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Human Impact on Hydrographic Processes in Aquatic Complex of Nature Park Hutovo Blato

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Abstract

Aquatic complex of Nature Park Hutovo blato has suffered several anthropogenic changes due to construction of hydroelectric power plant HE "Čapljina". These processes are significant especially in Donje (Lower) or Svitava blato. Donje blato has been transformed, through anthropogenic actions, into Svitava lake. This lake has been artificially separated from hydrographical complex and also a system of Hutovo blato. Since then this aquatic complex has a processes which are different related to time before construction of accumulation.

Anthropogenic changes disturb the natural balance of hydrographical systems in aquatic complex in Hutovo blato. These processes has been accelerated a change of a natural systems, especially in a potamological processes on river Krupa and limnological processes in Gornje (Upper) blato, also known as a Deransko lake. River Krupa, as well as Gornje blato, were out of range of direct anthropogenic engagements.

This paper includes several comparative analysis of previous natural state of the Hutovo blato and its recent status.

Keywords

aquatic complex, ornithological park, nature park, crypto-depression, ecological balance, hydrogeographic analysis, ecological problems, hydro technical action

Introduction

Complex analysis regarding recent changes of living habitats in aquatic complex Hutovo Blato, are looking for new methods and new specific approaches to restore earlier natural conditions. By doing so, this formerly famous ornithological part of unspoiled nature would be given its primary role. The complexity of such research and the introduction of new methodologies in the assessment of the existing situation involve a program of research, which includes a qualitative assessment of the functioning of the earlier natural hydrographic conditions in aquatic complex Hutovo Blato.

Qualitative assessment of hydrographic conditions, prior to anthropogenic interventions in this aquatic complex provides sufficient information on the identification of stability and balance factors, involved in the creation of the natural conditions in aquatic complex that support natural habitat for waterfowl (swamp birds). These studies are comparing emerging anthropogenic conditions that clearly differ from the original, nature ones. Confirmation to this clam is the disappearance of aquatic habitat for aquatic fauna and waterfowl.

Monitoring results of hydro geographic studies allow comparison with the current situation in the changed aquatic complex Hutovo Blato. In addition, monitoring results provide the basis for newly anthropogenic systems to by measured and adapted, in order to, at least partially, return complex's natural role. This could only refer to the Gornje Blato or Deransko Lake because the Donje Blato is permanently lost due to adaptation of reversible basin of Power Plant "Čapljina." In elaboration of this problem comparative analysis was used of water levels before and after anthropogenication of aquatic complex, with the overall objective of introducing anthropogenic into natural aquatic system. (Fig. 1.)

Figure 1: Gornje Blato (left) and Svitava Lake (right)

Materials and Methods

First hydrographic studies of Hutovo Blato and its water resources was carried out in the context of complex diagnostic studies in 1983, ten years after the construction of the new complex of anthropogenic Power Plant "Čapljina" in 1972. Studies were comprehensive and lasted until 1985. New recognition observations and monitoring of development aquatic complex were performed in a informative manner (by the authors of the study), during the regular course of performing field teaching for students of geography (University of Sarajevo), followed by numerous scientific conferences and workshops, as well as media coverage of the events addressing this extremely important aquatic complex. National Park Hutovo Blato, was first proclaimed, a state protected “Ornithological Park Hutovo Blato" in 1954. Its name was changed in 1995 to "Nature Park - Hutovo Blato". This valuable natural monument is in the early stages of their natural existence was enlisted in the “Registry of Wetlands of International Importance” in 1971. After one year, park’s natural component was changed to anthropogenic one. Nevertheless, during 1980, Hutovo Blato was included in the "International Project for the Protection of Mediterranean wetlands." These change, from natural to modified anthropogenic aquatic complex, demanded additional research, scientific observation, analysis of existing and previous conditions, etc. It was important to monitor these changes so that the new methodology to preserve and improve the functioning of its natural elements could be introduced.

Studies are based on the monitoring of seasonal, annual and statistical hydrological indicators in long term. Statistical data from the hydrological functioning pre-anthropogenic phase aquatic complex Hutovo Blato were compared with those after its anthropogenic changes. In addition to the analysis lacustrine-talmatologic (lake-wetland) monitoring, a detail fluvial (river) limnographic monitoring was considered, also including water levels on the river Krupa, which drainage Hutovo Blato into the lower course of the river Neretva.

Beside these statistical indicators, other scientific research methods were used: methods of field observation, morphometric methods, morphogenetic, geological, mineralogical and petrography and other contemporary geographical research methods. Monitoring methods in field research helped in determining the amount of water accumulation of Hutovo Blato in certain seasons.

In order to recognize current hydro-geographic state in aquatic complex Hutovo Blato, a periodical survey and measurements (of the quantity of the water) were conducted, including natural and other springs in the lower part of Gornje Blato, precisely Deransko Lake. On the bases of field observations, decade of data gathering, as well as diagnostically assessment in Hutovo Blato, a new cartographic map was introduced (Fig. 2.)

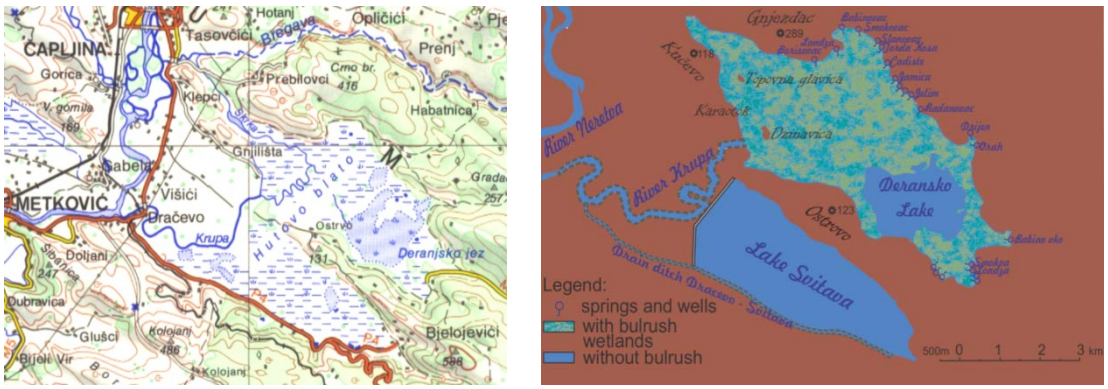

Figure 2: Topographic situation of Hutovo Blato before and after antropogenic actions

Survay Results

Hydrographic features Hutovo Blato - importance to define solutions to problem

Natural-aquatic complex Hutovo Blato, in modern age very anthropogenicly altered hydrographic system of the lower basin of river Neretva. Hutovo Blato is partially crypto-depressing, topographically situated on the left bank of the river Neretva, about 5 km southeast of the town of Čapljina. With a limestone ridge called Ostrovo, Hutovo Blato is divided into two morphological units, which in recent times (due to manmade dam on the Donje Blato) do not have a hydrographic functional connection. Gornje Hutovo or Deransko Lake is still a natural morphological unit, but since 1973 due to anthropogenic activities in aquatic geotechnical system, Donje or Svitavsko Blato has been turned into Svitavsko Lake. It was converted to compensation basin for Power Plant "Čapljina."

Its geographic location and great openness toward Neretva valley and the sea, aquatic complex and its surroundings have very prominent Mediterranean influences. The main characteristic of the climate in the area Hutovo Blato are mild winters with abundant rainfall and long bright summers. The hottest month is July (24.7 ° C), and it is most cold one is January (5.9 ° C). Cold period lasts 3 to 4 months, with average temperatures slightly lower than 10 ° C, and the warmer period regularly lasts 8 months. Annual rainfall is relatively high (1156 mm), but is unevenly distributed. In the colder part of the year is there is more than 60% of the total annual rainfall. According to pluviometric regime, wider basin of Hutovo Blato has two seasons: rainy (winter) and dry (summer). Maximum rainfall is usually during the December and minimum of rainfall is situated in July.

A wider basin of Hutovo Blato is made mostly out of Cretaceous limestone. These Limestones caused disorganization of the surface water to underground river networks. The Eocene flysh in the wider area of Hutovo Blato represents a partial remnant of a once much more spacious flysh zone. This zone is posteocenic orogenic

movements, especially erosion during the Late Quaternary and Tertiary, went through considerable changes. Therefore Eocene flysh occurs only in a narrow zone between Cretaceous limestones, particularly in the area of Svitavsko accumulation (SLISKOVIC et al. 1962).

Recent relief of the environment and the bottom of Hutovo Blato was created by tectonic lowering of the river Neretva terraces in a single plane. There are exceptions: Island Karaotok, Island Džinavica and Island Topova Glavica. Bottom of Hutovo accumulation has micro morphological features noticeable in hypsometrical shift of wetland-marsh vegetation (SPAHIĆ 1986).

General hydrographic conditions of Hutovo Blato are related to hydrographic system of the lower Neretva, geologic characteristics of wider basin, geomorphologic evolution of the area and in particular climatic features of Hutovo Blato basin. Mentioned hydrographic natural conditions have been significantly impacted with recent anthropogenic doings conducted in the 1970's, with construction of Power Plant "Čapljina."

Water levels of Hutovo Blato, before anthropogenic intervention, directly depended on the water level of the river Neretva. Anthropogenic activities have disturbed the hydro geological state of inflow of water from detritus springs and wells, since most of them lost the hydrological function. In the Upper Blato, springs occur in the southern edge of Deransko Lake. Major springs are Babino Oko and Londža.

Hutovo Blato, especially Deransko Lake is crypto-depression because its bottom is lower than the level of the Adriatic Sea. The lake's surface elevation varies from 1 meter to 3 meters, depending on the level of lake water. Gornje Blato has retained its natural features and it consists out of five separate lakes, namely: Deransko, Škrka, Jelim, Drijen and Orah. They are connected by canals and river Krupa. River Krupa also drains hydrological system of Hutovo Blato to the river Neretva Today, Lower or Svitavsko Lake represents compensation basin for Power Plant "Čapljina" and represents completely separate unit from the Gornje Blato. Today's interest is in the preservation of the natural habitat of the Gornje Blato that has following morphometric parameters:

Lake surface	3,7 km²
Lake length	3,3 km
Lake maximal width	2,4 km
The average width of the lake	1,1 km
Length of the coastline	13,0 km
Lake maximal depth	11,0 m
The average depth of the lake	2,0 m

Water regime in Hutovo Blato

Water regime in Hutovo Blato can be tracked on the basis of the regime and water balance of the river Krupa. It makes the river that drainage water of Hutovo accumulation. That is the last confluent on Neretva before its arrival in the Adriatic Sea. The total length of its course is 9 km with an average width of about 15 meters. Designations gradients in the longitudinal profile are insignificant and they are about 2 ‰.

For complete investigation of the water regime of Krupa, data from limnigraph of the Mala Svitava were used. This water level marker is based for the control of water levels in Bajovci, on the coast of Svitavsko artificial lake, and water meters on the banks of the Gornje Blato. How Svitavsko accumulation has direct impacts on water levels of Krupa, it was necessary to process and Svitavsko lake water levels. Frequent fluctuations of water in Krupa occur as a consequence of discharge water from the reservoir Svitavsko Lake.

The discharged water from the Svitavsko Lake creates a slowdown of water on the river Krupa all the way through Deransko Lake as a result of small designations gradients in the longitudinal profile of Krupa. High water levels on the river Neretva can cause natural slowdown of water on the river Krupa. They are seasonal, while the frequent and unnatural oscillation is caused by the release of water from Svitavsko Lake.

Based on the data from limnigraph, annual level of the water level does not depend directly on the amount of rainfall. This is a consequence of the Svitavsko artificial lake regime which directly depends on the work of power plant "Čapljina". Some of the water that is released from the reservoir Svitava, disturb the natural regime of the river Krupa. Because of small designation gradients on Krupas profile, discharged water from the reservoir partially drains downstream and partially goes upstream by river Krupa to Gornje Blato. Water slowdown on Krupa or its retrograde flow, affects the artificial water oscillations in the Gornje Blato.

To point out the artificial water level fluctuations, limnigraph data were analyzed and the results can be generalized in following facts: discharged of water from artificial reservoirs Svitava causes an increase in the average water level of 108 cm in the first 6 hours of an average day. Next 6 hours, the water level drops by 90 cm, and then for the next 6 hours increases up to 265 cm. Water level stagnation of 230 cm is maintained for the next 10 hours.

Artificial oscillations disturb the hydro- ecological system in aquatic complex Hutovo Blato. Early prognostic and technology solutions consider that this phenomenon will be avoided. Previous research programs, envisaged project "Hutovo Blato", by which the Donje or Svitavsko Blato should be transformed from swampland in to a lacustrine aquatic complex. Gornje Blato is supposed to preserve its natural environmental values of ornithological importance as it previously had.

Discussion

Assessment of the current situation

Study noted that the boundaries of the Gornje lake were far higher than today. Hydrological situation has significantly changed after power plant "Čapljina" construction. By field observations, initially in the first decade of the diagnostic and then in each repeated diagnostic, prognostic assessment were made for this once important ornithological station of migratory and resident birds that were settling in this nature park. Hydro-ecological

studies have defined the current situation, particularly in the Gornje Blato, which according to all estimates in the research program, should remain entirely natural without artificial influence factors.

Prognostic studies have shown significant discrepancies from previous natural condition caused by indirect effects of anthropogenic intervention. In the Gornje Blato water meters and coastal swamp contours show the artificial fluctuations in water level. Undoubtedly these effects are greatly influenced by water slowdown, generated by frequent discharge of water from reservoirs artificial Svitavsko Lake. In addition, hydro reclamation operations in Popovo Polje disturbed karsts hydrological system, which reduced the flow of underground water from wells and springs. All of this has an impact on Gornje Blato aquatic complex functioning.

The most significant effects of artificial intervention in the Hutovo Blato are:

- Disappearance of the very high flood water levels, which lasted an average of 70 days, for a period of elevated water levels, which rarely, in spring time, lasted no longer than one month;
- Discharges of excess water from the artificial lake in the basin Svitavsko lake to river Krupa creates a water slowdown and return of the water to the Gornje Blato, causing frequent artificial fluctuations of water, which affect the aquatic organisms, and reproduction of nektonic plankton and aquatic species;
- during the warmer periods within the year, due to reduced underground water, larger part of the aquatic complex remains without hydrologic function, which reduces the optimal habitat of aquatic organisms;

All things mentioned resulted in the disappearance of the former functions of aquatic complex, as is evident from the decrease in the domestic and migratory bird populations. Their reduction is the result of changes in conditions that reduce hydro ecological resources, reducing benthic and aquatic organisms as a food for the bird population. Moreover, devastating consequences for the development of fish populations, especially eels, by whom this national park was famous of.

Improvement of hydro-ecological conditions

By balancing water levels on this aquatic complex Hutovo Blato, it would be a possible to obtain protection from artificial oscillations that arise from inflowing water from compensation lake basin Svitavsko. In order to achieve this requirement, it would be necessary to build an artificial dam on the river Krupa. Dams function should to be to eliminate any artificial fluctuations in water levels of the Gornje Blato, and to provide such a water level and restoring it to the period of pre-anthropogenic doings. In this way, once again natural environmental conditions would return and that would revive talmatologic-lacustrine conditions for the development of former aquatic organisms.

Instead of Conclusion

Suggested measures are intended to restore original, natural framework of environment in aquatic complex Hutovo Blato, as the only solution for its rescue and as well the only possible one. These measures would be brought to the attention to the public, influencing it to take more active approach in protection of Hutovo Blato, as well as to avoid unforeseen accidents (like two recent bush and forest fires). In addition, Hutovo Blato would be allowed its natural function.

The reversibility of the primal, natural conditions is generally very difficult and problematic, due to re-introduce of anthropogenic factor which still has its flaws. Natural frames and natural systems, as much as we try, cannot be realized by anthropogenic activities.

Summary

The natural-aquatic complex Hutovo blato belongs in the hydrographic sense to the Donja Neretva river basin and system. Through anthropogenic actions of 1973 this complex was transformed into an aquatic geotechnical system, especially the Lower (Donje) or Svitavsko Lake that represents today the compensation basin HE »Čapljina«. Today the compensation basin disturbs the natural balance in Gornje Blato.

Through hydrographic and other modern physical-geographic methods and research it was established that it is possible to preserve and bring back the Gornje jezero (lake) into its original natural limits.

Analyzing the water-meter statistical data that refer to Deransko jezero (lake) and river Krupa from the period before to the anthropogenic undertakings and the periods afterwards, as well as analyzing the water impressions on the shorelines and the way of sedimentation, it is possible to equalize the water-levels in Gornje jezero (lake) and bring them closer to the original hydrographic levels. The water-level equalization in Gornje jezero is possible by means of constructing an artificial dam on the Krupa river. Through the dam, the water-level regime in Gornje Blato would be regulated according to the seasons by approximately same periods of the previous original conditions. In addition, the dam would stop production of artificial oscillations in Gornje jezero (lake) that were the result of releasing the excess water out of the Svitava compensation basin. In this way, the natural-aquatic complex Gornje Blato would be preserved and brought into its natural limits, which would in turn produce a positive effect on the lives of aquatic and other organisms living in this accumulation.

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