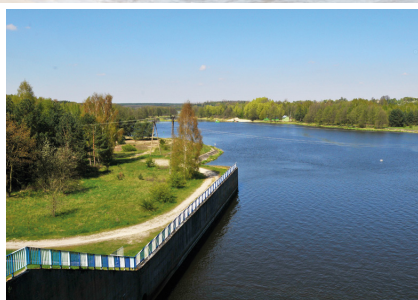




Bulletin No.3/2016



**„Analysis of factors affecting the ecological status of the Sulejow Reservoir
based on continuous monitoring and integrated 3D model
of the artificial lake (project MONSUL)”**

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Project

MONSUL

1. Introduction

We offer you the third, last issue of the bulletin of the MONSUL project which presents the most important results of our project. We will also discuss two conferences presenting results of our studies. The first one is the international geographic conference GEOMED 2016 which was held in Kemer, Turkey. The other one is the conference in Swolszewice Małe organized at the end of the MONSUL project. We finalize this stage of research on the Sulejów Reservoir with a sense of satisfaction which is related not only to the achievements and developed research tools. We feel that we managed to gather a group of highly involved and passionate people around the idea of improving water quality in the Reservoir. These are primarily the representatives of local governments, residents, community workers and specialists involved in water management, whom we thank for their help and support.

We wish you a pleasant reading – more information can be found on the project's website: www.monsul.wipos.p.lodz.pl

MONSUL Project Team

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2. Results of the project

Water is the most important part of natural resources for people. Meanwhile, the resources of surface water (rivers, lakes, artificially dammed reservoirs) are exposed to man's pressure. They should therefore be subjected to special protection, and any action within them should be reasonable, properly assessed and systematically controlled. Water in artificially dammed reservoirs formed as a result of deliberate human action to be used as e.g. a reservoir of drinking water, or for tourism, recreation and sports, should be of high quality. Hence, it is necessary to carry out frequent water tests, record the results, analyze reasons of changes and monitor the hazards. In order to analyze the state of water in the Sulejów Reservoir the MONSUL project was launched in January 2015, and today we can present its results, the most important including

- Continuous monitoring of the following water quality parameters in the Reservoir using multiparameter probes: chlorophyll concentration, content of ammonium ions, dissolved oxygen concentration, temperature, pH and the concentration of algae.
- The program of mobile measurements with the use of a multiparameter probe in installed on a motor boat along the whole length of the Reservoir – from the dam to the village of Barkowice – along the specified trail ('zigzag') so as to obtain data from both the mainstream and the bays, from the area of marines and river mouths. An example of a real trail of one-day sailing using the GPS system is shown in Fig. 1.

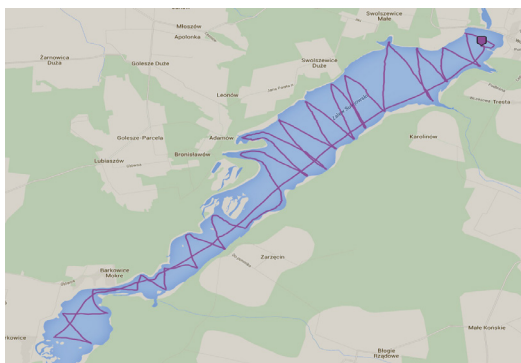
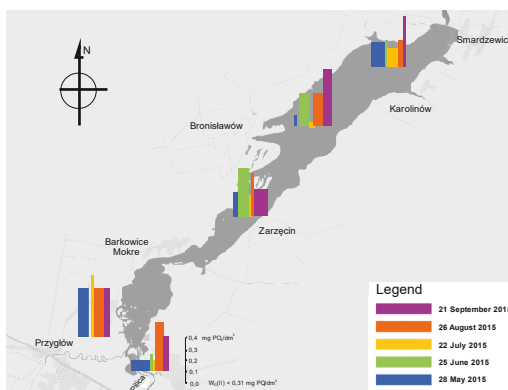
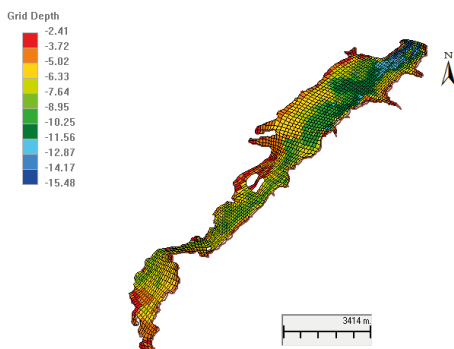


Fig.1

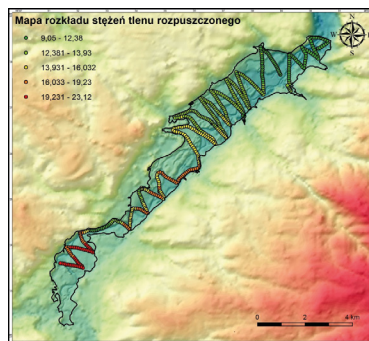
- Periodically, water samples were analyzed under laboratory conditions in order to determine the concentrations of phosphates and nitrates and of biological and chemical oxygen demand. The photo shows the phosphate concentration in selected points of the Reservoir during the growing season from May to September 2015.



- Using the Geographic Information System (GIS) the results of measurements constitute a database to verify a three-dimensional model of hydrodynamics and water quality parameters in the Reservoir, developed in cooperation with the NIVA Institute in Oslo (the GEMSS model). As a result, simulation of the ecological state of the Sulejów Reservoir depending on the changing human pressure will be possible.



Schematic of the GEMSS model used in the studies on the model of water quality in the Sulejów Reservoir and 3D map as a basis for mathematical analyses.



Map of the distribution of dissolved oxygen concentration in water of the Reservoir (mg/L) in the slipstream of a boat with probe on 22 July 2015

In conclusion one should emphasize the complexity and wide range of monitoring studies carried out under the MONSUL program; the developed model and its verification will be useful for modeling and simulation of the ecological status of the Reservoir and its surroundings.

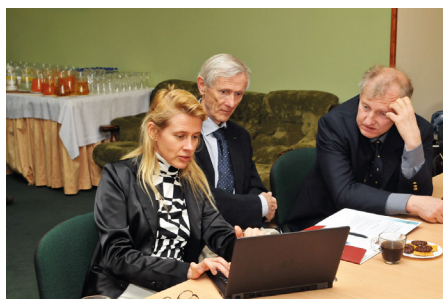
3. The MONSUL project presented at the conference in Kemer, Turkey

On 23 to 26 May 2016 the fourth international geographical conference GEOMED 2016 was held in Kemer, Turkey. This conference is a cyclical meeting of geographers held every three years on the south coast of Turkey. The fourth edition of this meeting was attended by scientists from five continents who during three days of the conference exchanged their experiences and methods and presented results of their researches. The MONSUL project was represented by Dr. Marcin Jaskulski who delivered a lecture on 'Monitoring of the Ecological Status of the Sulejów Reservoir in the Frame of Project MONSUL'. He presented a system for monitoring the Sulejów Reservoir consisting of three elements and maps showing results of the measurements.



4. Completion of the MONSUL project

The conference ending the MONSUL project was held on 26 April 2016 in Hotel Kruk in Swolszewice Małe. The seminar was attended by the representative of institutions involved in the project, i.e. the Faculty of Process and Environmental Engineering, Łódź University of Technology and the Faculty of Geographical Sciences, University of Łódź, Norwegian Institute of Water Research NIVA, as well as the representatives of municipalities, regional environmental administration and institutions connected with water management.



During the meeting results of water quality monitoring in the Sulejów Reservoir carried out from May to September 2015 were presented. It was emphasized in the summary that the year 2015 was extremely difficult to carry out research due to the drought and high temperatures (the highest recorded water temperature in the Reservoir was 28°C) which caused very intense algal blooms. Maps of spatial distribution of pollution and blooms of water in the entire area of the Reservoir were also presented.



Due to a large number of acquired data that required further analyses, the discussion was focused on the parameters critical for the Reservoir, i.e. chlorophyll concentration, biogenic compounds, temperature, etc. Researchers presenting results of the project agreed on the fact that the Reservoir is characterized by very high dynamics of changes in all tested parameters. The process of data analysis and development that is still in progress will allow us in the near future to put forward more precise conclusions, which in its final shape will lead also to a more accurate specification of the mathematical model of the Reservoir.

The most important results of the project were considered the formation and calibration of the system monitoring basic physicochemical parameters of the Reservoir based on 3 elements:

- Mobile monitoring made from the decks of boats sailing on the Reservoir;
- Buoys equipped with specialized equipment;
- Laboratory measurement system.

Polish researchers stressed the enormous support and commitment of Norwegian colleagues, in particular in the complex process of GEMSS model calibration as well as preparing, equipping and servicing the Norwegian measuring buoy.

Animations showing suggestively the dynamics of phenomena and tested water parameters in the Sulejów Reservoir were prepared with the use of the GIS model. Based on the use of all these tools it was easier to propose a 'diagnosis' and possible scenarios for improvement of the Reservoir state. Due to the modernization of the majority of local sewage treatment plants, attention has been focused on reducing uncontrolled emissions into watercourses in the catchment of the Reservoir (where undesirable substances exceed even 10 times the allowable concentrations). Modernization of sanitary infrastructure and eradication of leaking cesspools was postulated.



Norwegian partners presented examples of good practices related to financing domestic sewage treatment plants by municipalities. Such plants effectively reduce the amount of domestic sewage.

PhD Magdalena Kempa of NIVA also presented a negative impact of marinas during the sailing season – emptying septic tanks from boats and sailboats increases the concentration of coliform bacteria and dangerous pathogens.

The MONSUL project team stressed that the development of a calibrated, accurate mathematical model of the reservoir can become an effective tool for the rational management of water resources. With the help of such tools one can predict the effects of e.g. formation of a sanitary zone around the tank, reduction of surface runoff and the load of biogenic compounds in the tributaries, etc.

This model can be used by specialized institutions and local governments to make optimal decisions to improve ecological potential of the tested reservoir, as well as to localize investment or recreation sites.

The developed methodology can be used to build similar models for supporting decision-making process in the management of other water resources.

At the end, project leader, Prof. Dr. Ireneusz Zbiciński thanked everyone involved in the project and encouraged to further work, studies and efforts to improve the quality of water in the Sulejów Reservoir.



