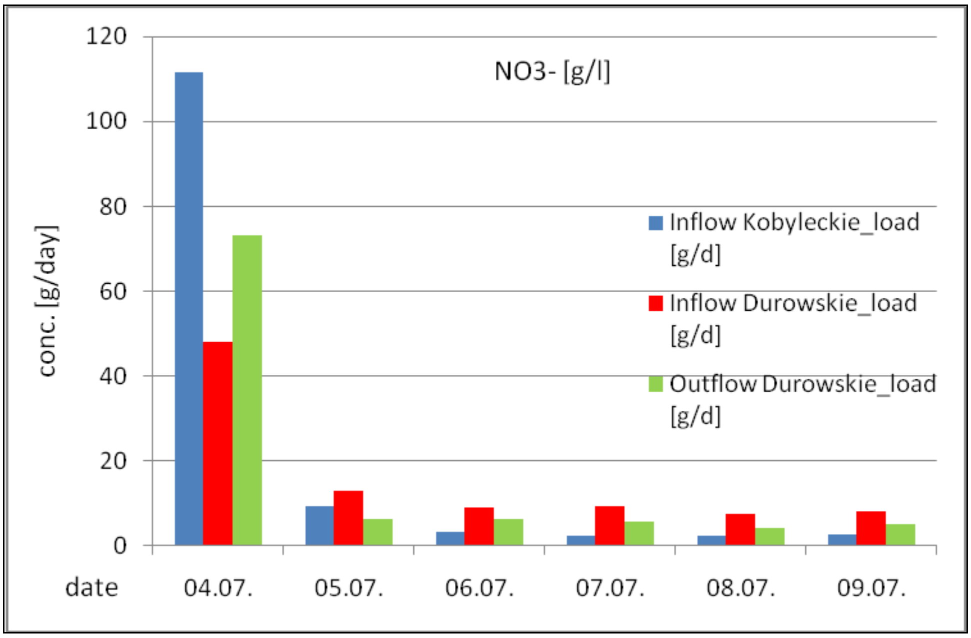

figure 10: Nitrate load at different sampling points over time

6.4. Temperature

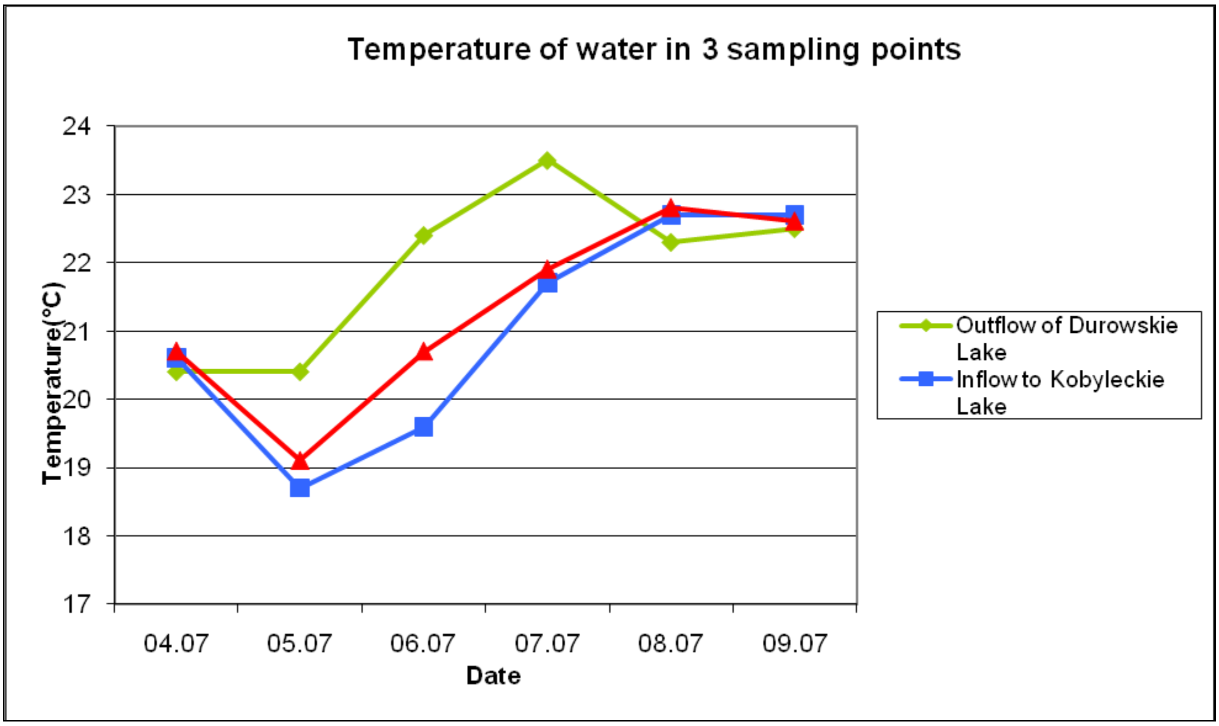

figure 11: Temperature of water in 3 points

In the beginning at the outflow of Lake Durowskie temperatute was stable. On Tuesday (05.07) is begins to grow till Thursday(07.07), then is drops a bit and turns stable again. Two inflows of Kobyleckie and Durowskie Lakes had the same tendency in temperature changes. From 4th to 5th it decreases and then it grows till 8th to begin stable again.

6.5. pH

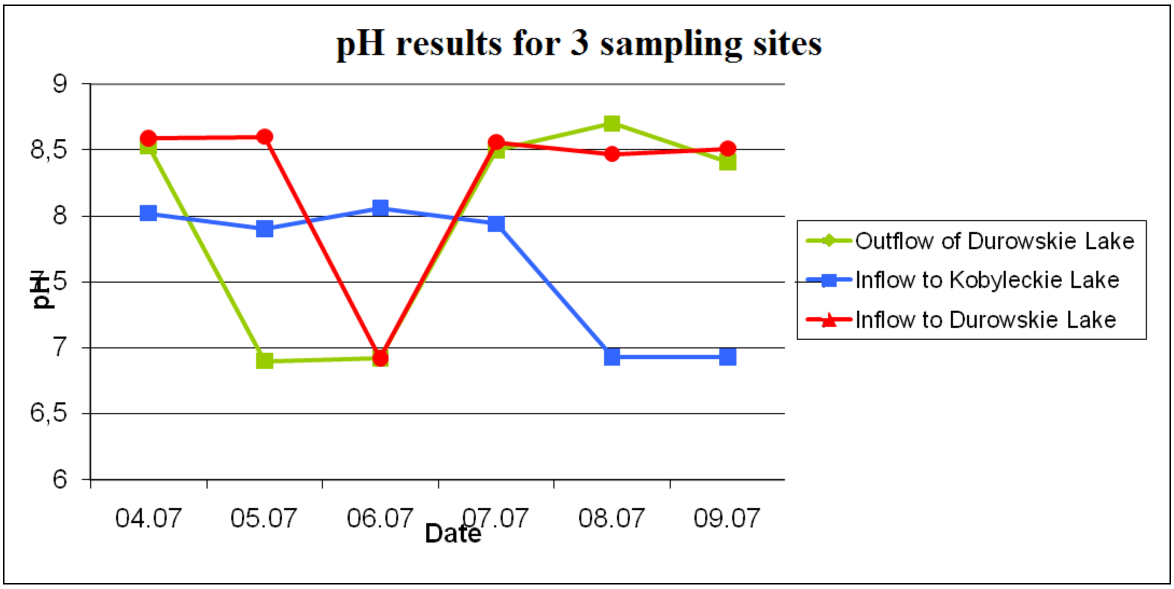

figure 12: pH results for 3 sampling points

For the inflow of Lake Kobyleckie pH was stable from 4th till 7th of July. Then it decreased and become stable. On Monday(04.07) pH was almost the same for outflow and inflow of Lake Durowskie. Both of them decreased but in different days and then they grow faster to become stable again.

6.6. Conductivity

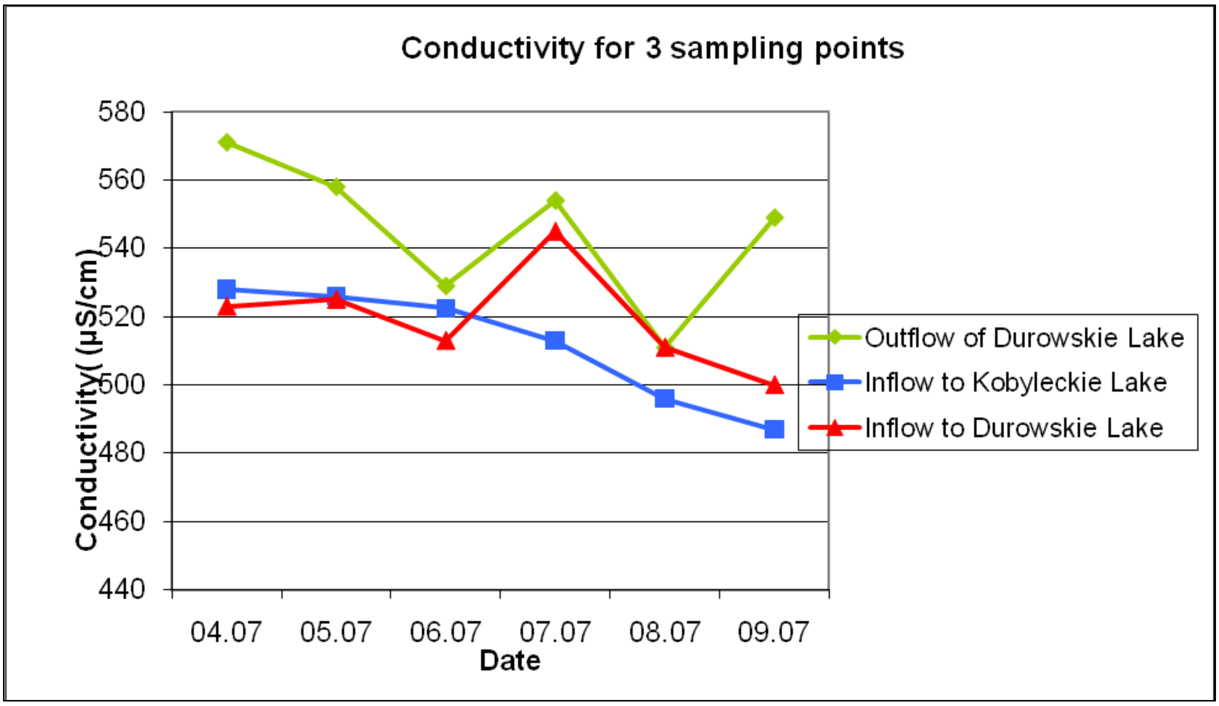

figure 13: Conductivity for 3 sampling points

As can be seen in the graph above, conductivity of water in the inflow to Lake Kobyleckie keeps on decreasing from Monday(04.07) to Saturday(09.07).

Conductivity of water from the outflow of Lake Durowskie was the highest at the 04.07, also comparing with other sampling points. Waters that come in and out of Lake Durowskie had similar tendency, theirs conductivity was becoming higher and lower at the same time, but on Saturday (09.07) for the outflow it became higher and for the inflow lower.

6.7. Chlorophyll-a

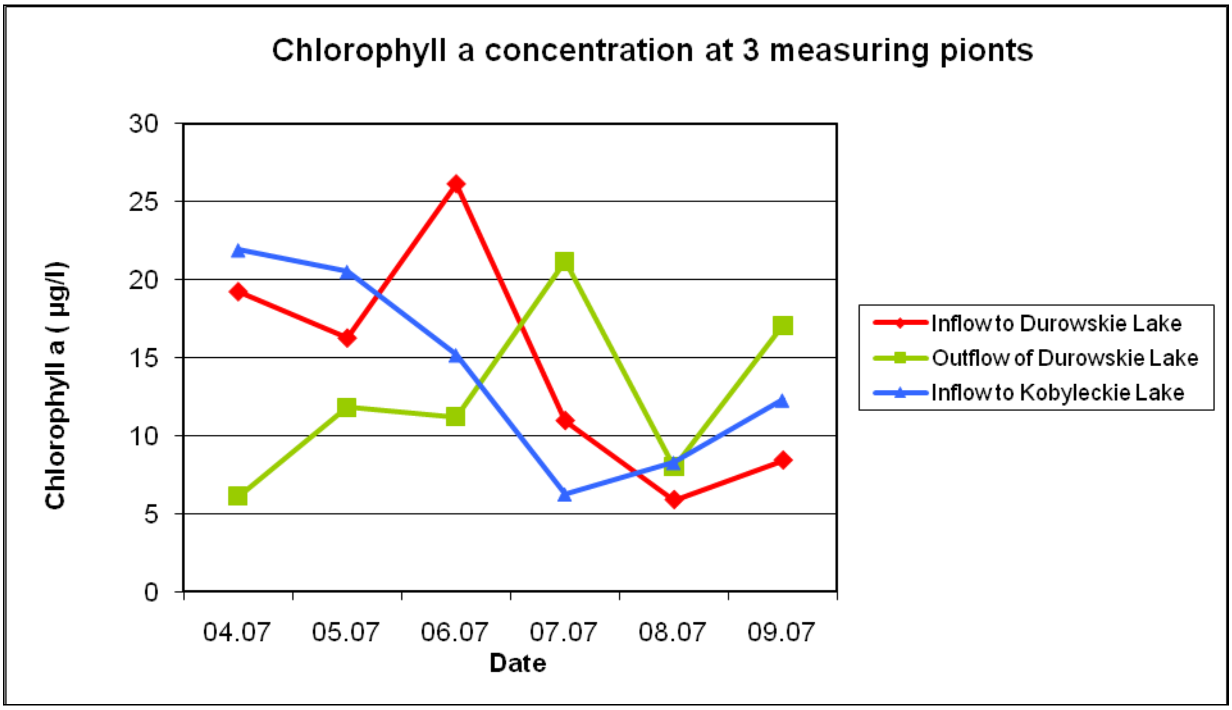

figure 14: Chlorophyll a concentration at 3 measuring points

At the inflow Kobyleckie sampling site, from Monday to Thursday, the concentration of chlorophyll-a is decreasing very fast from 21,91 µg/l to 6,27 µg/l. From Thursday on can be observed an increasing in the concentration.

At the Durowskie lake inflow can be observed big fluctuations in the concentrations, with a maximum concentration on Wednesday (26,17 µg/l) and a minimum concentration on Friday (5,88 µg/l).

At the Durowskie outflow we also see important daily fluctuations regarding chlorophyll-a concentrations. All the fluctuations can be correlated with daily weather conditions, water discharge, water velocity and some other parameters.

7. Discussion/ Conclusion

In the following chapter we go through the different parameters analyzed and give some explanation of the results.

Water temperature influences on the intensity of chemical reactions. Big amount of sun light causes increases in water temperature, but also greater primary production. With worsening of weather and rainfalls in 08.07 an decrease in water temperature was observed. The temperature values are in normal parameters for this period of the year.

Values of pH are changing with inflows and outflows of water to Lake Durowskie. Diversity in water pH says about changes in concentration of free carbon dioxide and primary production. Inflow of Lake Kobyleckie has pH around 8 what gives an evidence about a lack of free carbon dioxide. Researches on phytoplankton confirmed the presence of big number of blooms of Cyanobacteria in this water. pH of inflow to Lake Durowskie reaches almost 8,5 what says about big primary production and presence of free carbon dioxide. At the outflow of Lake Durowskie wasn't any Cyanobacteria. So the water which is coming out of the lake is in better condition than the water which comes in.

After rainfalls the measured amount of loads is over ten times higher than in normal weather conditions. The measurements indicate the possibility that lake Kobyleckie can also receive a much more quantity of loads from the above lake (lake Bukowieckie), in comparation with the released quantity. But this happens only after rainfalls.

The changes in values of conductivity as well as of the chemical parameters measured, can be explained by the hydro-morphological conditions of the lake and its catchment area. The steep shorelines lead to big runoff of sediments, in which nitrogen and especially phosphorous are bound. With heavy rainfalls those nutrients will be transported into the lake.
The concentration of total phosphorous is accumulated in organic matter while the orthophosphates are dissolved in water. The fact that there is still a high concentration of orthophate in the water (see figure 15), indicates, that the input of nutrients is too high to be uptaken by oorganisms.

Regarding the morphometry, in the Kobylackie lake, the rainfalls can action like a pump, pushing up nutrients from the bottom, increasing the total amount of loads overflowed in the Durowskie lake.

In normal conditions the Kobyleckie lake transports twice more nutrients into lake Durowskie than the amout of load wich is released.

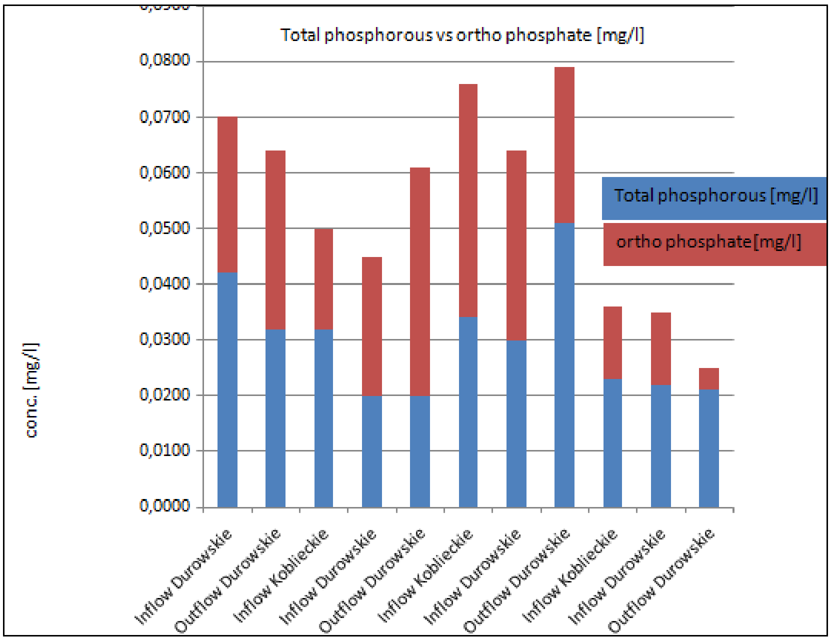

figure 15: total phosphorous vs ortho phosphate [mg/l] for all stations

The water discharge depends a lot of the weather conditions. In the rainy days a huge quantity of water overflows in both lakes.

The conductivity measurements reveals slightly higher salt concentrations at the Durowskie outflow measurement point. A possible cause can be the urban area present in the southern part of the lake.

The Chlorophyll-a values indicate an eutrophy state of the lake and the daily variations in the quantity are correlated with the water discharge and also with water velocity, temperature, pH and some other parameters.

8. Suggestions

Due to our results it can be easily seen, that we need to improve the state of Lake Kobyleckie and the other lakes situated northwards to improve the water quality in lake Durowskie. pH of inflow to Lake Durowskie reaches almost 8,5 and it gives good environment for Cyanobacteria blooms. At the outflow of Lake Durowskie was not any Cyanobacteria. So the water which is coming out of the lake is in better condition than the water which comes in. Conductivity changes show that there is a problem of additional inflows, which give more minerals coming into the lake. So we advice bigger supervision, of all additional contaminated water discharges from the city area which can be environmental hazard for the lake.

The loads shows us that on rainy days there is a large amount of nitrates, phosphorus, nitrogen, ammonium and this is not so good for the lake, because it leads to eutrophication. The concentrations for total phosphorous vary between 20 mg/m³ and 39mg/m³. This values identify an eutrophic lake (Bachmann, 1980). For total nitrogen the concentration range is between 10000 and 120000 mg/m³ what describes an hypothrophic character of the aquatic system.

We advice to stop using chemical fertilizers, pesticides, insecticides to agricultural lands surrounding the lake so in this way the water quality will be better.

To improve the water quality in lake Durowskie the catchment areas (including the city, wetlands, roads,…) have to be considered much more, especially the lakes and rivers situated northwards.

9. References

- W. - Dieter , Busch N. Busch, Sly, P.,1997: The development of an aquatic habitat classification System for lakes. CRC Press
- Dahal, R.C. 1977: Soil organic phosphorus. Advances in Agronomy. Volume 28, 83-117
- T. Davie, 2003: Fundamentals of Hydrology. Routledge Fundamentals of Physical Geography
- H.D. Frede, Dabbert, S.: Handbuch zum Gewässerschutz in der Landwirtschaft, ecomed, Landsberg. ISBN: 3609652721
- M. Westphal, Hollmann, B., Hugenschmidt, C. et al: Gewässeranalytik Modul 207, Laborskript, 2011
- H. Trang et al, 2010: Water quality in the lake Durowskie 2010, report
- U.S. Department of the Interior | U.S. Geological Survey Earth's Water: Lakes and reservoirs URL: http://ga.water.usgs.gov/edu/phdiagram.html_08-Feb-2011

10. Appendix

Annex 1 Discharge [l/day]

[l/d]	Inflow Kobyleckie	Inflow Durowskie	Outflow Durowskie
04-lip	12074,832	4132,135	7255,872
05-lip	1241,100	1743,376	656,058
06-lip	392,616	1234,911	731,638
07-lip	328,231	1143,861	579,600
08-lip	328,893	904,375	465,587
09-lip	374,026	941,868	513,960

Annex 2 Rainfalls [mm]

Date	Rainfalls [mm]
03.07	10,2
04.07	7,1
05.07	2
06.07	0
07.07	0
08.07	5,3
09.07	0

Annex 3 Temperature [°C]

Temperature (°C)			
Date	Outflow of Durowskie Lake	Inflow to Kobyleckie Lake	Inflow to Durowskie Lake
04.07	20,4	20,6	20,7
05.07	20,4	18,7	19,1
06.07	22,4	19,6	20,7
07.07	23,5	21,7	21,9
08.07	22,3	22,7	22,8
09.07	22,5	22,7	22,6

Annex 4 pH

pH			
Date	Outflow of Durowskie Lake	Inflow to Kobyleckie Lake	Inflow to Durowskie Lake
04.07	8,53	8,02	8,59
05.07	6,9	7,9	8,6
06.07	6,92	8,06	6,92
07.07	8,5	7,94	8,56
08.07	8,7	6,93	8,47
09.07	8,41	6,93	8,51

Annex 5 Conductivity (µS/cm)

Conductivity (µS/cm)			
Date	Outflow of Durowskie Lake	Inflow to Kobyleckie Lake	Inflow to Durowskie Lake
04.07	571	528	523
05.07	558	526	525
06.07	529	522,5	513
07.07	554	513	545
08.07	511	496	511
09.07	549	487	500

Annex 6 Chlorophyll a

Chlorophyll a [µg/l]			
Date	Inflow to Durowskie Lake	Outflow of Durowskie Lake	Inflow to Kobyleckie Lake
04.07	19,2456	6,1319	21,9186
05.07	16,2625	11,8040	20,5286
06.07	26,1740	11,2266	15,1933
07.07	10,9593	21,1702	6,2709
08.07	5,8806	8,0190	8,2863
09.07	8,4200	17,0644	12,2958

Annex 7 Total Phosphorus [mg/l]

	Ptotal [mg/l]								
Date	IK	discharge [l/d]	Inflow Kobyleckie_load [mg/d]	ID	discharge [l/d]	Inflow Durowskie_load [mg/d]	OD	discharge [l/d]	Outflow Durowskie_load [mg/d]
04.07.	0,0390	12074,832	470,918	0,0250	4132,135	103,303	0,0270	7255,872	195,908544
05.07.	0,0320	1241,100	39,715	0,0250	1743,376	43,584	0,0220	656,058	14,4332734
06.07.	0,0300	392,616	11,778	0,0420	1234,911	51,866	0,0320	731,638	23,4124183
07.07.	0,0320	328,231	10,503	0,0200	1143,861	22,877	0,0200	579,600	11,592
08.07.	0,0340	328,893	11,182	0,0300	904,375	27,131	0,0510	465,587	23,7449115
09.07.	0,0230	374,026	8,603	0,0220	941,868	20,721	0,0210	513,960	10,7931689

Total: E4 (l/day)*E4 (mg/l) = Load (mg/day)

Annex 8 Nitrate NO3 [mg/l]

		NO3- [mg/l]							
Date	IK	discharge [l/d]	Inflow Kobyleckie_load [g/d]	ID	discharge [l/d]	Inflow Durowskie_load [g/d]	OD	discharge [l/d]	Outflow Durowskie_load [g/d]
04.07.	9,25	12074,832	111,692196	11,6	4132,135	47,9327693	10,07	7255,872	73,06663104
05.07.	7,53	1241,100	9,345483	7,39	1743,376	12,8835462	9,75	656,058	6,39656433
06.07.	8,36	392,616	3,28226976	7,22	1234,911	8,91605655	8,56	731,638	6,262821897
07.07.	7,31	328,231	2,39936674	8,26	1143,861	9,44829461	9,6	579,600	5,56416
08.07.	7,22	328,893	2,3746079	8,46	904,375	7,65101013	9,1	465,587	4,23683715
09.07.	7,29	374,026	2,72664662	8,5	941,868	8,005878	9,68	513,960	4,975136889

Total: E4 (l/day)*E4 (mg/l) = Load (mg/day)

Annex 9 Total Nitrogen [mg/l]

Date	IK	discharge [l/d]	Inflow Kobyleckie_load [g/d]	ID	discharge [l/d]	Inflow Durowskie_load [g/d]	OD	discharge [l/d]	Outflow Durowskie_load [g/d]
	N total [mg/l]								
04.07	12,193	12074,832	147,228427	14,397	4132,135	59,4903517	12,464	7255,872	90,43718861
05.07	10,424	1241,100	12,9372264	11,165	1743,376	19,4647894	12,646	656,058	8,29650795
06.07	10,88	392,616	4,27166208	10,363	1234,911	12,7973814	11,56	731,638	8,457736113
07.07	9,754	328,231	3,20156268	11,538	1143,861	13,1978721	12,28	579,600	7,117488
08.07	10,473	328,893	3,44449703	11,322	904,375	10,2393306	12,271	465,587	5,713211942
09.07	28,146	374,026	10,5273245	11,194	941,868	10,5432704	11,996	513,960	6,165469227

Total: E4 (l/day)*E4 (mg/l) = Load (mg/day)

Annex 10 Ammonia NH4 [mg/l]

Date	IK	discharge [l/d]	Inflow Kobyleckie_load [mg/d]	ID	discharge [l/d]	Inflow Durowskie_load [mg/d]	OD	discharge [l/d]	Outflow Durowskie_load [mg/d]
		NH4-N [mg/l]							
04.07.	0,765	12074,832	9237,24648	0,657	4132,135	2714,812883	0,53	7255,872	3845,61216
05.07.	0,881	1241,100	1093,4091	0,904	1743,376	1576,011609	0,793	656,058	520,253899
06.07.	0,795	392,616	312,12972	0,868	1234,911	1071,902644	0,751	731,638	549,460192
07.07.	0,177	328,231	58,09684165	0,365	1143,861	417,5093867	0,251	579,600	145,4796
08.07.	0,721	328,893	237,1318971	0,961	904,375	869,1041059	0,839	465,587	390,627074
09.07.	0,682	374,026	255,0854592	0,143	941,868	134,687124	0,137	513,960	70,4125779

Total: E4 (l/day)*E4 (mg/l) = Load (mg/day)