Teka Kom. Ochr. Kszt. Środ. Przyr. – OL PAN, 2013, 10, 391–398

ASSESSMENT OF THE ECOLOGICAL STATE OF SMALL WATER RESERVOIRS IN THE LUBLIN REGION

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Summary. The aim of the study was to determine the diversity of ecological state of small reservoirs of hydrogenic landscapes in the Lublin region, varying in size, origin, land usage of adjacent areas, as well as the way of their usage. The research was carried out in 11 water reservoirs situated in different parts of Lublin Region. Examined small water reservoirs were varied in terms of ecological status. The largest group were the reservoirs of moderate natural values – class III. To this group belonged mainly reservoirs with the lowest surrounding valorisation. Huge impact on the natural values of small water reservoirs had use of reservoir and its catchment. Reservoirs of natural origin, not subjected to anthropogenic pressure characterized by the highest values.

Key words: small water reservoirs, valorisation, ecological state

INTRODUCTION

Small water reservoirs are especially valuable ecosystems in hydrogenic landscapes. They fulfill a number of ecological functions. On the one hand, they enhance the landscape, as well as a variety of habitats and species, on the other – store water. Due to their huge dependence on the surrounding areas, small size and depth, they are ecosystems very vulnerable to degradation [Juszczak 2001, Ożgo 2010].

Once, small water reservoirs were treated as valueless, and thus were outside of the scientific research' circle. For several years, they are in the center of interest in both, science and the environment protection, due to their multifunctionality [Juszczak 2001, Mioduszewski 2006].

The functioning of small water bodies differs in many respects from the lakes. These are ecosystems which are the most suitable for development of aquatic vegetation [Nagengast *et al*. 2007, Maślanko *et al.* 2010].

Differentiated way of the land use of small reservoirs' surrounding, as well as their usage appear to be one of the main causes affecting the state and the pace

of changes of these reservoirs. The aim of the study was to determine the diversity of ecological state of small reservoirs of hydrogenic landscapes in the Lublin region, varying in size, origin, land usage of adjacent areas, as well as the way of their usage.

STUDY AREA AND METHODS

The research were carried out in 11 ponds, in 2011 and 2012, situated in different parts of the Lublin Region. Most of investigated reservoirs were located in river valleys – Wieprz, Bystrzyca and Ciemięga, in the Lublin region. Some of

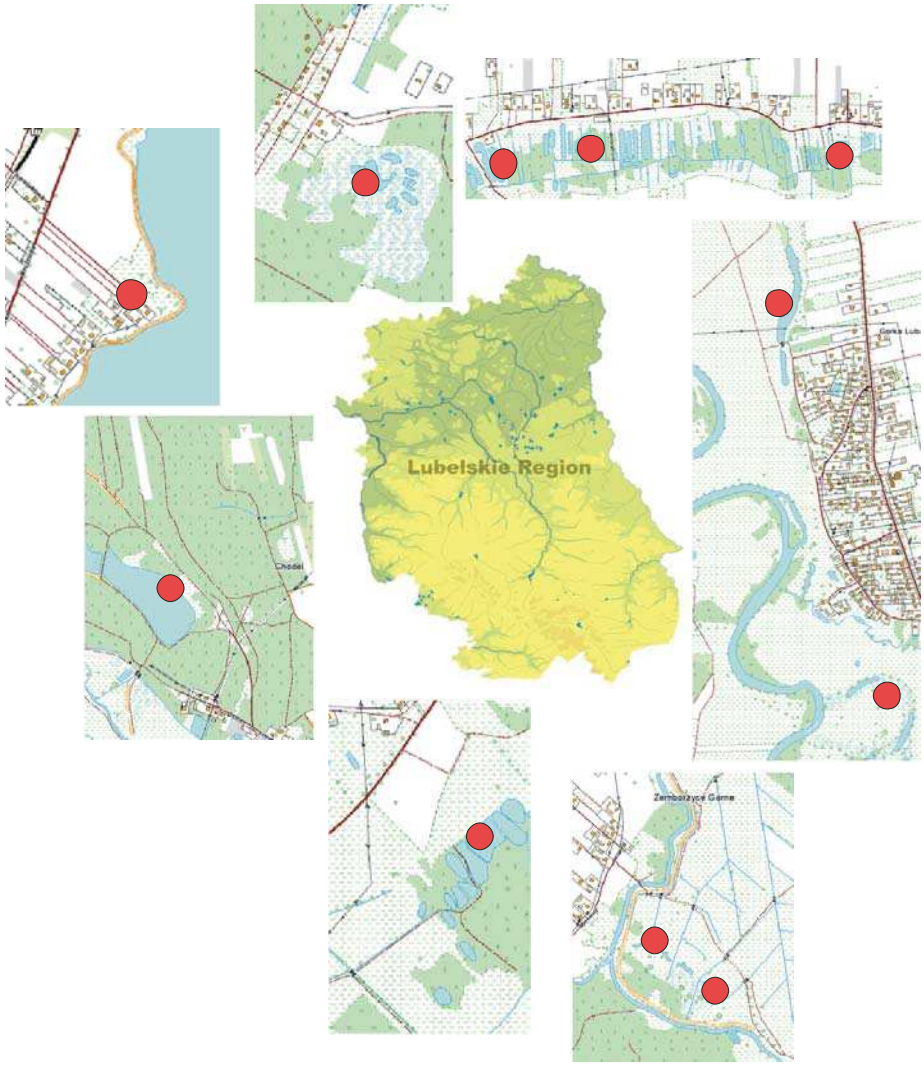

Fig. 1. Localization of investigated ponds: 1 – Ciemięga I, 2 – Ciemięga II, 3 – Ciemięga III, 4 – Wieprz I, 5 – Wieprz II, 6 – Bystrzyca I, 7 – Bystrzyca II, 8 – Zemborzyce, 9 – Jelino, 10 – Sumin, 11 – Chodel

them were old river beds varying sizes, depth, distance from the river current and the degree of vegetation development. Reservoirs in the Ciemięga valley were dug up ponds, varied mainly their type of use (breeding pond, natural, degraded – treatment). Reservoirs Jelino and Sumin were formed after extraction of peat. They are located in different habitats. Jelino is located in the peat-bog and Sumin is a mid-forest reservoir. The study included mid-forest, pond near Chodel, currently used for recreation as well as extensive fishing economy. It was analyzed also the reservoir adjacent the dam reservoir, located in the valley of the river Bystrzyca (Fig. 1).

All investigated reservoirs were permanent water bodies. Studied reservoirs are mostly shallow to 1.5 m deep and small average of 0.3 ha. Field studies were carried out in 2010–2011 period. Morphometric characteristics of reservoirs (depth, surface water table, flow) were analyzed. Threats and the way of surroundings development of reservoirs were identified. Vegetation was determined in the entire littoral zone, distinguishing the zone shallow – coastal and deep. The study was conducted using phytosociological releves according to Braun-Blanquet method [1954]. The surface of the catchment and its development was determined by the orthophotomaps, which were analyzed using the software ArcGIS 10.1.

Valorisation was based on the method of small water bodies valuation proposed by Skwierawski [2005]. This method is based on the analysis of the three zones of the reservoir: surroundings, shoreline and open water. It includes 19 criteria. It allows to qualify the reservoir to one of the four classes.

RESULTS AND DISCUSSION

Valorisation showed that the highest percentage – 54.5% of reservoirs belonged to third class (III). It means that most of those tanks is the average value, significantly transformed and requiring reclamation works. Approximately 36% of the analyzed reservoirs are naturally valuable but transformed and threatened, so that indicated for conservation work. Among the analyzed reservoirs, only 9.1% were in very good condition, indicating to enter them for protection (Fig. 2).

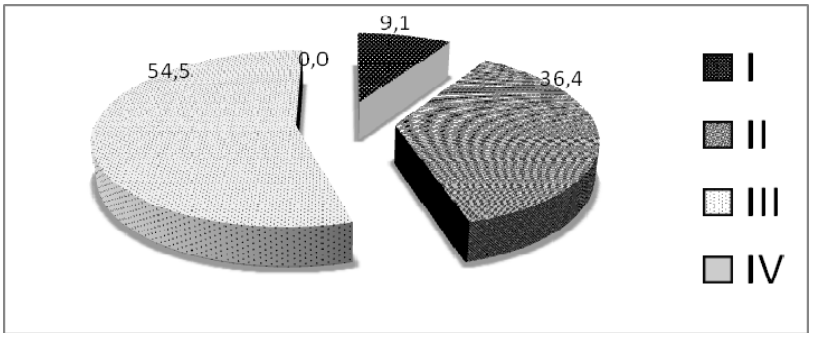

Fig. 2. Percentage share of particular classes (I–IV) of investigated reservoirs

Table 1. General classification of particular zones of the investigated reservoirs

Water reservoir zones	Ciemięga I	Ciemięga II	Ciemięga III	Wieprz I	Wieprz II	Bystrzyca I	Bystrzyca II	Zemborzyce	Jelino	Sumin	Chodel
A + B	II	III	III	II	II	III	III	III	I	II	II
C	III	IV	III	III	III	III	III	III	II	III	IV
A + B + C	II	III	III	II	II	III	III	III	I	II	III

Table 2. Score for each zone in studied reservoirs

Watre reservior feature	Ciemięga I	Ciemięga II	Ciemięga III	Wieprz I	Wieprz II	Bystrzyca I	Bystrzyca II	Zemborzyce	Jelino	Sumin	Chodel
	Valorization of littoral zone A										
Color, visibility, m	3	3	2	4	3	1	2	3	5	4	2
Conductivity, $\mu S \cdot cm^{-1}$	4	1	2	1	3	1	1	2	5	4	2
Water surface, ha	3	3	3	5	4	3	3	0	0	1	5
Stability of water table	4	4	4	5	5	5	4	1	5	4	2
Max. depth in summer, m	3	3	3	3	3	3	3	2	4	3	4
Phytolittoral surface, %	3	2	5	2	2	2	3	3	5	3	3
Free-floating vegetation and filamentous algae	3	2	4	4	4	2	2	2	5	3	2
Number of macrophytes species	3	2	2	0	1	0	0	2	2	3	2
	Valorization of shore zone B										
Stores configuration	0	0	0	1	1	0	0	0	0	0	0
Share of the belt rushes, % in shoreline	3	1	0	4	4	3	4	4	0	5	4

Number of emergent plant species	2	2	3	3	2	2	2	1	0	2	2
Share of vegetation in phytolittoral, %	4	5	3	3	4	4	4	4	5	3	4
Number of species of wetland vegetation around the tank	0	0	0	2	1	1	2	1	5	3	1
Woodlots and shrubs in the shore zone, %	1	1	0	5	3	2	2	4	4	5	4
	Valorisation of surrounding C										
The catchment area, ha	5	5	5	4	4	4	4	4	3	2	1
The catchment usage	3	3	3	4	4	4	4	2	5	4	3
Average slope, ‰	0	0	0	1	1	2	2	3	5	4	1
Type of flow	4	4	4	3	3	3	3	5	3	3	1
Sources of danger	3	2	3	4	4	4	4	3	5	4	2

Analysis of particular zones of reservoirs showed higher diversity. Usually natural reservoirs, old river beds of Wieprz, reservoirs in which human activity has been discontinued (Ciemięga I) or peat excavations (Jelino and Sumin) were the most valuable natural areas. They were moderately risk of degradation. Typically, a general valorisation decreased catchment area, the way it's usage and existing sources of threats (Tab. 1).

Plants are a good indicator of changes in ecological structure of ecosystems [Nagengast 1994, Kolada 2006]. Well-developed all groups of macrophytes reflect a very good habitat conditions and high natural values. Imbalance, that is the dominance especially emergent or pleustonic vegetation, and even the lack of macrophytes, indicates degradation of ecosystem [Sender 2011, 2012]. In investigated reservoirs totally 32 species of the vascular plants occurred. Only six species are typically aquatic plants. Others were related to the coastal zone. Very often in the studied reservoirs free-floating vegetation and filamentous algae appeared, especially in tanks subjected to strong human pressure (Tab. 2).

Among the analyzed small reservoirs, the best ecological status showed peat excavations – Jelino and Sumin (Fig. 3). Jelino reservoir is located among raised bog and buffer zone of the Polesie National Park, inhabited by specific vegetation and not subjected to any form of human pressure. Surroundings of Sumin reservoir in a significant part are formed by grassland, occurred as a wide belt of vegetation and forest. In small numbers only in these reservoirs there were stoneworts. Both analyzed areas are within the Natura 2000 sites.

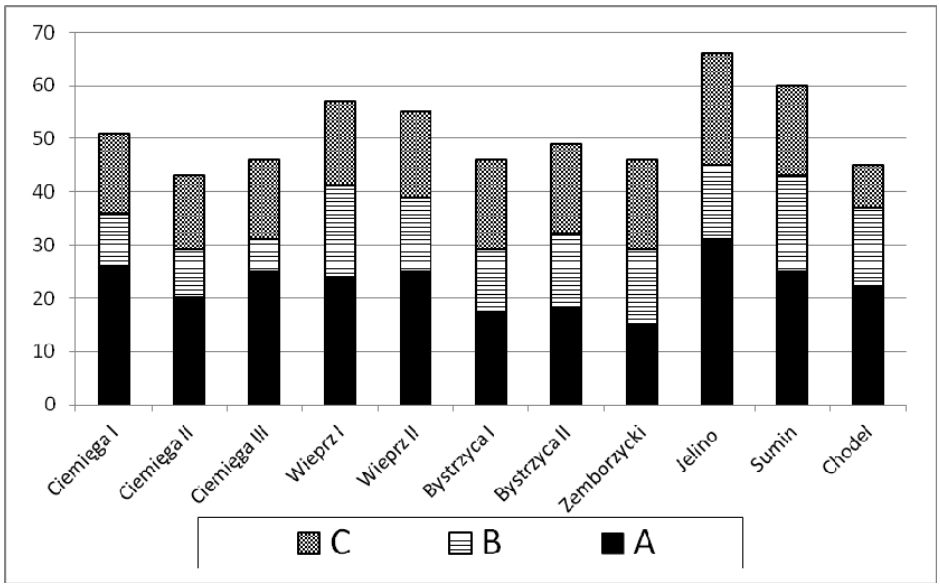

Fig. 3. Results of point valorisation of examined small reservoirs: A, B, C – water reservoir zones

Old river beds of the Wieprz river, frequently occupied by vegetation, were also highly evaluated. The main development of the catchment are wet meadows and cultivated fields. In terms of nature, the least valuable were reservoirs transformed in the highest way and intensively used by humans. Among them were ponds in the Ciemięga valley, Chodelski and Zemborzycki reservoirs. Among the reservoirs in the Ciemięga river only one is characterized by high values. Reservoir Ciemięga I was not in fishing use, flow and connected to the river. Reservoir Zemborzycki valorized before the revitalization works, was significantly dirty and overgrown. It is also known that the revitalization of this tank substantially enriched its natural beauty [Sender and Kulak 2013]. Until recently, reservoir near Chodel was used intensively by fishing. Cessation of fisheries strengthened the structure of vegetation, but the seasonal recreational use is still serious threat.

The relatively low valorised old river beds in Bystrzyca river, in particular Bystrzyca I, were located in the vicinity of rural housing (Fig. 3). These tanks are characterized by a high degree of succession, resulting in shading and in turn significantly reduced the occurrence of submerged macrophytes [Chambers and Kalff 1985].

CONCLUSIONS

Examined small water reservoirs were varied in terms of ecological status. The largest group were the reservoirs of moderate natural values – class III. To this group belonged mainly reservoirs with the lowest surrounding valorisation.

Huge impact on the natural values of small water reservoirs had use of reservoir and its catchment. Reservoirs of natural origin, not subjected to anthropogenic pressure were characterized by the highest values.

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OCENA STANU EKOLOGICZNEGO MAŁYCH ZBIORNIKÓW WODNYCH KRAJOBRAZÓW HYDROGENICZNYCH Z TERENU LUBELSZCZYZNY

Streszczenie. Zróżnicowany sposób zagospodarowania terenów otaczających małe zbiorniki, a także ich użytkowanie wydaje się stanowić jeden z głównych składowych oddziałujących na stan i tempo przemian zachodzących w tych zbiornikach. Celem badań było określenie zróżnicowania stanu ekologicznego małych zbiorników krajobrazów hydrogenicznych na terenie Lubelszczyzny, różniących się wielkością, pochodzeniem, zagospodarowaniem terenów przyległych, a także sposobem użytkowania. Badaniami objęto 11 zbiorników, których powierzchnia nie przekraczała 0,3 ha, a głębokość maks. wynosiła 1,5 m. Wśród analizowanych zbiorników najliczniejszą grupę stanowiły zbiorniki o przeciętnych walorach przyrodniczych – klasa III. Do tej grupy należały przede wszystkim zbiorniki o najniższej waloryzacji otoczenia. Ogromny wpływ na walory przyrodnicze małych zbiorników wodnych ma sposób zagospodarowania zbiornika oraz jego zlewni. Zbiorniki naturalnego pochodzenia odznaczały się najwyższymi walorami.

Słowa kluczowe: małe zbiorniki wodne, waloryzacja, stan ekologiczny