

# Water Reservoir Management and Nature Reserve Functioning – Jeziorsko Reservoir (Central Poland)

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## **Abstract**

Wetlands, which develop around water reservoirs, are home to a large variety of wildlife. These areas are often legally protected because of their natural values. New ecosystems need many years to create the natural environment in the littoral zone. A different situation can be observed around the Central Poland Jeziorsko Reservoir on the Warta River, the second largest, regarding the surface area, water reservoir in Poland. Built in the years 1986-1992, the reservoir is of a retention type with large water level fluctuations, up to 5 m in a year. More than a half of its bottom area is drained periodically each year. During minimum water level periods dried out parts of the bottom which is rich in food turn into bird feeding areas. Since 1998 this part of the reservoir has been protected as the Jeziorsko Bird Protected Area. It is one of the most important bird sanctuaries in Poland, where 150 bird species hatch every year. Another 100 bird species appear in the area periodically during spring and autumn. The Jeziorsko Reservoir is an example of the successful coexistence of a man-made lake and a legally protected environment.

Key Words: bird sanctuary, water reservoir, water management.

## **Problem Outline**

The reason for creation of artificial water reservoirs is the flooding of the area they occupy. The shore zones of the up-lifted rivers and lakes including the surrounding valley areas undergo partial or complete flooding. Frequently the flooded territories are of a high nature value and constitute homes, often under legal protection, for rich flora and fauna. The up-lifting gives rise to the development of a new shore zone in a morphological sense, for its development takes place on higher ordinates as well as biological one – the littoral vegetation is transformed or annihilated (Kajak, 1998) including the existing fauna. The shore zone is formed as a result of the wind wave and abrasion, which is provoked by the wind itself, as well as segregation, transport and sediment accumulation. Its development constitutes a long-lasting process. Under constant hydrodynamic conditions, which occur on lakes, the zone is stable and almost completely covered with plants. On artificial reservoirs, however, the shore zone remains active for many years. That is the result of both its young age, measured in years, as well as significantly higher than under natural conditions water level fluctuations that are provoked by the functions of artificial water reservoirs. Sediment movements as well as water level and water layer thickness changes make vegetation growth (Figure 1), which is characteristic and integral element of the natural lake shore zones, difficult not to say impossible.

The length of the reservoir shore zone activity period depends mainly on the height of water level fluctuations that oscillates from a couple of centimetres to a few metres. Together with the fluctuation growth, the shore zone stabilization process lengthens, whereas the vegetation

entrance is retarded (Ovčinnikov, 2003; Grobelska, 2005). In consequence, for many years the reservoir is deprived of the littoral that constitutes a natural home for fauna. Furthermore, the water level fluctuations in the reservoir also cause the periodic drainage of its bottom. The area grows together with the water level fluctuations. If minimal water level occurs on the reservoir during the vegetation period, the periodically drained bottom part of the reservoir is successively covered with plants following the lowering water table. The composition of vegetation species, their number and sizes depend on the distinctive features of individual objects, current humidity conditions and the length of the development period (Hellsten, 2000).

In general, the territories are dominated by reed rushes and willow tussocks that indicate high immunity to radical humidity condition changes and periodic, even a few-month near-flooding. The plant development period on that area is usually shorter than the vegetation period itself. When low water level is kept on the reservoir for longer periods, lasting up to 2-3 years, trees and bushes grow on the given territories. Because of the dependence of the retention reservoir water levels on the reservoir functions and hydrological situation in the basin one can observe quite a reverse situation. For one to two years high water levels on the reservoir may remain for a long time and low water levels may never be reached. This causes the vegetation extinction on the given area. Such a situation was observed at the beginning of the present century on the Pakoski Reservoir (The Western Noteć River). At low water levels, however, the reservoir bottom area is uncovered which favours vegetation and avifauna development. The Jeziorsko Reservoir, on the Warta (Central Poland) is the example of such a territory (Figure 2).



Figure 1. Shore zone of Jeziorsko Reservoir.

## The Jeziorsko Reservoir

The Jeziorsko Reservoir has been created as the result of the up-lifting of the Warta waters. The dam locked the 9021.8 km<sup>2</sup> basin. Here the average annual flow equals 49.8 m<sup>3</sup>s<sup>-1</sup> (Stachý, 1986). The preliminary reservoir filling commenced in 1986, yet the full up-lifting range was not achieved until 1992 (Orłowski, 1999; Szewczyk, 2007). It is fourth in terms of capacity and second in terms of area artificial water reservoir in Poland.

The Jeziorsko Reservoir lies within the Sieradz Basin and occupies the meridionally running section of the Warta valley. The direct surrounding of the basin includes up to 150 m ASL (above sea level) - quaternary uplands (Banach and Grobelska 2003). The territory lies in the edge zone of the Łódź Basin and the Przedsudecka Monoklin (Klatkova and Załoba, 1992). Here the oldest formations include severely crushed upper-cretaceous marls which remain 5-

40 m, locally two to three meters, underneath. Cretaceous formations constitute a direct basis of Pleistocene formations that cover the area. They mainly include glacial and fluvioglacial forms of the Warta stadal Middle-Polish glaciations. Their thickness reaches 20 m. The forms remain under older fluvioglacial formations or directly on the clay of the maximum range of the stadal. The formations are frequently disturbed glaciotectonically. Only the maximum stadal local clays occur directly on the surface of the territory (Klatkova and Załoba 1992; Załoba 1996).

The flat moraine upland in the reservoir surrounding is divided by two river valleys. First, running from southern-east to northern-west, is called the Vistulianska Pra-Warta valley (Baranowski and Mańkowska, 1972). It is currently used by the Pichna River, which branches from the Jeziorsko Reservoir, and the Teleszyna River in the further section of the valley. At present it constitutes a depression area protected by dams. The decline is crossed by the meridionally running contemporary Warta valley. The Vistulianska valley is filled with sand and river silts creating approx. four to seven metres slats in the direct neighbourhood of the Warta River. The bottom of the second, younger, valley used by the Warta and currently occupied by the Jeziorsko Reservoir is filled with Holocene formations. The forms mainly include sands and average two metre-thick river alluvial soils locally changing into aggregate mud. The edge of the Warta valley, which embraced the reservoir before its formation, had an erosion character on its significant sections. It is cut by numerous erosion-denudation valleys partly used by little watercourses. Slides occurred here locally in the past. The reservoir shore zone consists mainly of boulder clays and middle-polish glaciation fluvioglacial forms as well as Vistulian river silts. Locally they are accompanied with glaciolinnic sediments, clay slope washes and active slide colluviums. At low water levels on the reservoir the Warta slope are washed away by the waves. The process occurs in the top and middle part of the reservoir (Banach and Grobelska; 2003).

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The Jeziorsko Reservoir is characterised by high water level fluctuations which are the result of the reservoir anti-flood and retention functions. Permanent, approx. five-metre high, water level fluctuations occur on the reservoir in every annual cycle. Maximum levels are recorded in the spring-summertime, when the reservoir filling takes place, and minimal ones occur in

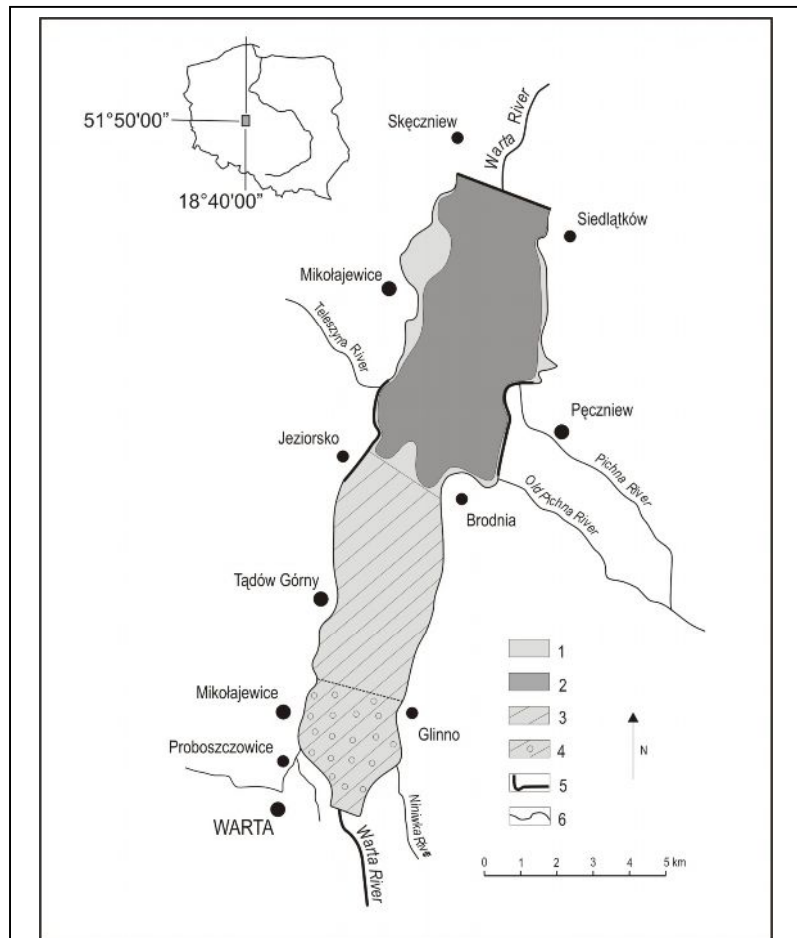


Figure 2: Jeziorsko Reservoir

1 – reservoir area in period of maximum water level, 2 - reservoir area in period of minimum water level, 3 – bird protected area “Jeziorsko”, 4 - part of reservoir with cute trees and scrubs, 5 – main and side dams, 6 – stream.

the autumn-wintertime, after the reservoir gradually emptying, which lasts from July until the end of November. From the half of April till the end of June, a stable up-lifting level, no higher than normal (120.5 m above sea level) is kept on the reservoir. Such a situation is favourable for the maintenance of the stable home conditions for water birds in the reservoir upper section.

The Jeziorsko Reservoir occupies the entire flat plain of the Warta. Depending on the water level the reservoir length varies from 16 to 7 m given the 2.5 km width; the average depth equals 1.7 up to 5.2 m. At maximum up-lifting coordinate the reservoir area reaches 42.3 km<sup>2</sup>, whereas its capacity comes to 202.3 mln m<sup>3</sup>. At minimum levels the area reaches 19.6 km<sup>2</sup> (at absolute minimum 17.6 km<sup>2</sup>) and the capacity equals merely 36,4 mln m<sup>3</sup> (at absolute minimum 30.2 mln m<sup>3</sup>), (Szewczyk, 2007). This causes that, at allowed minimum water levels, over half of the basin area is periodically uncovered and serves as the „Jeziorsko” bird sanctuary.

### **“Jeziorsko” Bird Sanctuary**

The „Jeziorsko” bird sanctuary was created in the southern part of the Jeziorsko Reservoir pursuant to the Minister of Environmental Protection, Natural Resources and Forestry Regulation from 23.12.1998. (Decree-low, 1998). The aim of the protection is the preservation for the sake of science, education and landscape sanctuaries for water-marsh birds including rare protected bird species.

The nature reserve occupies the area between the bridge on the Warta, which indicates the reservoir backflow range, and the line connecting Jeziorsko and Brodnica towns, which overlaps the water table range at the minimum water level on the reservoir (Figure 2). Its area equals 2350.6 ha. In the summertime, at low water level on the reservoir, the territory is uncovered and the marsh bottom periodically deprived of water constitutes an excellent source of food for preying birds. The territory is mainly grown by reed rushes and willow tussocks. The plants tolerate the interchangeably occurring water-land conditions including a few-month flooding quite well. The vegetation creates exquisite conditions for bird nesting.

The reserve, as well as the whole Jeziorsko Reservoir, is the water and water-marsh bird sanctuary. Living here for the whole year or only periodically during passages, the birds regard the area as their brooding place. There nest approx. 150 bird species, and for another 100 the territory constitutes a haven during spring and autumn passages. Periodically, about 10 000 birds stay on the reservoir area (Szewczyk, 2007). The dominant species include black-headed gulls (*Larus ridibundus*); common terns (*Sterno hirundo*), great cormorants (*Phalacrocorax carbo*) and grey herons (*Ardea cinerea*). Among rare species one can find the greylag goose (*Anser anser*), the little gull (*Larus minuus*) and herring gull (*Larus argentatus*), the ruff (*Philomachus pugbax*), the bluethroat (*Luscinia svecica*) and ducks: the mallard (*Anas platyrynchos*) and shoveler (*Anas clypeata*); the tufted duck (*Aythya fuligula*), the pochard (*Aythya Felina*) and grebes: the great crested (*Podiceps cristatus*) and the red-necked (*Podiceps griseigena*). Among species staying here periodically the worth mentioning ones include: the black stork (*Ciconia nigra*), the American crow (*Nicticorax nicticorax*), the great white heron (*Casmerodius albus*), the common crane (*Grus grus*) and the Eurasian oystercatcher (*Haematopuss ostralegus*). A great variety of birds and fish attracts the osprey (*Pandion haliaetus*), the greater spotted eagle (*Aquila Langa*), the peregrine falcon (*Falco peregrinusa*) and the white-tailed eagle (*Haliaeetus albicilla*) (Environmental Map, 2006).

In result the willow tussocks, occurring in the Jeziorsko Reservoir upper part, tolerate well the reservoir water fluctuations and caused by the fluctuations periodic near-floodings. Their growth is so intensive that, for fear of preserving good conditions of nesting and bird development on the reservoir, the Voivode of Łódź, supervising the nature reserve, pursuant to the Disposition no. 190/2005 from 14 September 2005 imposed the obligation of the annual tree-clearing on the host of the object. From 1 October until 31 March, in 2005-2009, the bushes covering altogether 150 ha within the reservoir backflow must be cut out.

## Conclusion

The existence and operation of both - the nature reserve and artificial water reservoir appears to be the enterprise doomed to failure, for the objects serve completely distinctive functions. Artificial reservoirs are subjected to human economic activity, whereas the function of the reserves involves the protection and preservation of the nature intact. The situation occurring on the Jeziorsko Reservoir, however, proves that such a compromise is plausible. The artificial water reservoir creation on the middle course of the Warta has provided exquisite home conditions for the water-marsh birds. Especially favourable for their development is the annual uncover of over the half of the reservoir bottom resulting from the reservoir water level lowering in the autumn-wintertime.

## References

- Banach, M. and Grobelska, H. (2003), The dynamics of Jeziorsko Reservoir shore zone (in Polish) *Ślupskie Prace Geograficzne*, 1, 91-106.
- Buraczyński, Z. (1986), Geology and engineer researches (on Jeziorsko Reservoir) (in Polish), *Gospodarka Wodna*, 8, 185–187.
- Grobelska, H. (2006), *Evolution of the Pakość Reservoir shore zone (Gniezno Lakeland)* (in Polish), Warsaw: Geographical Studies, 205.
- Hellsten, S. (2000), Environmental factors and aquatic macrophytes in the littoral zone of regulated lakes – causes, consequences and possibilities to alleviate harmful effects, in, *Environmental factors and aquatic macrophytes in the littoral zone of regulated lakes – causes, consequences and possibilities to alleviate harmful effects*, Oulu: Acta Universitatis Ouluensis, A, 348, 1-46.
- Kajak, Z. (1998), Hydrology-limnology. Ecosystems of inland waters (in Polish), Warszawa: Polish Scientific Publishers.
- Klatkova, H. and Załoba, M. (1992), Comments for Detailed Geological Map of Poland 1:50 000, Sheet Warta (in Polish), Warszawa.
- Geological Map of Poland (1972), 1:200 000.
- Orłowski, W. (1999), Enginery description of Jeziorsko Reservoir on Warta River, (in Polish), in, *Exploitation and influences of big size lowland water reservoirs base on Jeziorsko Reservoir*, Research and engineering conference, Uniejów, 7–17.
- Ovčinnikov G.I. (2003), The dynamics of shore zone of Angara River reservoirs (in Russian) Aftoreferat, Irkuck
- Decree-law of Environmental Ministry Act 23.12.1998 y (in Polish), 166: 1219.
- Stachý, J. (ed.) (1986), The Hydrology Atlas of Poland (in Polish), 2, 1, Warsaw: Geology Press,
- Szewczyk, G. (2007), Jeziorsko Reservoir, Poznań: RZGW.
- Biger man-made water reservoir (in Polish) (2007), in Grzesiak, M. and Domańska W. (ed.) *Environmental Protection, Information's and statistically study*, Central Statistical Office of Poland, 97.
- Załoba, M. (1996), Treces of oscilations of glacial Warta Stage..., *Acta Geographica Lodzensia*, 71, 275 – 287.

Disposition of the Lodz Voivode, 14 September 2005, 190.