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# APPLICATION OF A NEW MULTI-CRITERIA ABC METHOD FOR ASSESSMENT OF THE ECOLOGICAL POTENTIAL OF MOSTY AND ZAHAJKI DAM RESERVOIRS

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**Abstract.** The aim of the study was evaluation of ecological potential of reservoirs, once complexes of fish ponds, which are currently covered by international form of nature conservation. An effort to identify the source of reservoirs' water supply in biogenic substances has also been undertaken. Studied dam reservoirs, included in Natura 2000 site: a Special Protection Area (SPA) called 'Uroczysko Mosty--Zahajki' (PLH060014). The 'Uroczysko Mosty-Zahajki' consists of two neighboring, not very deep reservoirs: Mosty (390 ha) and Zahajki (240 ha), located in the Hanna river's catchment area, a tributary of the Bug and Zielawa rivers entering the Krzna river. Studied reservoirs represented moderate (reservoir Zahajki) and bad (Mosty reservoir) ecological potential. The buffer zones of Mosty and Zahajki reservoirs were dominated by large forest complexes. The studied reservoirs are supplied with rivers and ditches contaminated with nutrients. Mosty and Zahajki reservoirs, in spite of moderate and poor ecological potential, increase the water resources of the area, have a positive impact on the circulation of water and increase the landscape and recreational values of region.

**Key words:** dam reservoirs, ABC multi-criteria method, buffer zone, physico-chemical parameters

## INTRODUCTION

The main role of the dam reservoirs is water storage, hence their characteristic are large water level differences [Kajak 2001, Bajkiewicz-Grabowska and Mikulski 2007]. Fluctuations of water level lead to uncovering and thus re-flooding widespread areas of the bottom. Drained areas can be overgrown with different frequency with terrestrial vegetation dying decomposes after re-flooding [Kajak 2001].

The dam reservoirs are much younger than e.g. natural lakes, so that their lake basin are not formed by water movements, but for many years after its formation, as a result of intensive shore abrasion processes. In addition, reservoirs directly after creation do not have developed bottom sediments, the bottom of the basin is usually well developed soil and vegetation [Kajak 2001]. The important difference is retention time, which is stable and unchanging value for lakes. The dam reservoirs have a very variable water retention time, depending on flow changes in the inflow, the longer retention time and the worse water self-cleaning conditions [Kajak 2001, Bajkiewicz-Grabowska and Mikulski 2007].

The dam reservoirs, apart from water retention, together with various forms of small retention, are the most efficient way of increasing resources of surface water. They can also serve to the purposes of supplying agriculture, recreation, electricity (for small scale) and fire protection. They can fulfill a function of natural treatment plant, whereas above all can be a refuge of fauna and flora, thereby contributing to biodiversity and being an important element of the landscape [Chełmicki 2001, Kajak 2001].

The creation of a reservoir in a specified area results in, *inter alia*, climate changes, the intensity of which depends on the surface features of the surrounding area, a size of the lake, especially the capacity and the type of vegetation. The higher the shores, the faster the effect disappears and the greater the mass of water retained, the further its impact [Traczewska 2012]. The creation of a dam reservoir also leads to increase of erosion, mainly linear and evanescent erosion. The intensity of this process depends on the mass of the flawing water, the discharge height and a type of material that builds the bottom of the river and its banks [Traczewska 2012]. A phenomenon accompanying a construction of artificial reservoirs is raising of the groundwater-table in their surroundings and it depends on coastal zone sculpture, geological construction, as well as a height of water damming and water management regime [Traczewska 2012].

Connected with human economic activities, increasing processes of transforming and even degrading the aquatic environment cause that problems of its protection and proper use become the basis for further social and economic development [Dąbrowska-Prot and Hillbricht-Ilkowska 1991]. Urbanization, or intensive agricultural production in the catchment area, as well as a significant development of tourism, with the lack of adequately effective methods of water protection, affect overload with phosphorus and nitrogen [Kajak 2001, Berleć *et al.* 2013].

Dam reservoirs' susceptibility to eutrophication depends on many factors, *inter alia* a morphometry of lake basin (e.g. average depth, capacity), time of water exchange, or a character of the catchment (including geology, management) [Wagner and Zalewski 2000].

The basic problem of water quality in dam reservoir is to achieve a state of homeostasis, which is practically impossible due to its exploitation [Traczewska 2012]. If encompassing of legal protection of reservoirs and reduction of exploitation will result in a state of equilibrium and preservation of good ecological potential?

The aim of the study was evaluation of ecological potential of reservoirs, once complexes of fish ponds, which are currently covered by international form of nature conservation. An effort to identify the source of reservoirs' water supply in biogenic substances has also been undertaken.

## STUDY AREA

Studied dam reservoirs, included in Natura 2000 site: a Special Protection Area (SPA) called 'Uroczysko Mosty-Zahajki' (PLH060014) are located in the Lublin voivodeship on the border of two administrative units – Wyryki and Podedwórze communities (Fig. 1). The Natura 2000 area covers 5 185 ha and was approved by the Ordinance [Ordinance… 2007]. Studied area is dominated by the plain of ground moraine, which is built by boulder clay originating from the peak of Middle Poland glaciation. A flat surface of the plain is diversified by hollows on the ice in type of melt-out. A particular form of this plain is a basin filled with Holocene deposits of organic origin [Local Spatial Development Plan 2012].

The area includes the ecological water-forest-meadow nodes located on the Mosty and Zahajki water reservoirs considered as biocentres and buffer zones – elements of National Ecological Network ECONET-PL. This area plays an important role due to its location of intersection of important ecological corridors valleys: Hanna – Zielawa – Piwonia and Zielawa – Mulawa – Partisans Channel. It was included in the CORINE database as part of the refuge "Łęczna-Włodawa Lake District".

The 'Uroczysko Mosty-Zahajki' consists of two neighboring, not very deep reservoirs: Mosty (390 ha) and Zahajki (240 ha), located in the Hanna river's catchment area, a tributary of the Bug and Zielawa rivers entering the Krzna river. Their average depth does not exceed 2m. Both reservoirs have anthropogenic origin, formed by embankment causing water storing. Currently, the reservoirs serve as fishing ponds used by Polish Fishing Agency.

During the breeding season, this area occupied by more than 1% of the national bird population [Plan of Protection Tasks 2013].The key bird species found in the Uroczysko are e.g. red-necked grebe (*Podiceps grisegena* B.), black stork (*Ciconia nigra* L.), white-tailed eagle (*Haliaeetus albicilla* L.), lesser spotted eagle (*Clanga pomarina* C.L.B.), common kingfisher (*Alcedo atthis* L.), grey-headed woodpecker (*Picus canus* J.F.G.) or ortolan bunting (*Emberiza hortulana* L.) [Wilk *et al.* 2010]. The area included species from Annex II of Habitats Directive like European beaver (*Castor fiber* L.), Eurasian otter (*Lutra lutra* L.), European fire-bellied toad (*Bombina bombina* L.), northern crested newt (*Triturus cristatus* Laurenti), as well as moose (*Alces alces* L.) – species outside from the Annex II – however in Poland covered by moratorium since 2001.

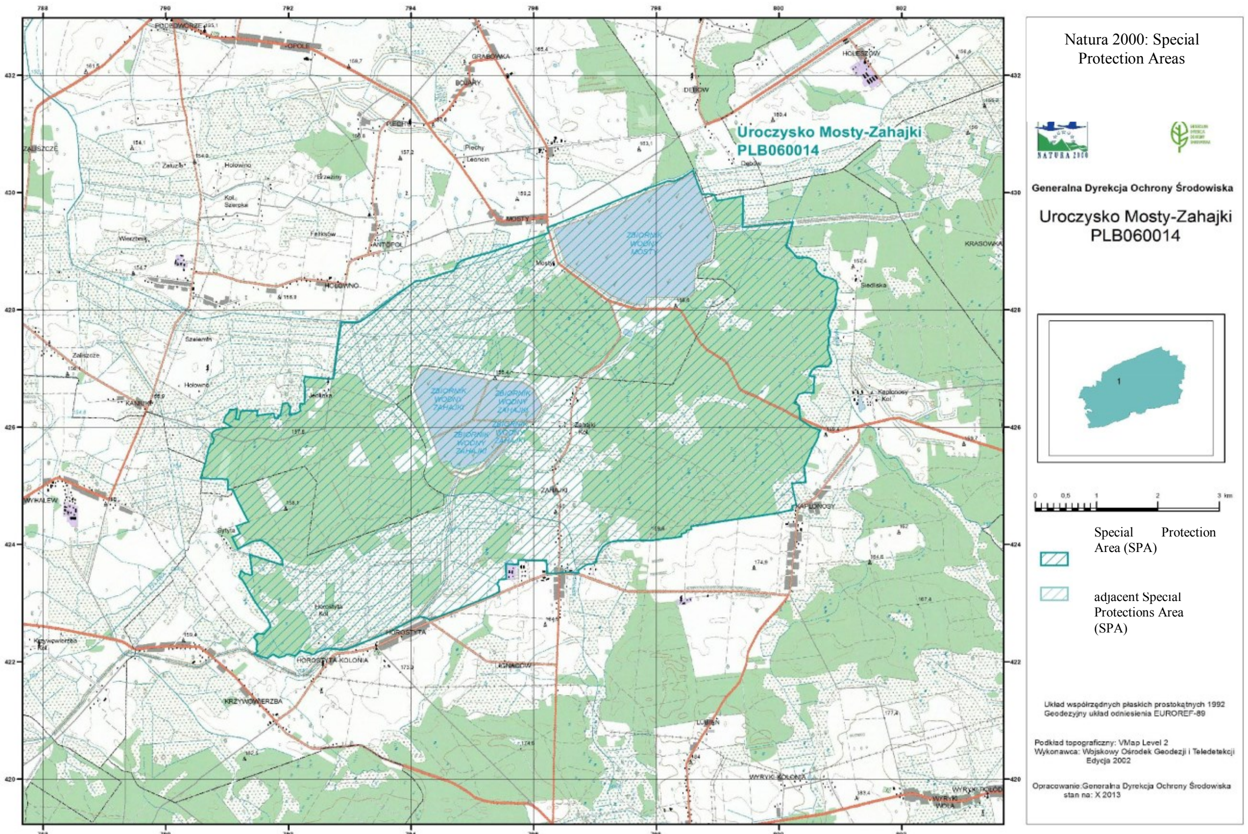


Fig. 1. Localization of Mosty and Zahajki dam reservoirs in Natura 2000 area called 'Uroczysko Mosty-Zahajki' [http://lublin.rdos.gov.pl]

## RESEARCH METHODS

The assessment of ecological potential of the reservoirs was made on the basis of research conducted in 2016 and 2017. Simultaneously selected physical and chemical parameters of the reservoirs' water and main rivers, supplying and drainage channels were analyzed. Hydro-chemical studies included an analysis of phosphate [mg $PO_4$ $\cdot dm^{-3}$], nitrate nitrogen [mg $N\text{-}NO_3 \cdot dm^{-3}$], total water hardness [mg $CaCO_3 \cdot dm^{-3}$] and electrolytic conductivity [μS/cm]. Samples were taken and stored in accordance with all recommendations of the Polish Committee for Standardization [PN-EN ISO 5667-3], whereas water analyzes were performed in accordance with standards specified in the Water and Wastewater Analytics Standards [Zerbe *et al.* 1999, List of standards for water and wastewater analytics 1993]. In addition, a measurement of water transparency with using Secchi disc was measured.

Water samples were collected from twelve research points (Fig. 2) along the shoreline of Mosty and Zahajki reservoirs and canals or rivers (Table 1).

Table 1. Characteristic of research points

| Resear points | Description | Geographic coordinates | Land usage |
|---|---|---|---|
| Z1 | West shore of Zahajki reservoir | N: 51°37'16.88", E: 23°15'11.97" | Forests and shrubs |
| Z2 | North-east shore of Zahajki reservoir | N: 51°37'23.66", E: 23°16'42.47" | Trees |
| Z3 | North shore of Zahajki reservoir | N: 51°37'48.23', E: 23°16'5.81" | Trees |
| M1 | West shore of Mosty reservoir | N: 51°38'40.09", E: 23°17'23.44" | Trees |
| M2 | North shore of Mosty reservoir | N: 51°39'18.12", E: 23°17'45.37" | Agriculture |
| M3 | North-east shore of Mosty reservoir | N: 51°39'36.79", E: 23°19'7.63" | Peat bogs and shrubs |
| D1 | Supply channel with a width of 3 m | N: 51°36'53.82", E: 23°15'33.22" | Forests and shrubs |
| D2 | Wieprz-Krzna Channel | N: 51°37'34.44", E: 23°16'58.3" | Meadows and agriculture |
| D3 | Wieprz-Krzna Channel | N: 51°38'20.15", E: 23°18'21.07" | Shrubs |
| D4 | Meliorated Zielawa river | N: 51°39'6.67", E: 23°17'2.25" | Agriculture and shrubs |
| D5 | Drainage ditch called supply channel | N: 51°39'3.81", E: 23°19'25.44" | Shrubs |

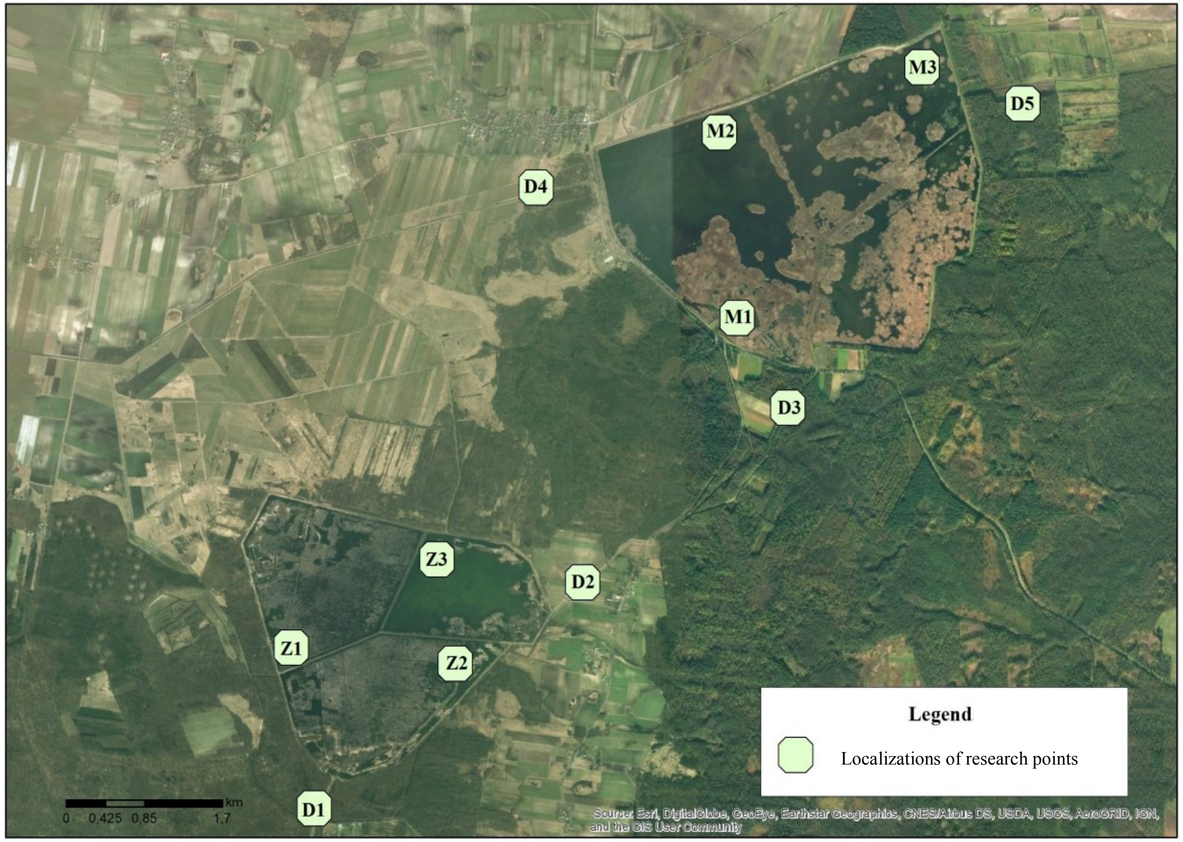


Fig. 2. Localizations of research points

The ABC multi-criteria method for ecological potential assessment is based on integrated macrophytes analysis with geomorphological, landscape and catchment threats. This method includes 22 criteria (e.g. land use, number of species or share of submerged macrophytes in the reservoir area) for assessing three different zones (A – shoreline zone, B – littoral zone and C – catchment basin; 500m from shoreline [Sender *et al*. 2017].

The way of land usage of the buffer and shoreline zones were developed on the base of field research using GIS tools. The orthophotomaps and raster maps of the analyzed area on a scale of 1 : 10000 were obtained from the governmental *Geoportal* [www.geoportal.gov.pl]. Satellite scenes were characterised by lower accuracy (1 pixel represented by 5 m in the field), but spectral channels allowed more precise distinction of different forms of land use types, such as wet meadows, agriculture agricultural fields paved roads, drainage ditches and water courses.

Detailed analysis of land use types were carried out in lakes buffer zones, assuming the same radius length for lakes – 500 m, measured from the centroid of lakes and set automatically by the ArcGIS software.

## RESULTS

### Characteristic of the buffer zones

The area of the buffer zone of Mosty dam reservoir was 452.7 ha. The largest share in the use of this zone – 45.6% had large forest complexes: Mostowski Forest (birch and pine stands located in the southern part of the buffer zone) and Koniusze Duże Forest (mixed forest, located in the eastern part). From the north, agriculture fields were located, which occupied 22% of the total area of the buffer zone. Peat bogs and meadows occupied a total area of 15% and were located in the north-east and west part of the reservoir (Fig. 3A).

In the buffer zone of Zahajki reservoir large forest complexes intersected by a dense network of drainage ditches predominated. These forests mainly constituted mixed woods with predominance of hornbeam and pine, whereas in the northern part of the wetlands – deciduous forests with an advantage of alder. Meadows with a total area of 23.6% occupied areas in the north-western part of the reservoir. Relatively large area was also covered by agriculture – 16.7% (Fig. 3B, Table 2).

In the analyzed area a dense network of drainage ditches with an average width of 1 to 3 m occurred. In the buffer zone of Zahajki reservoir, a length of drainage ditches was higher than in the vicinity of Mosty reservoir (Fig. 4).

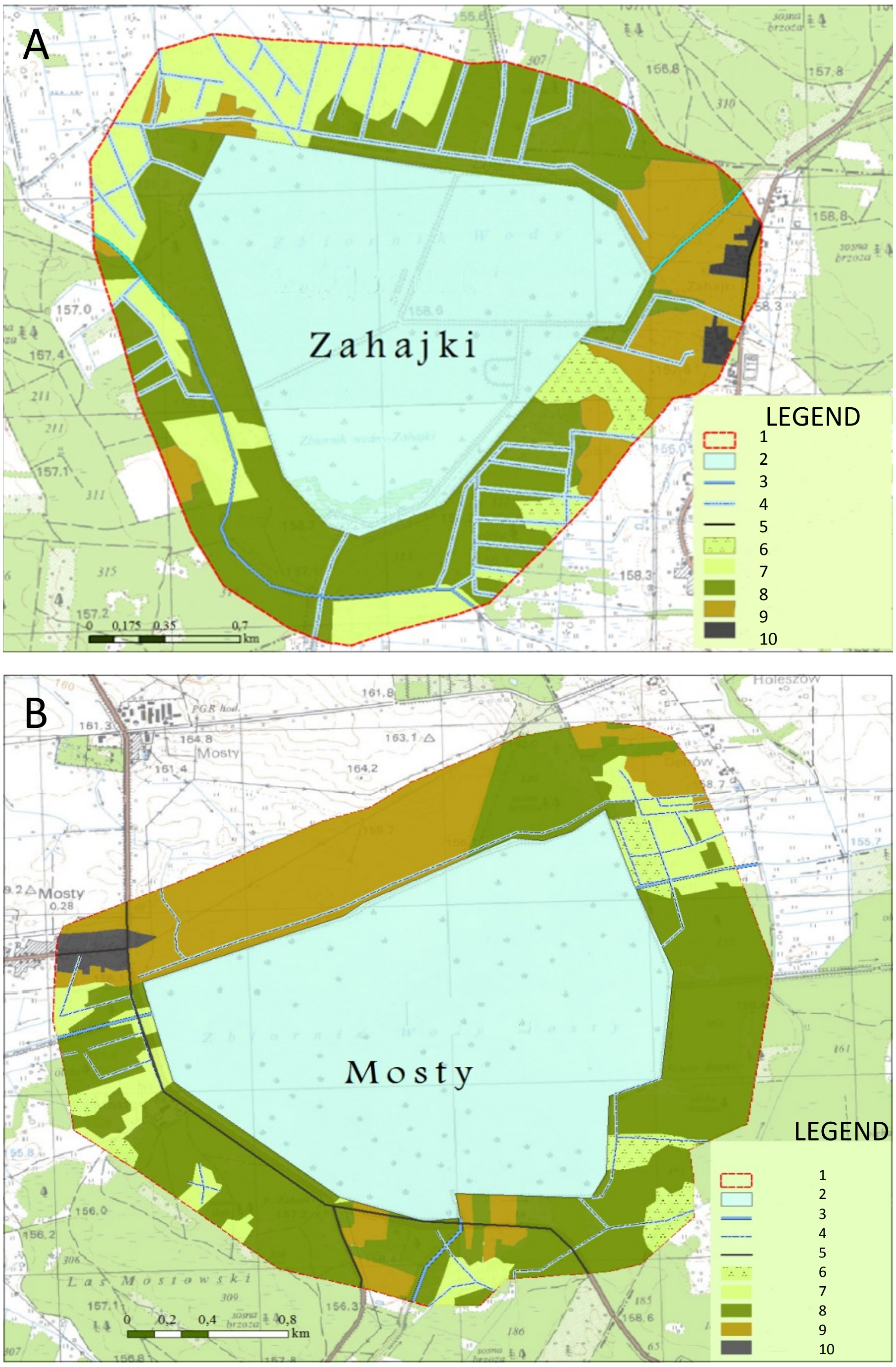


Fig. 3. Land use types of buffer zones of reservoirs: A – Mosty, B – Zahajki. Legend: 1 – border of the buffer zone, 2 – reservoir surface, 3 – watercourses, 4 – drainage ditches, 5 – roads infrastructure, 6 – peat bogs, 7 – meadows, 8 – forests, 9 – agriculture, 10 – buildings

Table 2. Share of particular land use types in buffer zones of Mosty and Zahajki reservoir

| Land use forms in buffer zones | Buffer zones of studied reservoirs | |
|---|---|---|
| | Zahajki (ha) | Mosty (ha) |
| Total surface of a buffer zone | 379.3 | 452.7 |
| Reservoir surface | 240 | 390 |
| Peat bogs | 16.0 | 22.0 |
| Meadows | 89.5 | 45.6 |
| Forests | 205 | 248.9 |
| Agriculture | 63.3 | 99.6 |
| Buildings | 5 | 6 |
| Watercourses, m | 3498.1 | 1659 |
| Drainage ditches, m | 17367.8 | 12553.2 |
| Roads infrastructure | 474.8 | 4379.4 |

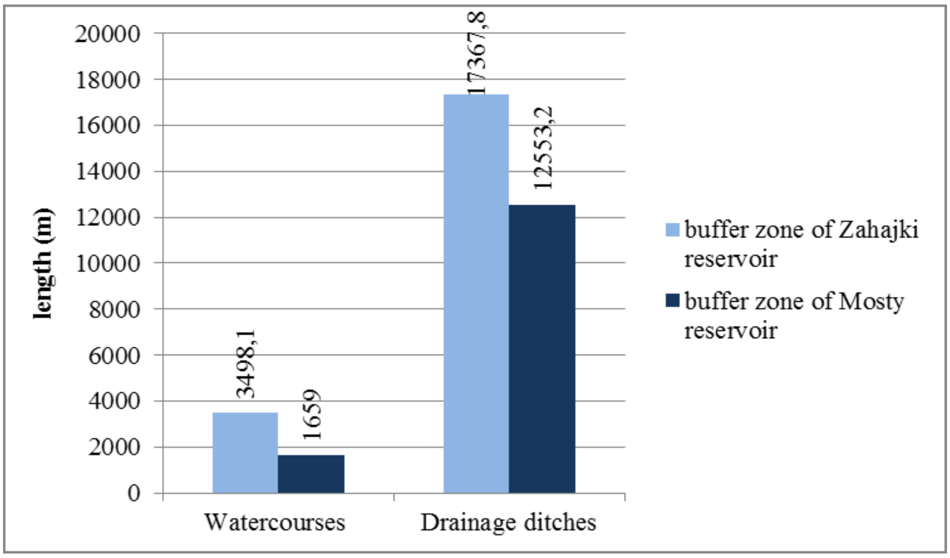


Fig. 4. Length of flowing waters in buffer zones of Mosty and Zahajki reservoirs

The flowing waters included the Krynica river in the south-west of Zahajki reservoir and the Zielawa river, flowing from the north-western part of Mosty reservoir. The total length of analyzed waters was 1659 m in the buffer zone of Mosty reservoir and even twice time more – as 3498.1 m in Zahajki reservoir' zone.

## Physical-chemical analysis of waters of Mosty and Zahajki reservoirs

The concentration of N-$NO_3$ in waters of Mosty and Zahajki reservoirs was little varied. In Zahajki reservoir ranged from 0.019 to 0.028 mg $NO_3 \cdot dm^{-3}$, whereas in Mosty reservoir ranged from 0.025 to 0.031 mg $NO_3 \cdot dm^{-3}$. The highest

Table 3. Values of chosen physical-chemical variables of reservoirs' water

| Research points | Total hardness of water (mg $CaCO_3 \cdot dm^{-3}$) | Electrolytic conductivity (µS/cm) | P-$PO_4$ (mg $PO_4 \cdot dm^{-3}$) | N-$NO_3$ (mg N-$NO_3 \cdot dm^{-3}$) | Visibility of Secchi disc (m) | Presence of water blooms |
|---|---|---|---|---|---|---|
| Z1 | 6.87 | 374.5 | 0.37 | 0.019 | 1 | ++ |
| Z2 | 10.02 | 586 | 0.55 | 0.028 | 0.5 | + |
| Z3 | 11.42 | 496.7 | 0.25 | 0.021 | 1.9 | + |
| M1 | 4.62 | 349.7 | 0.015 | 0.028 | 0.3 | + |
| M2 | 3.98 | 392.8 | 0.031 | 0.025 | 0.5 | + |
| M3 | 4.03 | 355.9 | 0.010 | 0.031 | 1.1 | + |

+ intensive; ++ very intensive

Table 4. Values of chosen physical-chemical variables of watercourses

| Research points | Total hardness of water (mg $CaCO_3 \cdot dm^{-3}$) | Electrolytic conductivity (µS/cm) | P-$PO_4$ (mg $PO_4 \cdot dm^{-3}$) | N-$NO_3$ (mg N-$NO_3 \cdot dm^{-3}$) | Visibility of Secchi disc (m) | Presence of water blooms |
|---|---|---|---|---|---|---|
| D1 | 9.91 | 507 | 0.416 | 0.084 | 0.4 | + |
| D2 | 13.27 | 558 | 0.344 | 0.040 | 0.35 | + |
| D3 | 13.58 | 563 | 0.310 | 0.033 | 0.3 | - |
| D4 | 10.82 | 591 | 0.544 | 0.064 | 0.25 | - |
| D5 | 7.91 | 549 | 0.222 | 0.043 | 0.5 | - |

- lack; + intensive

concentrations of P-$PO_4$ were recorded in waters of Zahajki reservoir. On the Z2 point, it reached even 0.55 mg $PO_4 \cdot dm^{-3}$, whereas the lowest values in Mosty reservoir reaching 0.010 mg $PO_4 \cdot dm^{-3}$ in M3 point (Table 3).

Total hardness of water [mg $CaCO_3 \cdot dm^{-3}$] resulting of the presence of mineral components in waters, the greatest value achieved in Zahajki reservoir – 11.42 mg $CaCO_3 \cdot dm^{-3}$ (Z3 point). Whereas in reservoir a maximum value was only 4.62 mg $CaCO_3 \cdot dm^{-3}$ (M1 point).

Similarly, significantly higher values of electrolytic conductivity were present in Zahajki reservoir, reaching a maximum of 586 μS/cm in Z2 point. In Mosty reservoir, maximum conductivity was 392.8 μS/cm in M2 point (Table 3).

At the control point D1, the highest concentrations of N-$NO_3$ in water (0.084 mg N-$NO_3 \cdot dm^{-3}$) and high of P-$PO_4$ (0.416 mg $PO_4 \cdot dm^{-3}$).

At points D2 and D3, located in the Wieprz-Krzna Channel connecting reservoirs, waters were characterized by the lowest values of nutrients concentration.

The research point D4, located in the channel of the meliorated the Zielawa river, led the waters with the highest concentration of P-$PO_4$ (0.544 mg $PO_4 \cdot dm^{-3}$).

Waters of the drainage ditch, also called the supply channel of Mosty reservoir, was characterized by the lowest content of P-$PO_4$ (0.222 mg $PO_4 \cdot dm^{-3}$) and values of total hardness of water (7.91 mg $CaCO_3 \cdot dm^{-3}$) (Table 4).

**Ecological potential**

Studied reservoirs showed different ecological potential (Table 6). Based on multi-criteria ABC method (included all zones) Zahajki reservoir belongs to III-rd category, whereas Mosty to IV-th, what means in poor condition, with significant level of transformation with no submerged macrophytes and therefore with predominance of emerged macrophytes (Table 5). From the point of view of the possibility of maintaining a biological balance, this reservoir with low natural values and low ecological status, is subject to rapid succession processes.

The III-rd category for Zahajki reservoir means that it is slightly transformed with small disturbances, in moderate status and with little natural value (Table 6). Each additional but unexpected factor can cause its rapid degradation.

Table 5. ABC valorization: shoreline zone of reservoir (A); littoral zone of reservoir (B); buffer zone (C); F – forest, P – peat bog, M– meadows

| Zone | Function | Mosty reservoir | | Zahajki reservoir | |
|---|---|---|---|---|---|
| | | Description | Points | Description | Points |
| A | Shoreline development | Anthropogenic shore | 0 | Diversity of shores, with dominance of slope | 3 |
| | Share of emergent communities in shoreline (%) | 72 | 4 | 78 | 5 |
| | Number of emergent communities | 9 | 4 | >10 | 5 |
| | Number of plant species | <5 | 0 | <5 | 0 |
| | Average width of helophytes (m) | >26 | 5 | >26 | 5 |
| | Trees and shrubs in the shore zone (%) | 38 | 2 | 74 | 3 |
| | Share of helophytes in phytolittoral (%) | > 85 | 0 | > 85 | 0 |
| | SUM | - | 15 | - | 21 |
| B | Turbidity, as Secchi disk visibility (m) | 1.2 | 2 | 0.7 | 1 |
| | Water conductivity ($\mu S \cdot cm^{-1}$) | 365 | 2 | 485 | 1 |
| | Lake surface (ha) | 390 | 6 | 240 | 5 |
| | Max depth of lake (m)<br>Depth of macrophytes occurrence (m) | Lack of data<br>>5 | -<br>5 | Lack of data<br>>5 | -<br>5 |
| | Share of submerged macrophytes in the lake surface (%) | 33 | 2 | 29 | 1 |
| | Phytolittoral surface (%) | 80 | 1 | >90 | 0 |
| | Number of submerged macrophyte | 2 | 1 | 3 | 1 |
| | Communities (with pleustonic and floating leaves plants) | | | | |
| | Number of species | ≤ 2 | 0 | ≤ 2 | 0 |
| | SUM | - | 19 | - | 14 |
| C | Surface of catchment (ha) | 20502.5 | 0 | 20502.5 | 0 |
| | Type of catchment use (%)<br>Catchment average slope (‰) | F, P, M >50<br>Lack of data | 4<br>- | F, P, M >50<br>Lack of data | 4<br>- |
| | Water flow type | Periodic inflows and outflows | 2 | Periodic inflows and outflows | 2 |
| | Sources of threats | Very low risk | 4 | Very low risk | 4 |
| | Shore length (m) / capacity ($m^3$) ratio | 7.7 | 0 | 7.2 | 0 |
| | SUM | - | 10 | - | 10 |

Table 6. Evaluation of Mosty and Zahajki reservoirs

| Reservoir | Zones | Points | Class | Interpretation |
|---|---|---|---|---|
| Mosty | A + B | 34 | IV | Poor state, a significant level of transformation, with clearly dominant group of emerged macrophytes; often with the lack of submerged macrophytes |
| | C | 10 | V | Very strong threatened |
| | A + B + C | 44 | IV | A little natural value, highly transformed |
| Zahajki | A + B | 35 | III | Minor disturbances, moderate state, with a slightly dominant group of macrophytes |
| | C | 10 | V | Very strong threatened |
| | A + B + C | 45 | III | A moderate natural value, slightly transformed |

## DISCUSSION

The assessment of the surface water status is carried out in relation to the homogeneous parts of water according to the classification of biological, physico-chemical and hydromorphological elements, based on the results of the national monitoring of the environment and presented by an ecological status assessment [http://www.gios.gov.pl]. An ecological status can be classified into one of 5 classes: very good, good, moderate, poor or bad [Directive 2000/60/EC].

Currently, water quality assessments are made with using of five independent methods based on selected groups of organisms for each type of water and five classes of ecological status are obtained in a given ecosystem or part of it [Ciecierska 2013].

A new multi-criteria method of ecological potential assessment developed as a variant that can be applied to all types of lakes, as well as to anthropogenic reservoirs. The method combined many parameters (biological, morphological and ecological) that can affect the environment of macrophytes' occurrence [Sender *et al*. 2017].

Dam reservoirs under the study were classified to moderate status class (in case of Zahajki reservoir) and bad (Mosty reservoir). The new multi-criteria ABC method characterize Zahajki reservoir as being slightly transformed with minor values and disturbances. While, Mosty reservoir, despite macrophytes domination stand out a significant level of transformation and simultaneously low natural values.

Studied dam reservoirs are mainly supplied with ditches and drainage channels, natural watercourses, as well as rainwater.

Based on values of selected physico-chemical parameters, their concentrations were lower in waters of Mosty reservoir. Zahajki reservoir is formed by three independent reservoirs, isolated from each other hence a smaller area, isolation and large proportion of meliorated lands in the buffer zone caused higher concentrations of nutrients.

A hydrographic network of the analyzed area is well developed. Mosty and Zahajki reservoirs are connected with the drainage channel Wieprz-Krzna. The length of the channel connecting the reservoirs is about 2.6 km [Local Spatial Development Plan 2012].

The main objective of the conservation activities in the Natura 2000 area of 'Uroczysko Mosty-Zahajki' is to improve a habitat of species such as: ferruginous duck (*Aythya nyroca* G.), Eurasian eagle-owl (*Bubo bubo* L.), black tern (*Chlidonias niger* L.), little crake (*Porzana parva* S.) by eliminating anthropogenic threats and active protection activities [Plan of Protection Tasks 2013]. In spite of moderate and poor ecological potential, Mosty and Zahajki reservoirs increase water resources of the area, affect positively on the circulation of water and improve landscape and recreational values. However, care should be taken to limit a supply of waters rich in nutrients, which may result in rapid eutrophication of the reservoirs and significantly reduction of natural resources.

At the same time, agro-forestry, water, fishing and hunting economy within the studied area must take into account conservation requirements of the Natura 2000 sites [http://natura2000.org.pl] and in consequence they allow maintain tested reservoirs in the current state of relative equilibrium and do not lead to their degradation.

It can be reach, among other things, by conducting economical activities friendly to habitat protection and species recognized as important throughout Europe and by avoiding excessive intensification of activities in these fields [Chylarecki 2005].

## CONCLUSIONS

1. Studied reservoirs represented moderate (reservoir Zahajki) and poor (Mosty reservoir) ecological potential.
2. The buffer zones of Mosty and Zahajki reservoirs were dominated by large forest complexes.
3. The studied reservoirs are supplied with rivers and ditches contaminated with nutrients.
4. Mosty and Zahajki reservoirs, in spite of moderate and poor ecological potential, increase the water resources of the area, have a positive impact on the circulation of water and increase the landscape and recreational values of region.

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## ZASTOSOWANIE NOWEJ WIELOKRYTERIOWEJ METODY OCENY POTENCJAŁU EKOLOGICZNEGO ZBIORNIKÓW RETENCYJNYCH MOSTY I ZAHAJKI

**Streszczenie.** Celem pracy była ocena potencjału ekologicznego zbiorników retencyjnych w obrębie 3 stref – linii brzegowej, litoralu oraz strefy buforowej – ponadto określenie źródła zasilania wód zbiorników w substancje biogenne. Badany teren obejmuje obszar Natura 2000 PLH060014 Uroczysko Mosty-Zahajki. W ostoi znajdują się dwa sąsiadujące ze sobą niezbyt głębokie zbiorniki retencyjne: Mosty (390 ha) i Zahajki (240 ha). Są położone w zlewni rzeki Hanny, dopływu Bugu i Zielawy. Na podstawie przeprowadzonych analiz metodą ABC określono potencjał ekologiczny zbiorników Zahajki jako umiarkowany oraz zły w przypadku zbiornika Mosty. Na podstawie przeprowadzonej waloryzacji zbiornik Zahajki zaliczono do lekko antropogenicznie przekształconych akwenów, z niewielkimi walorami przyrodniczymi oraz zaburzeniami w funkcjonowaniu. Natomiast w zbiorniku Mosty, pomimo obfitego występowania makrofitów, zaznaczył się wyraźny poziom transformacji, dlatego jego walory naturalne oceniono jako niskie. Zbiorniki retencyjne Mosty i Zahajki zasilane są przede wszystkim rowami i kanałami melioracyjnymi, naturalnymi ciekami zanieczyszczonymi, bogatymi w biogeny, takie jak fosforany i azotany. Na podstawie analizy parametrów fizyczno-chemicznych wody stwierdzono ich mniejsze stężenia w zbiorniku Mosty. Strefa buforowa badanych zbiorników retencyjnych zdominowana była przez duże kompleksy leśne.

**Słowa kluczowe:** zbiornik retencyjny, wielokryteriowa metoda ABC, strefa buforowa, parametry fizyczno-chemiczne