

Ecological state of lake during restoration measures

Working Group

“Lake management”

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1. Introduction

1.1. The European Water Framework Directive and Lake Durowskie Restoration

The paradigm of Integrated Water Resources Management has been generally accepted and is the basis for improving management in the water sector worldwide. The Water Framework Directive (WFD) (European Parliament and Council 2000) introduced new approaches in the management of water resources in Europe, as it requires not only the compliance of polluters with emission targets but also the achievement of “good status” for surface and groundwaters and the integration of economic issues such as polluter-pays principle and full cost recovery. The WFD thus pursues an integrated approach and addresses core elements of Integrated Water Resources Management.

Previous surveys, conducted since 2009, have shown Lake Durowskie to be in a poor ecological state due to factors such as agriculture (i.e. intensive use of fertilizers) or sewage contamination. Consequently, and in order to fulfill WFD requirements, a complex procedure to restore the lake to more favorable conditions was initiated in 2009. Restoration measures include the installation of two aerators and restocking of top predator fish (pike – *Esox lucius*).

1.2. Strategic plan for Wagrowiec and Lake Durowskie

The long-term development plan for the town of Wagrowiec emphasizes modernization of the town’s infrastructure and expansion of the tourism and recreation sectors. The Wagrowiec Mayor’s office has provided numerous examples for development projects around the town, including:

- Renovation of the lake side promenade
- Creation of a kayak-only lake zone
- Construction of a golf course, beach volleyball courts, badminton, and new tennis courts
- New cross country trails around the lake
- Establishment of picnic areas

- New lakeside viewpoints
- Organization of tourist buses
- Upgrades of eco-friendly infrastructure, such as recycling and water quality
- improvement programs

1.3. Need for lake management

Management of lakes should be regarded as an important part of sustainable development of any country. Managing lakes in an environmentally sound way is one of the important activities of the United Nations Environment Programme. The traditional friendly relationship between lakes and humans is now in peril due to unbalanced development. The misuse of surrounding lands has increased sediment inflow and has filled many natural or man-made lakes to the extent of completely diminishing their utility value. Toxic chemicals produced or used in watershed have contaminated lake water, bottom sediments and fishery products and endangered the use of these resources. Nutrients contained in industrial, agricultural and domestic wastewaters have caused the eutrophication of lake water, completely changing the aquatic ecosystems by the explosive overgrowth of planktonic and other plants and degrading the quality of the water we use. With ever increasing recreational use and growing populations residing near and along waterways, lakes can also suffer from small and large cumulative impacts and cannot manage themselves.

As state above, Lake Durowskie is very important to the local community and economy in Wągrowiec and the activities of many categories of people (e.g. fishermen, water sports enthusiasts) are directly connected to the lake. These activities could also potentially negatively influence the lake ecosystem. Furthermore, the quality of the lake is essential for an important part of community.

1.4. Aims of the study

Taking into account the previously mentioned information, the Lake Management team 2013 aimed to: evaluate the current condition of Lake Durowskie, identify the main factors

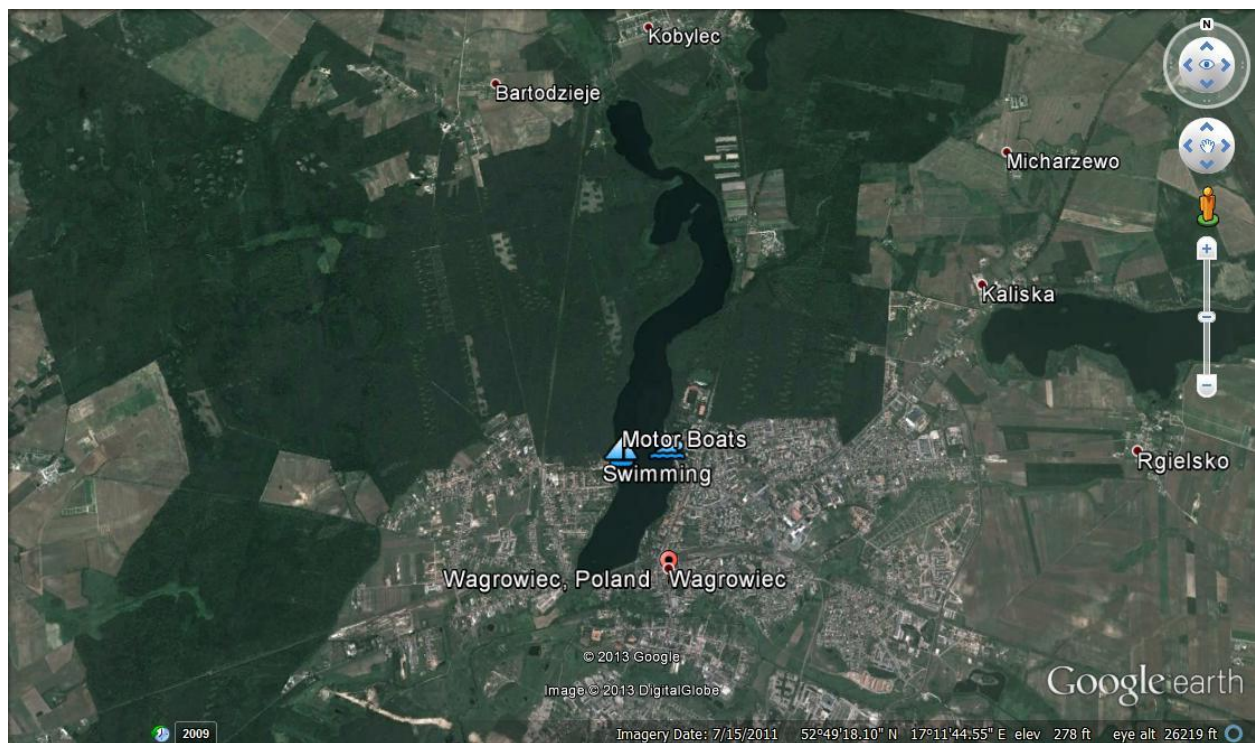
negatively influencing the water quality and offer workable solutions for improving the ecological state of the lake.

2. Materials and methods

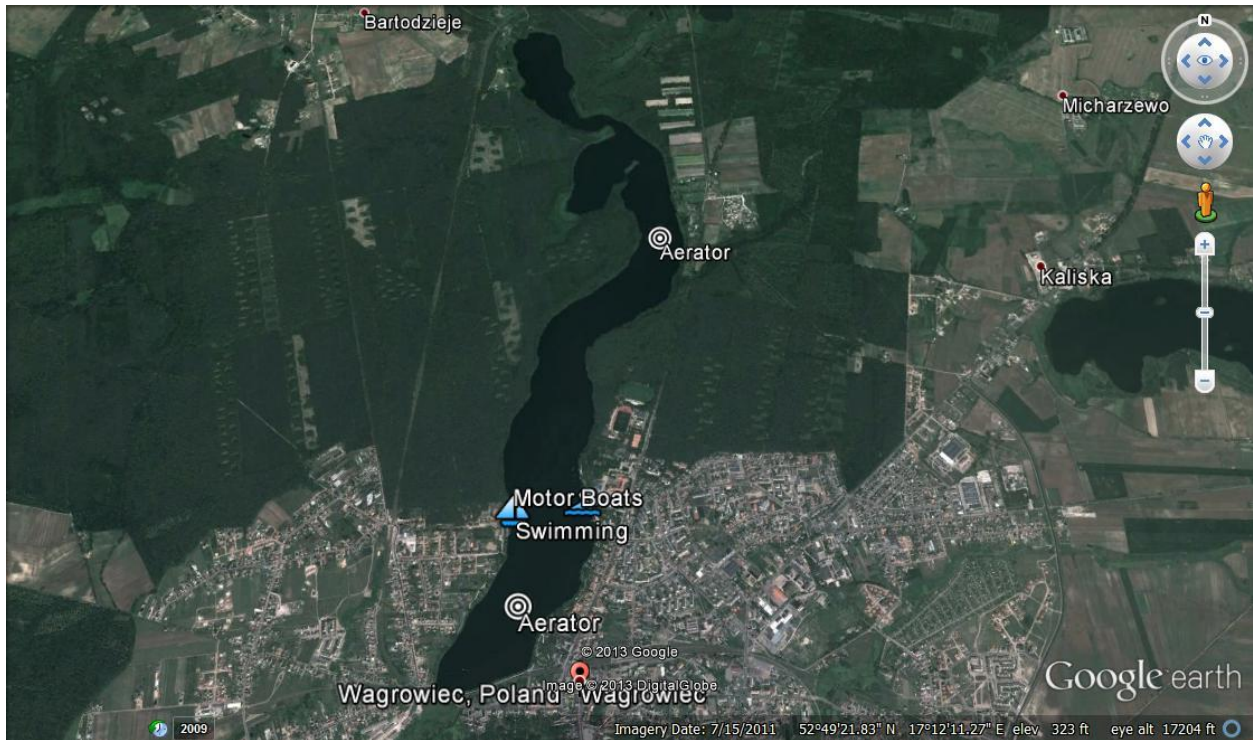
2.1. Data Collection and mapping of important locations

A detailed visual survey of the lake was conducted in order to understand current situation of lake and different activities that are being performed at the Lake Durowskie. During the visual survey photographs were taken and important locations were marked using handheld GPS.

Some of the photos taken at and surrounding of the lake are presented in the Appendix of this report. In addition Google Earth maps were used to understand the landuse in the surroundings of the lake.



Overview of Lake Durowskie



Location of Aerator in the Lake Durowskie

2.2. Surveys

To get a better idea of the local people, visitors and fishermen a questionnaire was prepared and distributed among different groups of people representing the social scheme of town. Three different surveys were conducted to capture the preferences of the communities at large.

Questionnaire used during the survey is presented at the end of this report in the Appendix, with the summery presented in the table below;

Category	Participants
Locals	40
Tourist	40
Fishermen	26
Total	106



Survey with Fishermen at the Lake Durowskie














2.3. Investigation

Data from the above mentioned surveys were compiled to form visual representations of locals, tourists and fishermen preferences and desires. Analysis was conducted and presented in this report.

3. Results

This chapter presents results of surveys conducted during the Summer School of 2013. A comparison has been made to between the other working groups from 2011 through 2013.

3.1. Current state of the lake Durowskie

Indicators of quality	2011	2012	2013
Physico - Chemical			
Macrophytes			
Algae (Noth)			
Algae (South)			
Macroinvertebrates			
Fish assemblages	N/A	N/A	



Physico-Chemical results shows that the quality of the Lake Durowskie is decreased since last year, the Concentration of chlorophyll α has increased, which represents the biomass of algae has increased from last year. There are more nutrients input than output.

Macrophytes belt is increased this year, but in unequal surface for all the lake, because is increased in north part, but in south part seems to decreased. This is due to the human activities and results a lot of gaps in the macrophytes belt.

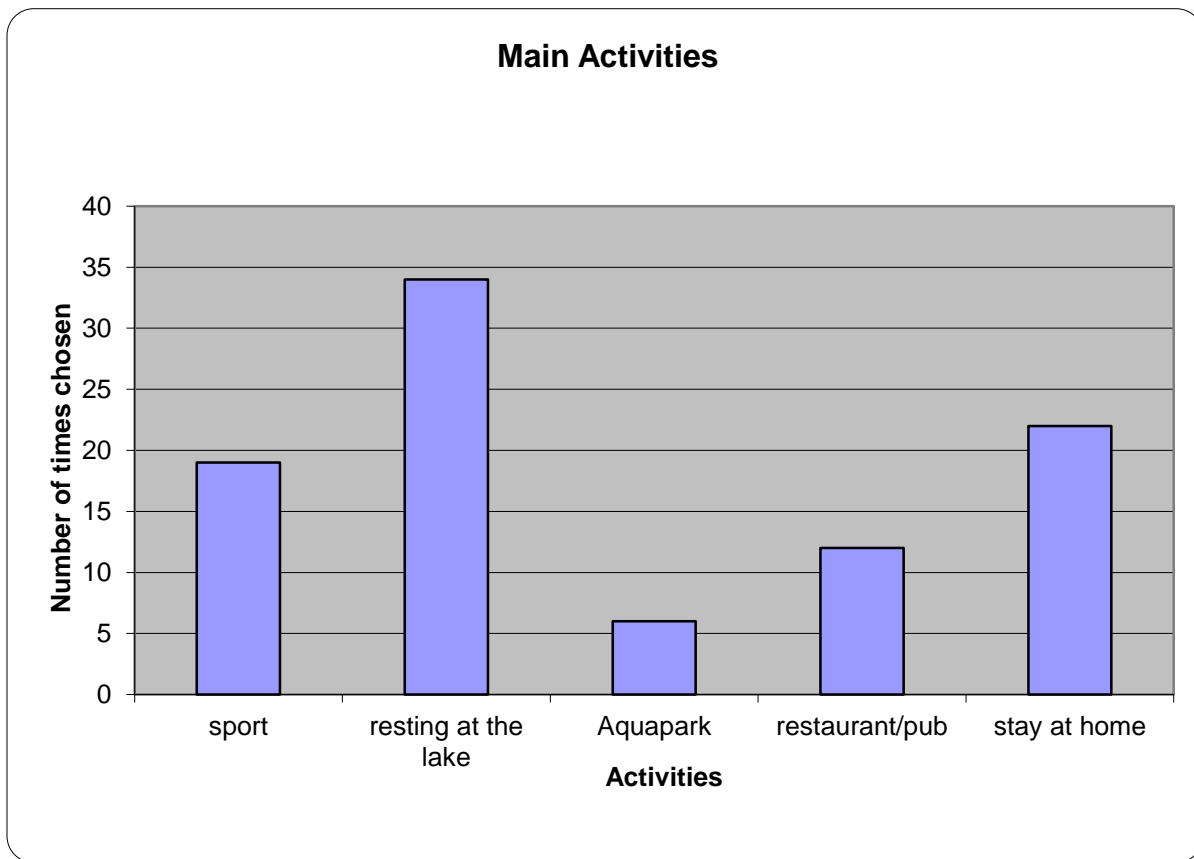
According to Algae results (Diatom index), while the north part of the lake has a Moderate state, the south one has a Poor state. Trophical state for the lake in 2013 is Hypertrophy, based on the Nyggard index of number of species from all sorts taxonomical groups of algae.

Macroinvertebrates research shows that this year the quality of the lake, from macroinvertebrates point of view, is worse than the last year. Number of identified taxa with wide ecological range continue to increase → adapted to worse conditions and according to the EPT-Index¹ the species adapted to good water quality are less abundant.

The year of 2013 is the first for fishing assemblages researches and we can't make comparisons with previous year, but as a conclusion of the survey made in this year, the state of the lake is changed the Corigonid Lake in Bream Lake. The oldest records for stocks fish in the Durowskie Lake indicate that were 18 species of fish presents, but now still only 9 species of them. All so, the biomass seems to decrease. This fact is due the lack of dissolved O₂, abundance of nutrients input into the water.

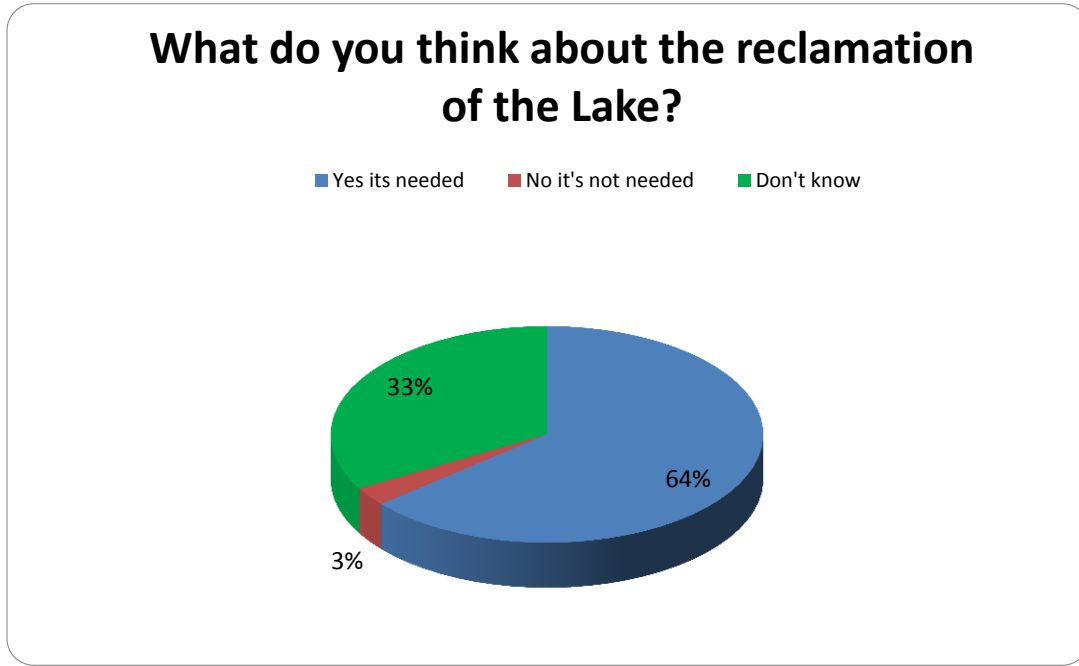
3.4. Human activities in the lake area

From our research and collected data, the main activities in the lake area are: fishing, motor boating or other sport boating, jogging, walking along the banks, swimming, biking, mountain bikes competitions and beach sports. This activities cause a major impact over the banks of the lake producing erosion, over the macrophytes belt and quality of the water. According to this impacts, the quality of the ecological conditions is degraded.

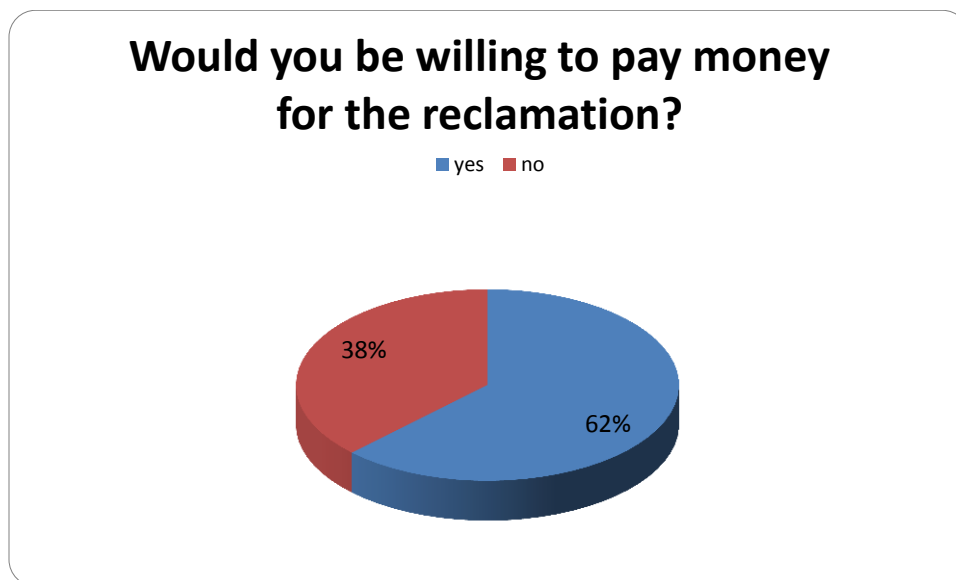


3.5. Comparison of Results

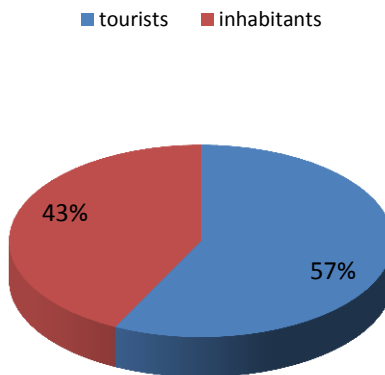
Results of the questionnaires for the locals, fishermen and tourist



More than a half of the respondents aware that the quality of the lake has to be improved and they are agree with the rehabilitation actions.

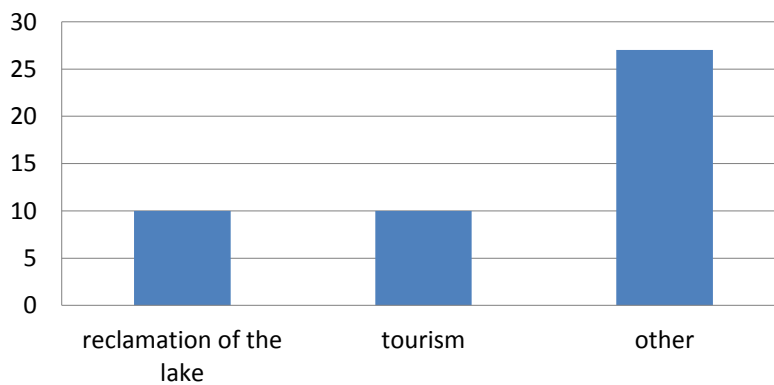


Who should pay for the reclamation?



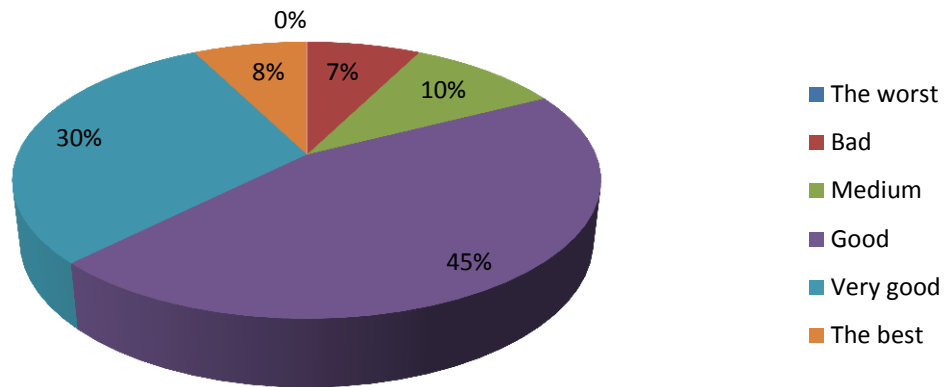
More than a half of the respondents are agree that local authority to pay for the reclamation of the lake. But also they think that the tourist shall be liable to pay the costs of the reclamation.

Investments



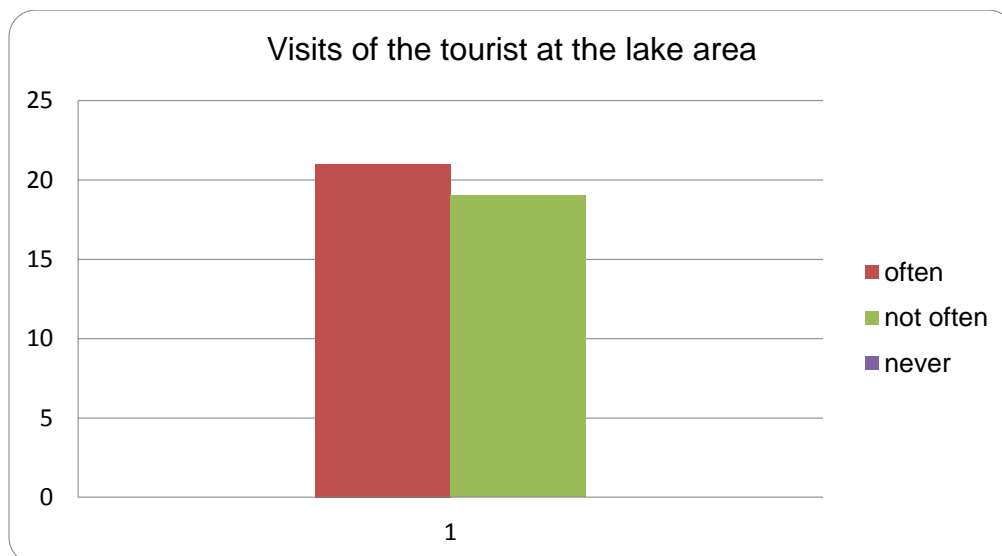
The reclamation of the lake is seen as an investment also, and the locals consider it as a priority for the local development.

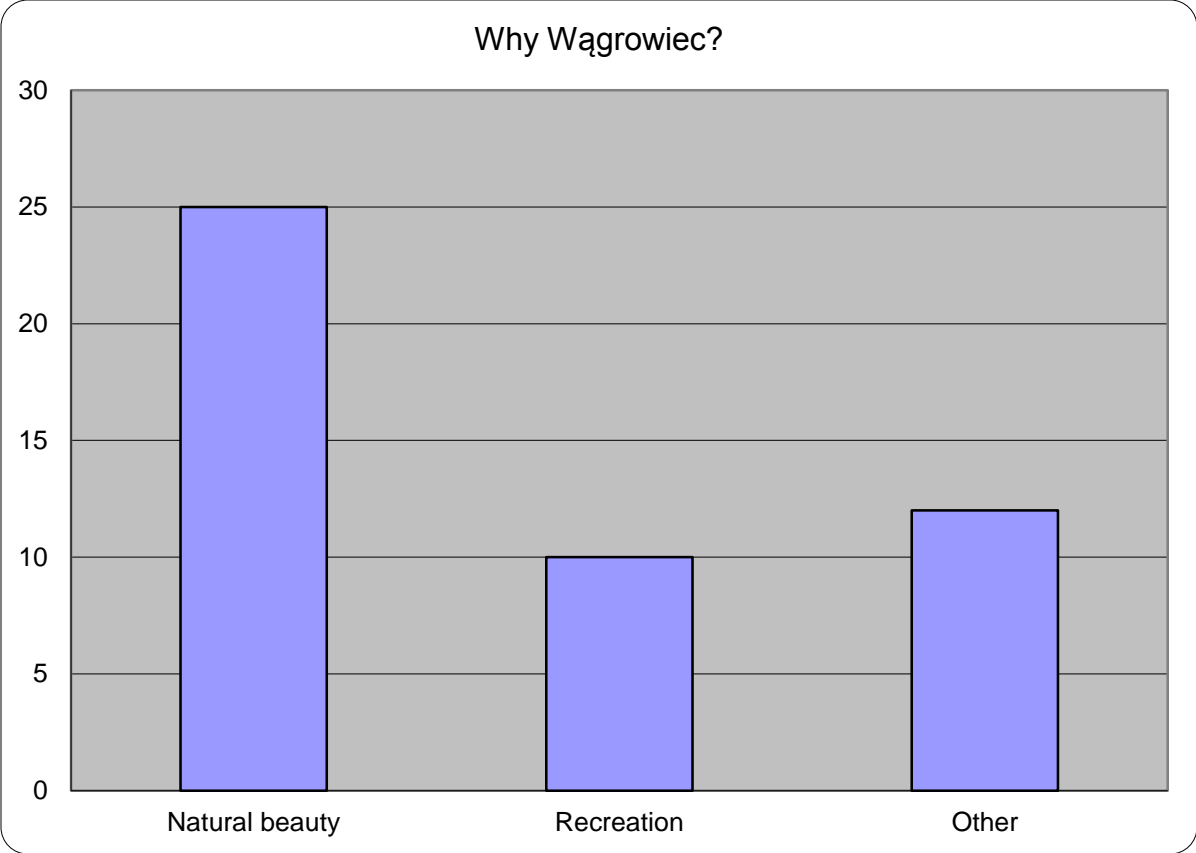
What do you think about the Mayor of Wągrowiec and his work to improve the quality of the water in the Lake Durowskie?



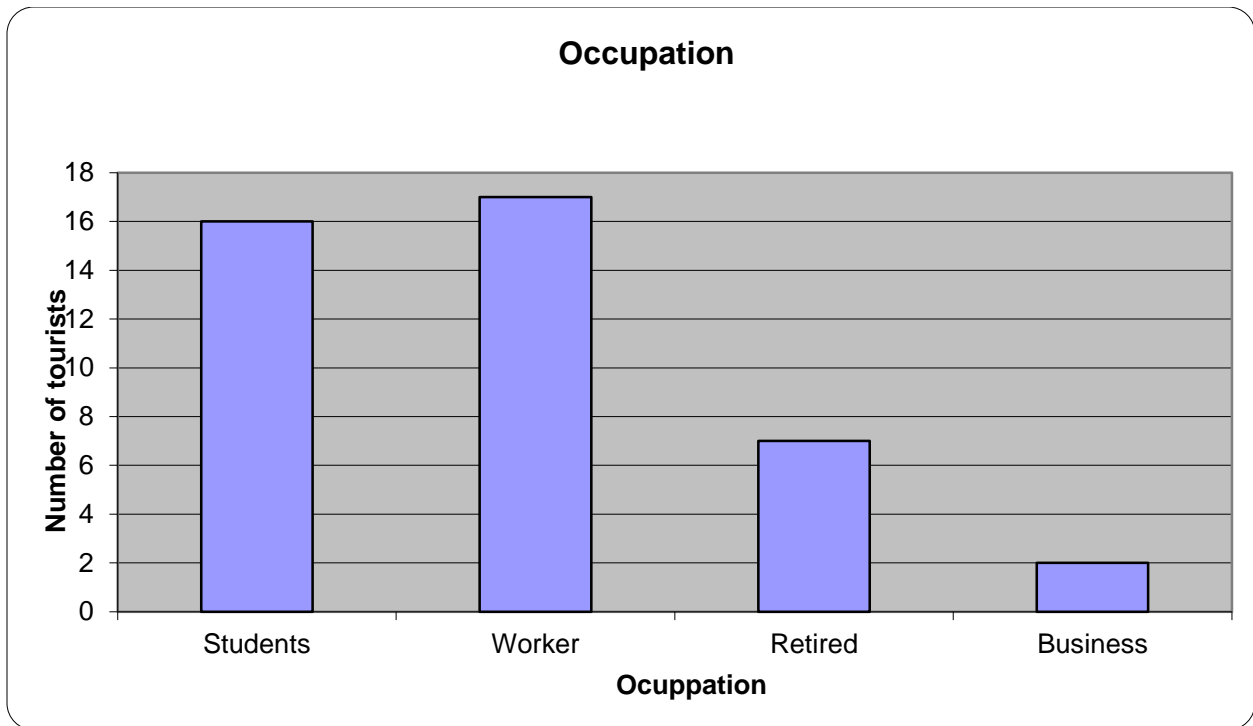
Local's opinion is that the Mayor is doing a good and a very good job by improving the state of the quality of Durowskie Lake.

The tourists of Wągrowiec City are mainly from the other region, and they are visiting the lake area very often, means that the lake is the top choice for them.

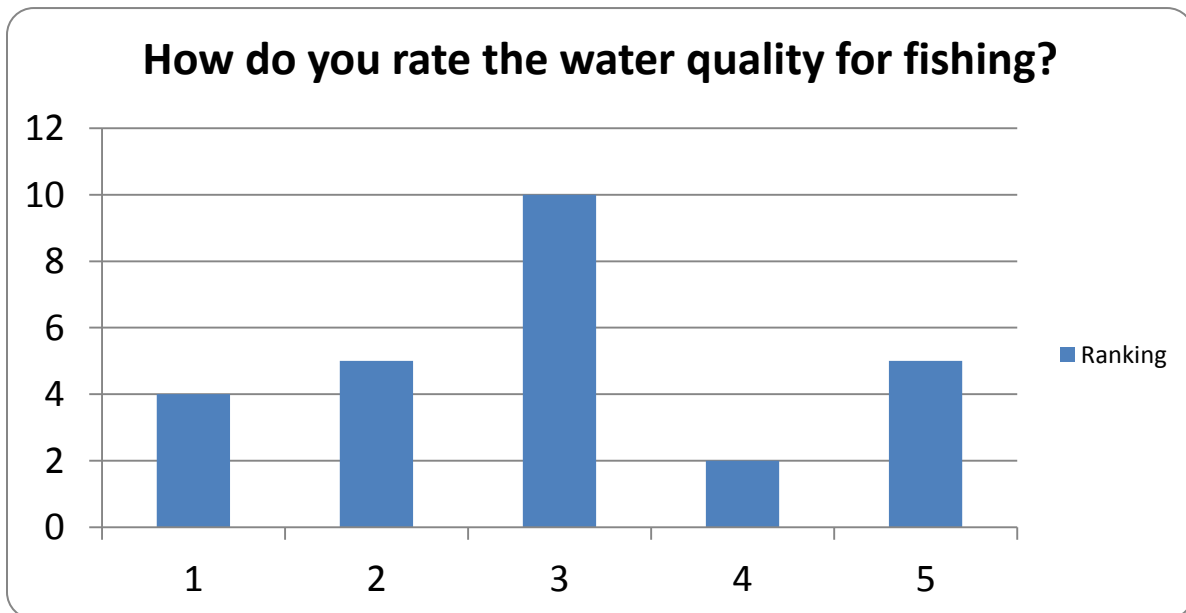




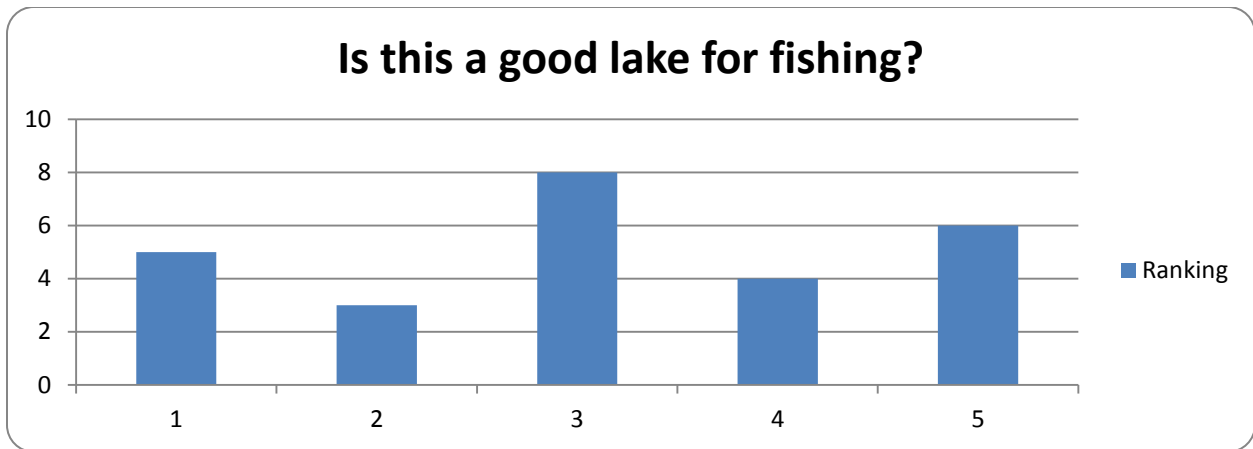
The tourists choose Wągrowiec especially for the natural beauty, and reclamation of the lake should be a top priority for the local economy.



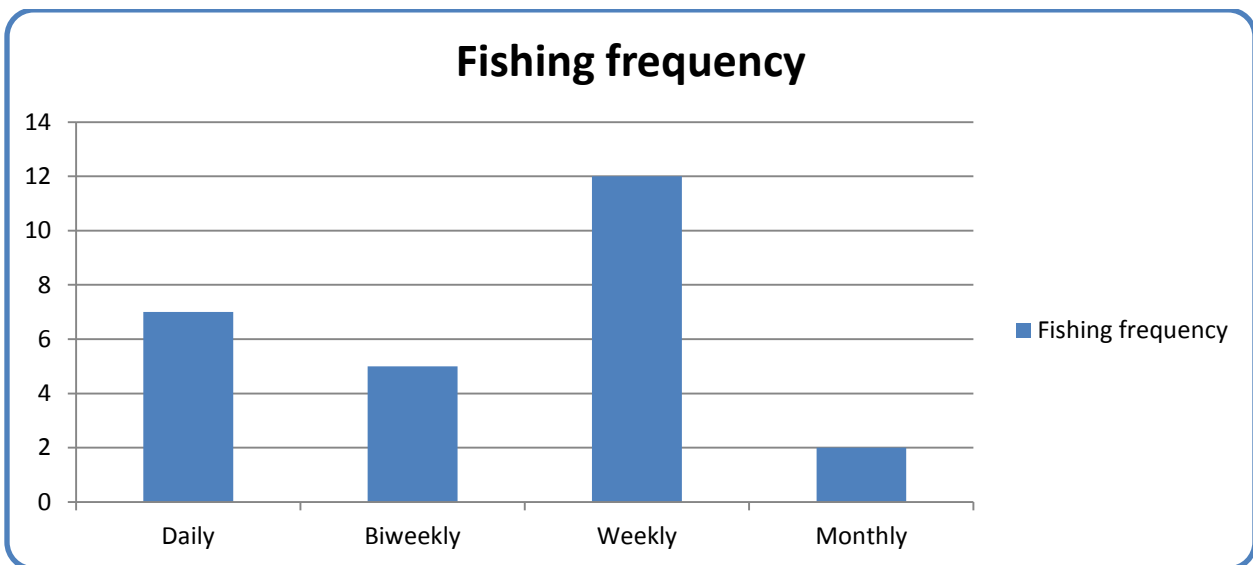
The fishermen demands for stocking the fish on the lake, they don't know the real state of the lake: in their opinion, state of the lake is moderate.



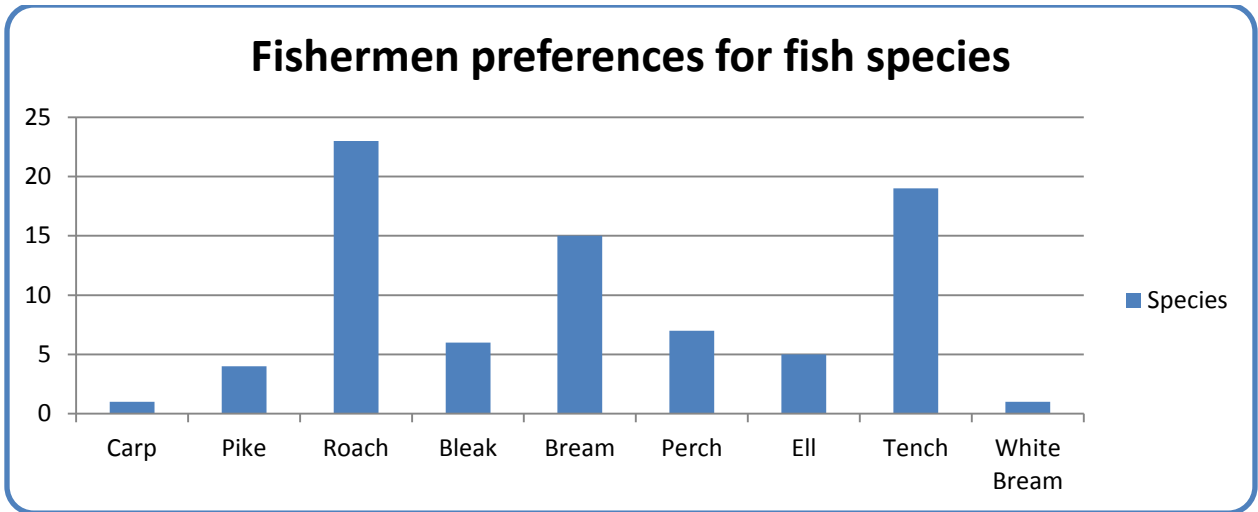
On a scale of 1 to 5, 1 being the least good value and 5 the best.



On a scale of 1 to 5, 1 being the least good value and 5 the best.



As it seen in the responds of the questionnaires, the lake is very common for the people with want to fish and this big frequency has a very big impact over the state of the lake.



The preferences for the fish species are roach, tench and bream.

4. Conclusions & Recommendations

The city of Wągrowiec and Lake Durowskie are downstream from several other lakes which, heading away from Durowskie, increase the level of contamination. Lakes Kobyleckie, Bulkowieckie, Grylewski and Golancz reservoir have severe algal blooms due to eutrophication. (taken from the “Lake Management Group: final report 2011”).

“Lake Management” working group review the results from other working groups from the year 2011 through 2013 (current year). Results published by other working groups showed that macrophytes quality and distribution had been major issue and most of the problems are linked directly or indirectly with the macrophytes at the Lake Durowskie.

Results presented in the section 3 of this report shows that overall ecological state of the Lake Durowskie has declined over the last years.

Indicators used for this survey showed that the quality of the lake seems to have degraded, and requires a long term monitoring plan to better understand the ecosystem of lake Durowskie.

The main task of the group Lake Management in the classroom on the lake Durowskie was carried out tests to make the results of its ecological condition. After developing the results obtained from each group acting as a Summer School in 2013, I found that Durowskie lake located in the municipality of Wągrowiec, Wielkopolska region is largely degraded.

Pollution of the lake will include fishing activities. Fishermen in order to increase their catch, bring the water ground bait that contain large amounts of nitrogen and phosphorus. These elements are nutrients that cause eutrophication of water bodies. In order, to reduce this practice to increase the environmental awareness of fishermen, through the introduction of environmental education program. It should also reduce the number of positions within the fishing vessel and completely eliminate the position of illegal (in any way insecure). Platforms destructive fishing also affects the macrophytes belt along the lake. To improve the condition of

lakes should provide private jetty fisherman to restrict fishing in prohibited places. Each fisherman with its private jetty will be more care about its purity. You might also consider the prohibition of ground bait or limit the amount of nutrients entering.

Another reason for the degradation of reservoir is using by tourists of motor boats and personal watercraft. They cause a commotion mirror lake, which is destructive to the belt of macrophytes, causes erosion banks of the lake, and also causes turbidity sediments. Therefore, we infer a total ban on the use of watercraft in the areas the most degraded. We are aware of the fact that water attractions attract tourists and local residents should be aware of, however, that in some places they cause a large degradation of reservoir.

Large impact on the lake also has a cycling, which also causes erosion of the lake. Especially visible degradation of the area occurs during heavy rainfall followed by the descent into the lake's shores. To prevent the erosion of this type should be designated bike routes in areas farther away from the lake shore.

The degradation is not caused only by the actions of the local community. Pollutants causing environmental deterioration are delivered to the lake from other reservoirs (Lake Kobyleckie) by the flow of water with lots of nutrients.

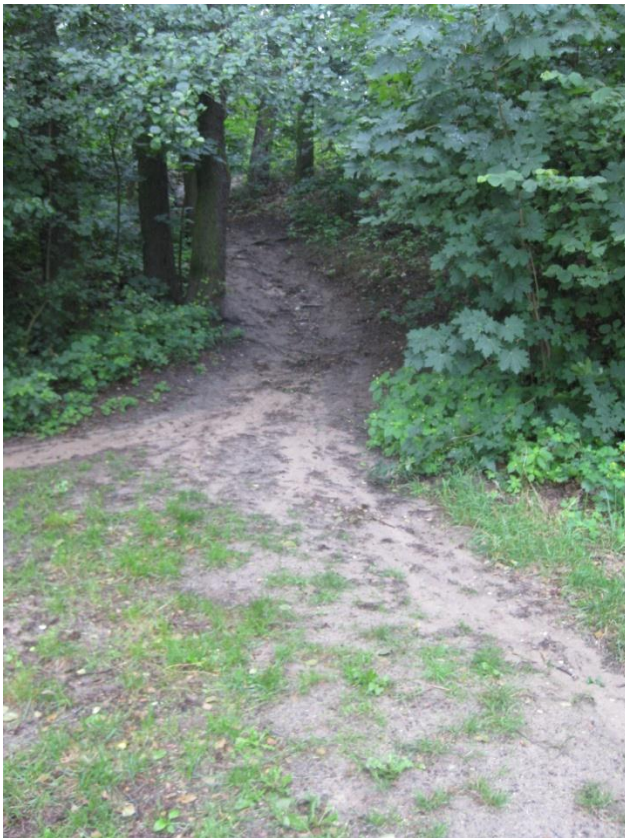
In order to improve ecological condition lakes Durowskie primarily have to increase the environmental awareness of residents Wągrowiec including fisherman. Environmental education can be done in many ways: through public awareness campaigns, happenings, educational programs, workshops, etc. This is the only way you can affect the local population.

Factors contributing degrading the current condition of the Lake Durowskie can be divided into two external and internal factors.

- External Factors; include inflow from Kobyleckie. Inflow from Lake Kobyleckie includes high concentrations of nutrients which add to the eutrophication of Lake Durowskie. It was reported during the Summer School that waste water is discharged directly into the Lake Kobyleckie without treatment.

- Internal Factors; from Lake Durowskie are listed below;
 - Erosion from Surface Runoff (includes furrow erosion);
 - Fishing Impacts Lake Durowskie in multiple ways, primarily by adding Nutrients (Fishing baits) and in addition effecting Macrophytes belt along shoreline from jetties. Also it has been noted that direct fishing from lake bank results in erosion.
 - Intensified Leisure Activities including motor boats and biking effects the lake. Motor boats cause strong waves in lake resulting in effects on macrophytes belt.

Photos presented below shows the level of erosion resulting from intensive leisure activities along the Lake Durowskie.



Erosion on forest path



Eroded soil at the shore



Fishing bait in bucket (at one of the jetty on Lake Durowskie) Fisherman in macrophytes gap

4.1. Recommendations

To establish a coordinated system to develop and implement programs to improve the water quality of Lake Durowskie following recommendations are made;

- Round table capacity building (Public awareness campaign)
- Majority of the locals sustain the rehabilitation of the lake.
- Educate fishermen to reduce use of fishing bait
- Allow more fishermen to use private jetties to reduce impact on macrophytes belts ?
- Zoning of lake in North and South (Limit activities in the North of Lake)
- Change route of biking along the lake to limit erosion events.
- Construct jetties to reduce foot print on macrophytes belt.
- Ban use of motor boat in certain areas ?
- Motor boat rides to be limited to reduce effect on macrophytes

5. Appendix

Template 1. Questionnaire for the locals:

QUESTIONNAIRE

1. Personal info:

- a. Nationality
- b. City
- c. How close do you live from Lake Durowskie? ... km

2. What is your profession:

- a. Student
- b. Labourer
- c. Running a business
- d. Retired

3. How do you spend your free time in Wągrowiec?

- a. Sport
- b. Resting at the lake
- c. Aquapark
- d. Restaurant, pubs
- e. Staying at home

4. How often do you visit lake Durowskie?

- a. Often (>10 times/month)
- b. Not often (<10 times/month)

c. Never

5. Why do tourists choose Wągrowiec to spend holidays?

a. Natural beauty

b. Recreation

c. Others

6. What do you think about the Mayor of Wągrowiec and his work to improve the quality of the water in the Lake Durowskie? (1 – the worst, 6 – the best)

1	2	3	4	5	6
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7. What do you think about reclamation of the Lake Durowskie?

a. Yes, it is needed

b. No, it isn't needed

c. I don't know

8. Would you be willing to pay money for the reclamation of the Lake Durowskie?

a. Yes

b. No

9. Who should pay for the reclamation in your opinion?

a. Tourists

b. Inhabitants

10. **Would you prefer the government to invest money more on:**

- a. Lake restoration (beauty, water quality, etc)
- b. Lake's supporting facilities (lodges, sports facilities, etc)
- c. Others. Please specify:

11. **Are you pleased with the current situation in Lake Durowskie** (Tourists, water quality, fish stocks, cleanliness, scenery, etc)?

- a. Yes
- b. No. Why?

Template 2. Questionnaire for the tourists:

Questionnaire Wągrowiec 2013

1. Personal info:

a) nationality:.....

b) city:

2. What do you do?

a) you are student

b) you are worker

c) you are retired

3. What's your main activity in free time?

a) sport

b) resting at the lake

c) Aquapark

d) restaurants, pubs

e) stay at home

4. Are you accompanied?

a) friend

b) family

c) alone

5. Why did you choose Wągrowiec?

a) natural beauty

b) recreation/ leisure facilities

c) other

6. What would you improve here?

7. What was missing?

8. Did you have **positive/negative** impression?

9. Will you come back?

a) yes

b) no

Template 3. Questionnaire for the fishermen:

1. Are you a local fisherman or a tourist?

--

2. Are the jetties/places private?

--

3. What are the prices for the fishing license?

Day	Week	Month	Year

4. Which are the major species you are fishing?

--

5. Which equipment do use?

--

6. Is there a season prohibited for fishing?

--

7. How often are you going to fish?

--

8. Do you use your catch for personal use or for sale?

--

9. Do you feel disturbed by the tourist?

1	2	3	4	5
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10. How do you rate the water quality for fishing?

1	2	3	4	5
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11. Is this a good lake for fishing (location)?

1	2	3	4	5
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12. What do you think needs to be improved?

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References

- Jorgensen S.E., Vollenweider R.A. (1989): Guidelines of Lake Management, Vol. 1: Principles of Lake Management. International Lake Environment Committee, United Nations Environment Programme.
- Leupolz-Rist R.A., Baltag E.S., Tabacaru A.C., Zietek P., Miniecki M., Newman D. (2011): Lake Management Group: Final Report, July 2011, in Summer School Ecological state of the lake during restoration measures.
- Richter S., Volker J., Borchardt D., Mohaupt V. (2013): The Water Framework Directive as an approach for Integrated Water Resources Management: results from the experiences in Germany on implementation, and future perspectives. Environmental Earth Sciences 69: 719-729.
- Chitescu M., Shafiei S., Sikorska J., Sroka J., Strungaru S.A., Zullo G. (2012): Lake Management (Report), in Summer School Ecological state of the lake during restoration measures.
- The Interagency Lakes Coordinating Committee (1996): Developing a Lake Management Plan.

¹ **EPT index** is an index of water quality based on the abundance of three pollution-sensitive orders of macroinvertebrates