THE USE OF THE LONG-TERM MONITORING DATA OF BELARUSIAN STATE UNIVERSITY IN THE PROGRAMS OF ENVIRONMENTAL REHABILITATION OF THE LARGEST IN BELARUS LAKE NAROCH (NATIONAL PARK "NAROCHANSKY")

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Naroch is the largest waterbody in Belarus (80 sq. km). The lake is situated in the North-West of the republic (540 52' N and 260 50' E) within the drainage area of the Neman river which flows into the Baltic Sea. Because of some unique nature peculiarities, the lake is considered to be a national property of the country, and its protection from pollution and euthrophication is a task of state importance. For a long time the lake has been used for recreation. Since 1960s the Naroch has been treated as a republic health resort. Its importance grew after the Chernobyl Catastrophy in 1986, for the radioactive rainfall was rather insignificant on the territory of the Naroch region. So many people from affected regions can improve their health on the Naroch.

Lake Naroch also became the key element of the National park "Narochansky" that was formed in 1999. National Park "Narochansky" is the ownership of the government that's why the whole shoreline zone is 'communal'. One can see private land only within the settlements, where each house has a parcel of land in private ownership. There are two towns and 37 villages with approximately 15000 permanent residents altogether.

Today the recreation shoreline zone has numerous sanatoriums, health centers, camping grounds, etc. The number of people visiting the Naroch is up to 100-120 thousands a year. National Park provides a great variety of water activities: sport fishing, boating, waterskiing, different water attractions, which are common in the day-time.

On the other hand, being a typical waterbody for temperate zone Lake Naroch draw attention of scientists as well. In 1947 on the Naroch shore the Naroch Biological Station (NBS) of the Belarusian State University was founded. Further formation, development and outstanding scientific attainments, which made NBS world-wide famous, are inseparably associated with G.G. Vinberg, who in 1947 became the head of the Invertebrate Zoology Department and worked at the Belarusian State University for 20 years. The investigations of the water ecosystems functioning conducted at NBS were based on the energy approach elaborated by G.G. Vinberg. These investigations brought world-wide fame to the Belarusian scientists and Lake Naroch in the field of productional hydrobiology. Nowadays the full name of the NBS sounds as the Education and Research Center «Naroch Biological Station named after G.G. Vinberg».

The important role in the research work at NBS is played by the Research Laboratory of Aquatic Ecology of the Belarusian State University, that was formed in 1965 on the initiative of prof. G.G. Vinberg. As a matter of fact this Laboratory and NBS represent a united complex, that for many years (since 1967 till 2012) was headed by the corresponding member of the National Academy of Sciences of Belarus A.P. Ostapenya. The Laboratory of Aquatic Ecology has the direct relation to all fundamental and applied research work at NBS. The research field of the laboratory is closely connected with the study of biodiversity, long-time changes, mechanisms of substance and energy transformation in lakes. Major part of the investigations is held on Lake Naroch.

Since 1978 all-the-year-round regime observations on the lakes Naroch, Myastro and Batorino began, so from that time the unique database of long-term hydroecological monitoring rows is constantly replenishes. Since 1999 on the materials of monitoring observations and current research the annual "Bulletin of the ecological state of the lakes Naroch, Miastro, Batorino" is published. The "Bulletin..." reflects the modern state of the Naroch Lakes ecosystem and the tendencies and changes occurring in it.

The ERC "Naroch Biological Station named after G. G. Vinberg" is the place where numerous international and regional scientific conferences, meetings and seminars on the actual

ecological, biological and regional problems are held. It is necessary to mention here the International conference "Lake ecosystems: biological processes, anthropogenous transformation, water quality" that become traditional and is conducted each four years since 1999. These conference is very popular among hydrobiologists and usually collects participants from all regions of former Soviet Union as well as from other countries.

So, for more than 60 years Lake Naroch serves as a testing site for profound hydrobiological and limnological research that is conducted by the Naroch Biological Station and Laboratory of Aquatic Ecology of BSU. Such long rows of observations have an extraordinary scientific and practical value and serve the basis for understanding the biological self-cleansing processes, analyzing the recent state of lake ecosystems and predicting its alterations. As a result the Naroch enters the limited number of the most studied lakes in the world.

The monitoring data of the Naroch Lakes undoubtedly represent great scientific and practical value as it is the basis for the reliable analysis of the water ecosystem state and also helps to forecast changes caused by anthropogenic influence. The results of long-term hydrobiological observations form the unique database, that allows to track the evolution trends in polytypic lakes under anthropogenic influence and global climatic changes, so that it can be considered as national scientific property of Belarus. They are also necessary when developing lake management and restoration programs, cause together with the fundamental hydroecological research much efforts is put into the applied research work aimed at the water quality improvement in the Naroch Lake and preservation of its unique natural features. As a result, the main ways of nutrients and pollutants input in the lakes have been deciphered and quantitatively estimated. These materials provided a scientific basis for practical actions aimed at the Naroch Lakes protection from organic pollution and eutrophication, that were worked out within the framework of the "Plan of complex use and protection of water and land resources of the Naroch Lake's basin". Even partial and not always qualitative implementation of this plan has completely confirmed the euthrophication theory and allowed to turn the euthrophication process back.

After the National Park was formed, NBS and Laboratory of Aquatic Ecology render the methodical assistance to the scientific department of the National park "Narochansky" when developing and performing nature protection activities. The important practical value have the applied documents "Recommendations on preservation of natural potential of the lakes Naroch, Miastro and Batorino" and "Recommendations on the use of ecologically safe methods of Lake Naroch coastal recreational zones preservation from degradation".

The other line of activity is to assist in carrying out the research work at the biological faculty and scientific subdivisions of the Belarusian State University.

During the period of observation, the trophic state of the lake has been significantly altered for several times. In the 1970s the lake was exposed to anthropogenic eutrophication, caused mainly by the intensive development of agriculture and increasing recreational activity and till the mid 1980s we observed considerable decrease in water quality. Lake Naroch has changed from oligothrophic to mesotrophic. For prevention of ecosystem degradation, the government program of Naroch lakes restoration has been worked out in 1981. This program was carried out with the direct participation of scientists of the Laboratory of Aquatic Ecology and NBS. The hydrobiological data of long-term monitoring were of great use too.

The complex of environmental protecting measures covering the whole catchment area included deflection or partial deactivation of sewage, prohibition of agricultural use in the shoreline zone, replacing ploughed fields by meadows. Application of mineral fertilizers was strictly limited and stock buildings were either removed from the catchment area or completed with modern equipment. These measures took place in early 1980s, and this caused a decrease of external nutrient load approximately in 1/3 and stopped the deterioration of the lake. Since late 1980-s the data on nutrient load and the state of planktonic communities showed, that the trophic state of the lake has been considerably lowed. At that very time Zebra mussel invasion and rapid expansion in the lake took place. The redistribution of nutrient and energy flows in the ecosystem from the water mass to bottom layer due to a combination of environmental protective measures and the invasion

of Zebra mussel led to the phenomenon of bentification, that means an increase in the importance of benthic processes following increased water clarity promoted by nutrient reduction and Dreissena introduction(Mayer et al., 2006; Ostapenya, 2011). That showed the possibility of ecosystem processes reorganization and that in future there could happen the transition of most part of organic mater production back to water column. As a result the water quality and recreation potential of Naroch lake can decrease.

In order to save and rehabilitate the lake's ecosystem the second government program "National Lake Naroch Restoration Program 2005-2008" has been worked up. The program was aimed at nutrient load decrease and throphic state lowering. The Laboratory of Aquatic Ecology was among the organizations taking part in elaboration and implementation of the program. The program was based on the analysis of databases (rows of ecological observations for Lake Naroch), and study of merits and demerits of the Lake Naroch restoration government program held in the 1980s.

Both scientists and experts from different sectors of the national economy took part in National Lake Naroch Restoration Program development. Main priorities in the restoration and management of the lake were defined using the so-called "expert panel" method. This method has been developed in details for Lake Naroch when carrying out the research work on the INTAS-BELARUS project №-97-0306 in 1998–2000. Scientists in limnology and noted specialists in different sectors of the national economy (pisciculture, recreation activity, tourism) were brought into the project as experts. Conducting and analysis of the survey work on the project "Sense-of-Place Attitudes in the World's Temperate Lake Districts" in the Naroch Lakes district (held in 2001-2002) gave a possibility to compare the priorities in the lake restoration of experts, residents and people, taking their vacation in Naroch district.

At present time, there is a strong need in systematization of the accumulated information and in further development of restoration measures undertaken in 1980s and in 2000s.

Close cooperation between Laboratory of Aquatic Ecology, Naroch Biological Station and Ecology department of BSU works in many directions: solving scientific and practical problems (eutrophication and bentification processes, zebra mussel invasion and expansion and its influence on the ecosystem, prevention of ecosystem degradation, etc.), undertaking scientific expeditions and research work with students, conducting regularly international conferences.

The organization and carrying out of long-term monitoring of Lake Naroch by scientists of the central state university joins the education of biology students, post-graduate students and preparing of scientific dissertations with the effective participation in solving of practical ecological tasks. The history of Lake Naroch study and management shows the evidence of rationality of such approach and mutual understanding and cooperation of scientific and educational organizations with state institutions in the field of conservation of natural resources and water management.