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SIGNIFICANCE AND DEVELOPMENT OF SMALL WATER RESERVOIR IN THE NEAREST NEIGHBOURHOOD OF ZEMBORZYCKI RESERVOIR IN LUBLIN

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Summary. Small water reservoirs are a basic element of creating water resources through „small water retention". Moreover, they improve the water balance of the terrain and also have a huge meaning for the life and survival of many plant and animal species, enriching natural values of landscape. Investigations were carried out in a small water reservoir which was created in 2007 as a result of construction of a bicycle path in the western part of the Zemborzycki Reservoir. As a result of construction works, after the creation of an embankment, one of the bays was cut off from the Zemborzycki Reservoir, creating a separate reservoir in the nearest neighbourhood, connected to the main reservoir by a concrete sluice. It is a small, with only approx. 0.13 ha area, depression of the terrain, permanently filled with water.
The depression, in its present state, is occupied by few valuable species of macrophytes, while the direct surroundings are covered mainly with ruderal species which are treated as less attractive, burdensome weeds. The present state of the water reservoir development causes that its only function is that of a receiver of pollutants. Proper development of this shallow reservoir will allow to increase its attractiveness, both natural and aesthetic.

Key words: macrophytes, small water reservoir, development

INTRODUCTION

As a result of anthropogenic activity, the landscape is subject to incessant changes – its elements and features are transformed. These phenomena are produced by almost every kind of human activity, but in the most intense way they are seen in urbanised and industrial areas. The expansion of municipal construction leads, among other things, to geomechanical transformation of the terrain relief, degradation of habitats and soil cover, changes of water circulation, causing

intensification of surface runoff and also limitation of deep infiltration, moreover it contributes to introducing sewage and wastes into the environment and influences changes of mesoclimate.

Water reservoirs are one of environmental elements of importance in the revaluation of landscape, including those created by man due to the need of water retention for municipal and economic purposes. Additionally, at present they are perceived as objects that can serve the rest and recreation function in the broad sense, and also act as high-value enclaves of the natural environment [Plichta 1996, Mioduszewski 1999, Celiński *et al*. 2001].

That is why taking care of areas adjacent to reservoirs should be well organised and they should be developed harmoniously. Pro-ecological works of area development of whole catchment areas of reservoirs have to accompany such works, in the same way as protective interventions concerning the reservoirs themselves, allowing successive improvement of their ecological state [Rzętała 2003]. Only this kind of activities will limit the eutrophication of such reservoirs that causes a reduction of their landscape values [Kajak 1995].

The Zemborzycki Reservoir belongs to small, shallow, flow, municipal and lowland water reservoirs which are characterised by a short period of water exchange. Because of these unfavourable features [Kasza 1999], Zemborzycki Reservoir is exposed to the delivery of considerable quantities of matter, relative to the capacity of the reservoir, which causes quick eutrophication and deterioration of water quality. Apart from the accumulation of mineral sediments, accelerated accumulation of organogenic sediments takes place as well. The depth and the usable capacity of the reservoir gets smaller, and its recreational values deteriorate [Michalczyk (ed.) 1997, Radwan (ed.) 2006].

To determine the possibility of slowing this process down, works consisting in the establishment of littoral habitats and the settlement of areas adjoining the reservoir are indispensable. Proper development of potentially valuable natural areas can be one of such undertakings.

STUDY AREA AND METHODS

The Zemborzycki Reservoir was created in 1974 r. as a result of partitioning the narrowing of 0.5-one-kilometre length of the Bystrzyca valley with an earth dam and damming the water up by about approx. 5 m. The surface area of the Zemborzycki Reservoir is 278 hectares, average depth approx. 2 m, total capacity $6.3 \cdot 10^6$ m^3 [Rodzik *et al*. 2009]. From its catchment, with an area of 725 km^2, an average of 2.8 $m^3 \cdot s^{-1}$ of water flows into the reservoir, that is $88.3 \cdot 10^6$ m^3 annually [Włodarczyk 1991, Michalczyk (ed.) 1997]. The main purpose of creating the Zemborzycki Reservoir was water retention, and the memorable flood which took place in Lublin in spring 1964 had a considerable influence on this decision [Bryński 1968]. Together with the Zemborzyce village, the reservoir is situated wholly within the administrative area of the city of Lublin.

The proximity to the city, convenient transport connections and accessibility of the banks of the reservoir cause that it provides a convenient recreational base for the inhabitants of Lublin, especially in summer time.

The village Zemborzyce, together with the cultivated fields, adjoins the Zemborzycki Reservoir from the western side and, in the place of a former farm, there is the recreational complex „Marina".

In 2007, after building a bicycle path along considerable section of the western edge of the reservoir, as a result of construction works during the building of the embankment, one of the bays was cut off from the Reservoir, thus creating a separate reservoir in close proximity to the Zemborzycki Reservoir, connected with the main reservoir by means of a concrete sluice (Fig. 1, 3).

a)

b)

Fig. 1. The area of the study a) in 2003, b) in 2007, after building the bicycle path

Wastelands and intensively cultivated fields constitute a significant part of the catchment to the northeast of the created small reservoir, with one-family houses in the north and the Zemborzycki Reservoir in the west. This is a small depression (with area of approx. 0.13 ha), filled with water all the time (Fig. 2).

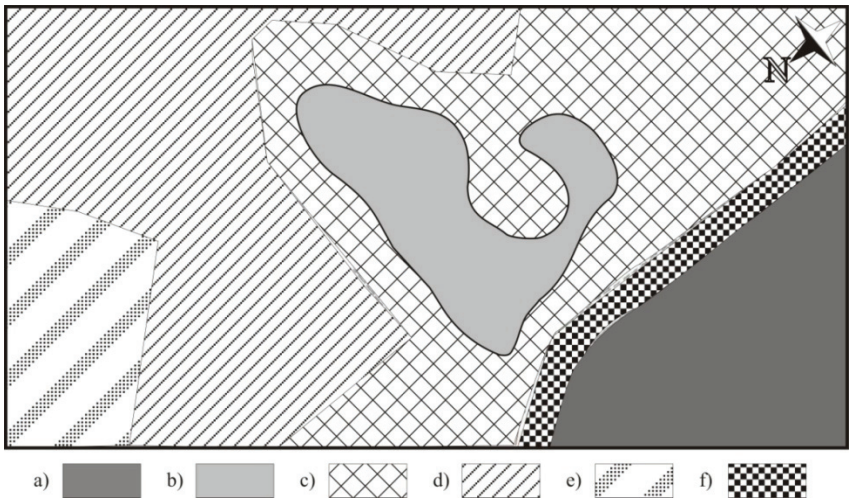


Fig. 2. Diagram of land use structure of the reservoir surroundings: a) water of the Zemborzycki Reservoir, b) water of the small reservoir, c) wastelands, d) cultivated fields, e) buildings, f) bicycle path

At present this small reservoir is untidy and serves as a receiver of pollutions flowing down from surrounding areas. Its revitalization would contribute to increasing of the landscape-aesthetic values and to enriching the biological biodiversity of the Zemborzycki Reservoir's catchment.

In the process of creating the concept of area development of the water reservoir joined with the Zemborzycki Reservoir, plenty of analyses were carried out. Owning to those analyses, it was possible to become acquainted with the specificity of the terrain and to create an optimum solution reconciling the needs of nature and landscape protection with the needs of the users.

The undeniable role of water reservoirs in enriching the species and habitat diversity was the reason for undertaking the investigations, which will contribute to an increase of the natural and landscape values of this fragment of the reservoir's catchment.

The project of floral development was based on following analytical methods: – general analysis of natural-landscape conditions (fieldwork and cartographic investigations), – analysis of natural values of adjacent areas, conducted on the basis of natural fieldwork – landscape – architectonical fieldwork (coloristic vegetation analysis).

All the graphics of the developed concept were elaborated using the Bentley MicroStation V8i program and CorelDRAW.

RESULTS AND DISCUSSION

The water depression in the immediate vicinity of the Zemborzycki Reservoir functions as an illegal dumping site, overgrown with *Typha latifolia*. At present it does not have any natural and aesthetic values, although the bicycle path is near (Fig. 3).

a)

b)

Fig. 3. a) connection of the Zemborzycki Reservoir and the studied water reservoir with a concrete sluice, b) present development and usage status of the water reservoir

The depression, in the present state of usage, has only a few valuable species of macrophytes (Tab. 1), while in the direct surroundings there appear mainly ruderal species which prefer habitats rich in nutrients and are usually treated as less attractive, burdensome weeds.

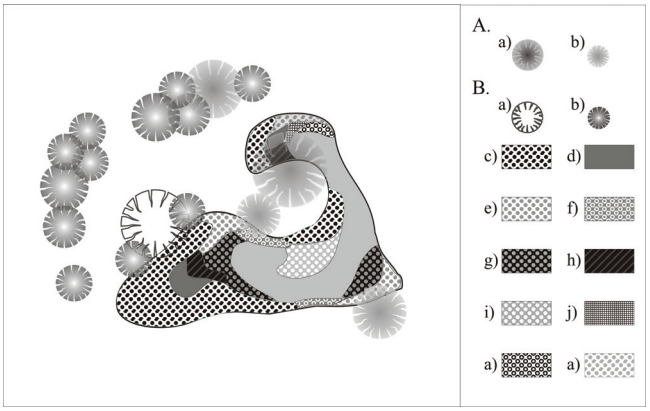
Table 1. Present and planned plant species structure in the water reservoir and in the adjacent Zemborzycki Reservoir

Stand species	Present plant species	Planned plant species	Littoral zone in the Zemborzycki Reservoir
Typha latifolia	+	+	+
Epilobium hirsutum	+		
Alisma plantago aquatica	+	+	
Aegopodium podagraria	+		
Calystegia sepium	+		
Nymphaea alba		+	
Sparganium erectum			+
Nuphar lutea		+	
Artemisia vulgaris	+		
Solidago canadensis	+	+	
Tanacetum vulgare	+	+	
Senecio vulgaris	+	+	
Iris pseudacorus		+	
Lychnis flos-cuculi		+	
Polygonum lapathifolium	+		
Lythrum salicaria	+	+	+
Eupatorium cannabinum	+		
Mentha aquatica		+	
Chenopodium album	+		
Utrica dioica	+		
Phalaris arundinacea	+	+	+
Salix fragilis	+	+	
Ceratophyllum demersum		+	
Potamogeton pectinatus			+
Potamogeton perfoliatus			+
Elodea canadensis		+	+
Lemna minor	+	+	
Rumex hydrolapathum		+	+
Glyceria maxima	+	+	+
Butomus umbrelatus		+	
Oeanthe aquatica		+	
Carex acutiformis	+	+	
Carex elata	+	+	
Carex gracilis	+	+	
Carex pseudocyperus		+	
Bidens tripartita	+	+	+

The principal condition of a water reservoir's existence is its constant or periodical supplying with water [Bajkiewicz-Grabowska and Mikulski 1999].

The project of the reservoir's development provides for species enrichment in the littoral and pelagial zones (Tab. 1). The main condition of proper functioning of the reservoir is the raising of water level by about 0.5 m. It will permit the

occupation of the reservoir by different species of macrophytes, especially involving open water and the littoral, and it will eliminate ruderal species. This can be realised by partial limitation of water flow through the concrete sluice joining the water reservoir with the Zemborzycki Reservoir.



Legend: A. present plant species: a) *Salix fragilis,* b) *Gliceria maxima* B. planned plant species: A) *Salix alba,* b) *Salix cinerea,* c) *Typha latifolia,* d) *Iris pseudacorus,* e) *Acorus calamus,* f) *Schoenoplectus lacustris,* g) *Nymphea alba,* h) *Alisma plantago-aquatica,* i) *Nuphar lutea,* j) *Hydrocharis morsus-ranae,* k) *Hottonia palustris,* l) *Sparganium erectum*

Fig. 4. The concept of floral development of the water body under study

The nature and landscape values will be enhanced by proper management of the reservoir area – cleaning it of the litter and introduction of plant species proposed in the project (Fig. 4).

The analysis of macrophytes structure showed that the analysed water reservoir has more attractive conditions for the growth of plants than the Zemborzyski Reservoir (Tab. 1). The structure of macrophytes was changed after the isolation of the Zemborzycki Reservoir from the water reservoir. The main reason was the decrease of the water level [Vaquer and Champeau 1991, Sender 2006].

The meaning of waterside brush is very important in a landscape. They are natural and huge retention reservoirs which store a lot of water and regulate the inflow. The organic matter is also a sorbent deactivating various kinds of pollution. Plants constitute a refuge for different kinds of microorganisms. The waterside brush are also the habitat for lots of plants and animals, very often rare species. Moreover, properly developed and functioning water reservoirs can play the role of biofilters that catch nutrients – nitrogen and phosphorus – from surrounding areas. The proper selection of plants is the condition of correct working for a water environment [Oksijuk *et al*. 1980]. The analysed reservoir partly serves such a function already. However, the current way of usage and the pace of its shallowing and overgrowing will cause that the water reservoir will disappear within a short time. Only a small depression, dry and overgrown with trees and shrubs, will remain.

Correct development of catchment areas often decides about the possibility of utilisation of water reservoirs. It is especially important if we want to accumulate clear water in the reservoir. A water reservoir for recreational usage should also combine both natural and aesthetic values of a given place. The present condition of the analysed water reservoir does not fulfil such requirements.

CONCLUSIONS

The quick pace of filling and uncontrolled overgrowing of the water reservoir will cause the loss of its basic functions, in the immediate future. The proposed works seem to be indispensable.

Proper development of this shallow reservoir will allow to increase its attractiveness, both natural and aesthetic, as well as its biodiversity.

The present status of the water reservoir's usage is as an attractive habitat mainly for ruderal species. The concept of its development provides for increasing the water level, which will cause the elimination of undesirable species and help the introduction of species with high natural values.

REFERENCES

Bajkiewicz-Grabowska E., Mikulski Z., 1999. General hydrology (in Polish). Wyd. Nauk. PWN, Warszawa.

Bryński K., 1968. Die Überschwemmung in der Lubliner Woiwodschaft im Frühling 1964 Jahres. Annales UMCS, sec. B, 20 (1968), 243–280.

Celiński F., Czylok A., Kubajak A., 2001. The nature guide to Dąbrowa Górnicza (in Polish). Wyd. Kubajak, Krzeszowice, pp. 72.

Kajak Z., 1995. Eutrophication of lowland water reservoirs, in: Zalewski M. (ed.) Biological processes in protection and the reclamation of lowland water reservoirs (in Polish). Bibl. Monit. Środ. PIOŚ, WIOŚ, ZES IŁ, Łódź, 33–41.

Kasza H., 1999. Anthroporession and development of water trophy in water reservoirs. Conf. mat. The biological aspects of water reservoir functioning (in Polish), Lublin, 9–12 September 1999, 8–14.

Michalczyk Z. (ed.), 1997. The strategy of utilization and the protection of waters in river – the basin Bystrzyca. Hydrographic investigations in cognition of the environment, 5, Wyd. UMCS Lublin, pp. 192.

Mioduszewski W., 1999. Protection and formation of water supplies in agricultural landscape (in Polish). Wyd IMUZ, Falenty.

Oksijuk O.P., Stolberg F.W., Olejnik G.N., 1980. Biological filter and its use in canals (in Polish). Hydrotech. Melior. 8.

Plichta Z., 1996. Development of adjoining terrains to the reservoir Siemianówka (in Polish). Mat. Konf. Boundary.

Radwan S. (ed.), 2006. Zemborzycki Reservoir – ecological structure, anthropogenic dangers and protection (in Polish). Wyd. AR, Lublin, 99.

Rodzik J., Dobrowolski R., Melke J., 2009. Estimation of kind, amount and mechanism of sedimentation in the Zemborzyce reservoir near Lublin. Teka Ochr. Kszt. Środ. Przyr. 6, 261–276.

Rzętała M.A., 2003. Shore processes and bottom sediments in some water reservoirs under diverse anthropopression (with the use of an example of Silesian Upland and surrounding areas) (in Polish). Prace Naukowe Uniwersytetu Śląskiego w Katowicach nr 2169 Wyd. UŚ, Katowice, pp. 147.

Sender J., Radwan S (ed.) 2006. The Zemborzycki reservoir. Ecological structure, anthropogenic threats and protection (in Polish). Wyd. WAR Lublin, 26–32.

Vaquer A., Champeau A., 1991. Spatial distribution of aquatic macrophytes in the resent reservoir of Ste Croix, Province, France. Hydroecol. Appl., 3, 127–145.

Włodarczyk Z., 1991. Monograph of the Zemborzycki reservoir. Manuscript in Department of Cartography UMCS (in Polish), Lublin, pp. 56.

ZNACZENIE I ZAGOSPODAROWANIE DROBNEGO ZBIORNIKA WODNEGO W SĄSIEDZTWIE ZALEWU ZEMBORZYCKIEGO W LUBLINIE

Streszczenie. Drobne zbiorniki wodne to podstawowy element kształtujący zasoby wodne poprzez tzw. małą retencję. Ponadto poprawiają one bilans wodny terenu, mają także ogromne znaczenie dla życia i przetrwania wielu gatunków roślin i zwierząt, wzbogacając tym samym walory przyrodnicze krajobrazu. Badania obejmowały powstały po wybudowaniu w roku 2007, na znacznym odcinku zachodniego brzegu Zalewu Zemborzyckiego k. Lublina, ścieżki rowerowej. W wyniku prac budowlanych po utworzeniu nasypu jedna z zatok została odcięta od Zalewu, tworząc odrębny zbiornik w bezpośrednim jego sąsiedztwie, połączony z nim betonowym przepustem. Jest to niewielkie, bo liczące zaledwie ok. 0,13 ha, zagłębienie terenu stale wypełnione wodą. Zagłębienie zasiedla w obecnym stanie użytkowania niewiele cennych gatunków makrofitów, zaś bezpośrednie otoczenie głównie gatunki ruderalne, traktowane jako mało atrakcyjne, uciążliwe chwasty. Obecny sposób jego zagospodarowania sprawia, iż pełni on jedynie funkcję odbiornika zanieczyszczeń. Właściwe jego zagospodarowanie pozwoli na podniesienie jego atrakcyjności zarówno przyrodniczej, jak również krajobrazowej i estetycznej.

Słowa kluczowe: makrofity, drobny zbiornik wodny, zagospodarowanie