

ECOLOGICAL EVALUATION OF THE TERRITORY OF THE GABČÍKOVO-NAGYMAROS DAM PROJECT

LADISLAV MIKLÓS, MIKULÁŠ LISICKÝ, MÁRIA KOZOVÁ

Institute of Experimental Biology and Ecology of the Centre of Biological and Ecological Sciences of the Slovak Academy of Sciences, Obrancov mieru 3, 814 34 Bratislava, Czechoslovakia

Abstract

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Large preassumed changes of the landscape due to the operation of the water construction system "Gabčíkovo-Nagymaros" on the Danube force the nature scientists to intensive research aimed at the alleviation of the unfavourable influences and at the proposals of ecological optimum arrangement and utilization of this territory. The submitted paper contents a brief summary of the wide-concepted ecological works performed in this territory at the Institute of experimental biology and ecology of CBES of SAS, especially for the upper part of this system -- for the area of reservoir "Hrušov-Dunakiliti".

1. Introduction

Construction of the water works on the Danube River Gabčíkovo-Nagymaros (hereafter SWW) represents at present the greatest interference of man with the natural environment of Central Europe. Wider aspects of the SWW effects on the environment have already been discussed at different levels. In this paper the ecological problems evoked by the construction and operation of the Hrušov retention reservoir will be elucidated in brief, as well as the main principles of the ecological solution of these problems elaborated in the study entitled "Ecological Evaluation and Biological-Ecological Arrangement of the Special-Interest Area of the Hrušov Retention Reservoir" (Miklós, Lisický, Kozová et al., 1986). Large team of the Centre of Biological and Ecological Sciences of the Slovak Academy of Sciences cooperated in the solution of this study. It was prepared in the Department of the Landscape Ecology of IEBE of the Centre of Biological and Ecological Sciences of the Slovak Academy of Sciences with participations of the Department of Geobotanics, Department of

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Soil Biology, Department of Hydrobiology, Department of Plant Physiology, Department of Ecosystem Production, Department of the Influence of Immissions upon Animals from IEBE of the Centre of Biological and Ecological Sciences of the Slovak Academy of Sciences, as well as of workers from other institutes and workplaces -- Institute of Dendrobiology of the Centre of Biological and Ecological Sciences of the Slovak Academy of Sciences, Zoological Institute of Comenius University, Department of Zoology of the Faculty of Natural Sciences of Comenius University, etc.

The study is a part of a joint international target-oriented programme of the Hungarian Academy of Sciences and the Slovak Academy of Sciences entitled "Landscape-Ecological Arrangement of the Territory of the Construction of SWW Gabčíkovo-Nagymaros on the Danube River" and of the target-oriented project of the basic research "Ecological Optimization of the Utilization of the SSR Lowlands".

Of course, the chief role in all ecological considerations concerning SWW is played by water. All natural scientists are afraid of the future of unique ecosystems caused by the changes of the present hydrological conditions. This fear penetrates the awareness of the general public as well as the awareness of the designers of SWW. Therefore, the requirements for the so called "ecologization" of the SWW are intensified to reduce the negative impacts of the construction on landscape. However, one should immediately emphasize that at the present stage of the construction on ecological proposals can principally change the technical solution of SWW, therefore they have focused their attention on the possible, ecologically more optimum organization of the territory within the given limits, eventually they ask for certain solutions which could be implemented by proper technical measures (and, of course, by corresponding investments) during the SWW construction. This was the aim of the cited Hrušov retention reservoir study as well as wider elaborated conception of the ecological evaluation of the whole special-interest area of the SWW.

2. Decisive ecological factors of the special-interest area of the Hrušov retention reservoir

As already mentioned, water and its dynamics are most important factors in this territory, however, they are not the only ones. The conception of the solution of the problems concerning water is the integral component of a general method of the landscape ecological planning — LANDEP (Ružička, Miklós, 1982) which is aimed at the proposal of the ecologically optimum organization of the space and the proposal of resulting ecological measures. Therefore, also the above specified study is the synthesis of a wide spectrum of the research in

abiotic, biotic and socio-economic components of landscape. The decisive factors analysed were as follows:

- a) Chosen characteristics of the microrelief with particular focus on hydrological conditions. In this case relative altitudes of the relief surface have been studied, as well as the relief conditions of the surface waters run-off (classification and characteristics of microbasins), depression of surfaces, marked slopes of the residues of the former river branching system.
- b) Surface and groundwaters. These will be discussed in more details below.
- c) Substrate-soil complex, particularly selected physical and physico-chemical properties of soil, cultivability and potential trophism of soil.
- d) General characteristics of the microclimate and a very important specific index — insolation of the reservoir dam.
- e) Present vegetation and present structure of landscape as well as the assumed changes appearing with the change of hydrological conditions.
- f) Characteristics of animals, changes of biotopes due to water works, assumed changes in the gamekeeping.
- g) Selected socio-economic phenomena related to the immediate proximity of Bratislava, its urbanization, development and the junction of the interests of urbanization, agriculture, recreation, protection of nature and natural resources.

Of course, all these factors are manifested everywhere on the territory in mutual cooperation both in vertical and horizontal directions.

3. Surface and groundwaters

The theoretical conception of ecological solution of the problems of water economics in landscape comprised in the LANDEP method is focused on water retention on our territory both in the required forms and proper positions. This is exceptionally topical for the SWW territory as well, where just in the vegetation period (warm six months) the precipitation deficiency is considerable in comparison with evaporation (more than 200 mm), and it is assumed that the groundwater level decreases in many areas into the depths from which it cannot be utilized by plants, thus, the moisture deficiency is even more remarkable.

The essential principle of the conception of water retention in a certain territory is draining of waters from the production areas and their concentration in the low productivity areas possessing at the same time microrelief and soil conditions for water retention (depressions, residues of dead branches with heavy soils). Ecological proposals were focused on these aspects also in the territory of the Hrušov retention reservoir.

a) *Surface waters*

The investigated area is situated at the top of the Danube River delta where the flow often changed its bed forming thus a rich system of branches from which only residues remained. These permanently or contemporary through-flowing as well as non-through flowing branches secured life for the present ecosystems, at the same time, they created unique features of the Danube natural environment. Considerable part of these residues of the branch system will disappear under the water after completing the retention reservoir. Therefore, the ecological suggestions were focused — after a thorough analysis of the microrelief, biological conditions as well as projects — on the maximum possible saving of the natural features of these changes (and thus on interbranch space) which will not be drawn. This effort was partially successful in the region of the Rusovce Islands due to the joint effort with the nature protectors.

In the outside inundation space less distinct remnants of branches appear which are mostly dry at present. The most distinct of them below Bratislava are the Biskupice branch on the left side and the region of the Rusovce and Čuňovský canal on the right side of the Danube River. Except these, after a thorough analysis of the relative altitudes, after determination of microbasins and the analysis of their interlinking it was possible to map the system of depressions connected at present by little pronounced beds of the branches forming a continuous network.

Theoretical conception of ecological solution of the problems of water in the landscape is applied here in the proposal of the formation of short hydrological systems interlinked by the system of revived residues of the former dead branches and ditches with water surface and rich verdure which would be filled in the period of the excess of water in the Danube River. This system would satisfy both hydrological functions (retention of water on the territory, improvement of moisture balance, eventually supply of groundwater reserves, drainage basis of small melioration systems in potentially waterlogged areas) and various biological and ecological functions (place of reproduction, forage source, refuge of the original fauna and flora, gene resource), microclimatic, antierosion, hygienic functions as well as important functions in the territorial system of ecological stability (biocentres, biocorridors, interaction elements). It is quite clear from these facts that the solution of water problems is an integral part of the general solution of ecological problems.

b) *Groundwaters*

The system of waterworks on the Danube River exceptionally interferes with the regime of groundwaters which also cause essential changes in the whole

ecosystem. Therefore, we have re-evaluated in detail the latest available forecastings (from 1978, 1984) on the level and dynamics of the groundwater level (GWL) after completion of the SWW which has been elaborated by V. Hálek, Assoc. Prof. from Technical University Brno. As it results from the forecasts, the functions of the waterwork — from the viewpoint of a longterm average state — will cause an elevation of the groundwater level by 1 to 3 m on the whole territory compassing the Hrušov retention reservoir. The highest increase in the GWL is assumed in the areas immediately connected with the water reservoir (by as much as 3—3.5 m).

It is obvious from the map illustrating the average depth of the forecast state of the groundwater level under the relief surface that the increase of the groundwater level will influence physical and chemical properties of soil, soil regimes, present vegetation and fauna, and of course, also agricultural utilization of the territory.

c) *Assumed waterlogging of soil by ground and surface waters after completion of the waterwork*

Based on the spatial synthesis of soil waterlogging by surface and ground waters it is possible to point to the most important expected problems already now. These are:

- critical waterlogging by ground waters and precipitations in the interdam space and in the region of the former bed of the Danube River between Rusovce and Jarovce. Here, particularly forests are endangered,
- intensive waterlogging can be expected in the residues of the branch system in the region of the Biskupice branch, at Jarovce, in the area round the canal at Čuňovo, etc.,
- important large-area increase in the groundwater level (up to 1 m under the terrain surface) in the area from the Kopáč Island up to Mliečno. In this area waterlogging will have impact on agricultural production as well.

Based on the data on the assumed waterlogging the expected changes in the soil properties were evaluated, particularly those which were caused by the groundwater level increase where local salting to serious gleyization of soil could take place.

4. **Evaluation of the current state of biocenoses and assumed changes in their composition**

The ecosystem of the Danube flood plain forests represents a unique phenomenon as for the species, productivity, as well as specificity of the feed-

backs. Complex ecological processing is only expected. At the simplified evaluation a short term specifically oriented research in several model groups was taken into consideration along with the mosaics of published papers, and in the case of animals also external cooperation was considered (Department of Zoology of the Faculty of Natural Sciences of Comenius University, Zoological Institute of Comenius University). In general, one can state that the hydroregulation measures and plantation methods of the forestry in the last decades influenced rather negatively the qualities of this system. The dynamics of its development was retarded, the number of species reduced, populations lost their differentiation ability and thus they became more prone to decay in the time of depression and neophytes and synanthropic species asserted themselves more remarkably. The original designers' idea would mean the extinguishment of this ecosystem. Therefore we focused not only on the defeatistic preservation of its residues, but also on the support of its regeneration and securing the continuity of survival during construction.

From this viewpoint the following biotopes were evaluated as the newly formed: Hrušov retention reservoir, approach canal, filtration canal and the dam body, and as endangered, or extinguishing biotopes the natural forests, through-flow branches, shallow dead branches, swamps and wetlands.

As for the aquatic animals for which seemingly new biotopes are formed the retention reservoir and the approach canal cannot form such favourable conditions as a natural water reservoir because of the asphalt-concrete character of the banks, almost non-articulated bank line and pronounced water level amplitude. Substituting biotope for more species of plants and animals can be created on an artificial island whose establishment was suggested by the designer in the river km 1848-9. However, it will be necessary to ensure silencing of the water level amplitude so that a lagoon with partly controllable level will be formed. In the case of proposed area no less than 3 ha a stabilized littoral community of trees are recommended, even drying ones as the nesting sites for birds.

Character of the banks as well as slower flow will shift the ratio in favour of submersed epibiontes which can cause problems for the power-plant particularly in the case of Dreissena.

The change of a large territory partly into a building site and partly into ruderalized areas evokes the necessity to establish at least temporarily stands for swamp and littoral organisms, and particularly for amphibians. Therefore it has been suggested to stop filling and recultivation of sand and gravel pits which could be used for this purpose.

In the territory below Bratislava on the upper part of the retention reservoir which will not be eliminated from the inundation regime the designer insists on deforestation and subsequent plantation of so called hydraulic forest, i. e.

poplar cultivars in normal rows without shrub layers. If omitting the low aesthetic value of such a growth even conditions for quality biocenosis are not created, expansion of some undesirable species (fieldvoles, rats) is supported. Therefore, recalculation of the tree density coefficient is suggested respecting the permissible value not restricting the runoff of the flood water for planting groups of trees and shrub layers.

This is only a brief survey of the problems to be solved in this connection. Some of them are only drafted and will become more factual in the following months.

5. Ecological presumptions of the use of the special-interest area of the Hrušov retention reservoir

By gradual application of all limiting and restricting values of the above specified factors proposals for optimum functional arrangement of the territory in question can be submitted. The final summary of ecological proposal involves:

- basic proposal of ecologically optimum organization of the territory,
- proposal of the structure and way of the forest,
- proposal of the territorial system of ecological stability,
- proposal of keeping the ecological functions of fauna,
- proposal for planting out the dam verdure,
- proposal of articulation of the territory into functional zones and their utilization.

Comments to some important groups of the proposals:

a) Basic proposal of ecologically optimum organization of the territory

These proposals result in the determination of ecologically most suitable location of the required functional elements (i. e. the most suitable utilization of each area). It concerned the proposal of localization of 6 types of water system elements, 13 types of verdure and forest elements, 4 types of grassy areas, 6 types of arable lands and perennial cultures, 3 types of recreation areas, 6 types of settlement and industrial elements, 6 types of special and supplementing objects of educational and recreation routes and sunny areas. The proposals are shown in the scale of 1 : 10 000.

The second stage of this group is the proposal of dividing the territory into functional zones and their utilization. At this stage all previous groups of the proposals are synthesized, and the particular functional zones represent a specif-

ic combination and territorial integration of related functional elements. The proposal of the functional zones is illustrated in Fig. 1.

The particular functional zones were characterized in detail by the following items:

- the most important present properties, expected changes and prevailing present utilization.
- the most important problems resulting from the social and economic phenomena — encounter of interest in the landscape.

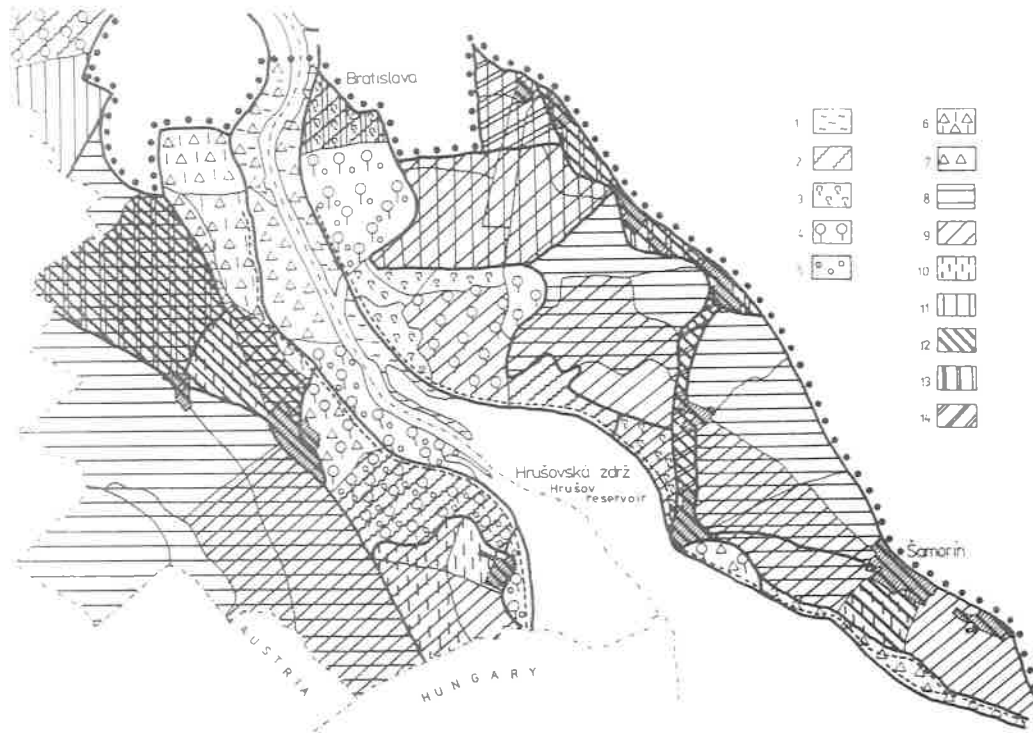


Fig. 1. Proposal of functional zones. Proposed prevailing functionality of spatial units:

- 1 — hydraulic zone, 2 — water management zone (water resources), 3 — forest management zone,
- 4 — ecological — stabilization zone, 5 — scientific — research zone and instructive — recreation zone,
- 6 — recreation — sports zone (grounds), 7 — recreation zone, 8 — zone with prevailing arable land with staples,
- 9 — zone with prevailing arable land with forage crops, 10 — fruit-growing zone,
- 11 — zone with prevailing arable land with non-nourishment crops, 12 — settlement zone, 13 — industrial zone,
- 14 — agricultural-technical zone.

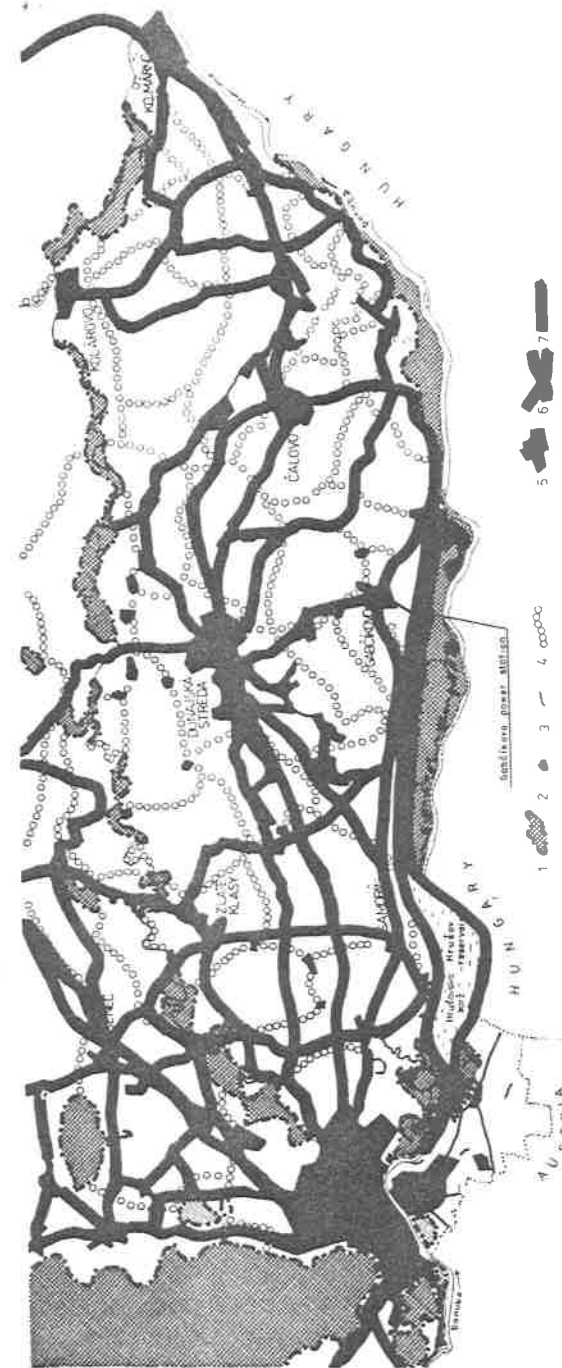


Fig. 2. Outline of the territorial system of ecological stability (TSES). 1 — elements of the supraregional TSES, 2 — core elements of the local TSES (elaborated only for Gabčíkovo special-interest area), 3 — biocorridors of the local TSES (elaborated only for Gabčíkovo special-interest area), 4 — schematic directions of proposed biocorridors in the remaining territory, 5 — areal barriers of TSES continuity (coherent settlement areas), 6 — the most significant line barriers of TSES continuity (main roads and railway lines), 7 — main dams.

b) Proposal of the territorial system of ecological stability

With respect to the natural science values of the environment of Bratislava it represents a part of special importance in this study. The starting point was the existing proposal of supraregional territorial system of ecological stability (TSES) within a wider environment (The Small Carpathians, Šúr, meandres of Čierna Voda and Malý Dunaj) and existing declared protected territories or those being prepared. The point of the study consisted in the balance and the proposal of preservation of areas important from the aspects of ecology and landscape at the local level (tens to hundreds of acres by order) and their interlinking into a unified network breaking up the intensively utilized country (Fig. 2). The system was supplemented by the proposal of new verdure plantation according to more criteria (antierosion, microclimate and other functions). Of course, no complete interconnection was possible because of the barrier effect caused by the Bratislava agglomeration and technical works in the country allied with it. In general there are 39 most important TSES elements registered together with the characteristics of the most important functions which are as follows:

- E — localities and lines important from the aspects of ecological landscape balance,
- G — areas of genetic resources conservation,
- R — present or potential refuges,
- Z — localities important as breeding and food affording places for animals.

6. Conclusion

The aim of the study was to suggest functional, ecological and biological arrangement of the landscape based on forecastable changes of abiotic and biotic components, and to submit a proposal to the control institutions how to manage them in proper time. The proposal of the optimum functional utilization coming out from the existing elements of the skeleton of the ecological landscape stability and their final formation into the territorial system of ecological stability provide an efficient tool for the solution of prognosed problems. However, its efficiency depends on the willingness to implement it as a whole, otherwise it is disintegrated into small mending measures the effect of which is limited.

Regarding the fact that a dynamically changing system has been analysed and not all variables are exactly known, some prognoses are of orientation character only. The study draws attention to elements and phenomena which are to be monitored for a long time to be able to apply the principles of the

adaptive management of the newly arising system, and to elaborate the proper management for it as soon as possible.

Translated by Videopress

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Miklós L., Lisický M., Kozová M.: *Ekologické hodnotenie územia vodných diel Gabčíkovo-Nagymaros.*

Veľké očakávané zmeny krajiny v dôsledku prevádzky vodných diel na Dunaji „Gabčíkovo-Nagymaros“ nútia prírodovedcov k intenzívnemu výskumu zameranému na zmiernenie nepriaznivých vplyvov tohto diela a na návrhy ekologicky optimálnej organizácie a využitia územia. Predkladaný článok obsahuje krátky súhrn výsledkov širokokoncipovaných ekologických výskumov, ktoré boli uskutočnené na Ústave experimentálnej biológie a ekológie CBEV SAV na záujmovom území najvyššie položeného člena systému vodných diel — zdrže Hrušov-Dunakiliti.

Миклош Л., Лисицки М., Козова М.: *Экологическая оценка территории гидротехнических сооружений Габчикова-Надьмарош.*

Большие ожидаемые изменения ландшафта вследствие эксплуатации гидротехнических сооружений на реке Дунае (Dunaj) «Габчикова-Надьмарош» (Gabčíkovo-Nagymaros) заставляют естествоиспытателей осуществлять интенсивное исследование ориентированное на ослабление неблагоприятных влияний упомянутых сооружений, и подготавливать проекты экологически оптимальной организации и использования территории. Настоящая статья содержит сжатую общую сумму результатов широкосоставленных : конспектов экологических исследований, которые были осуществлены Институтом экспериментальной биологии и экологии Центра биологических и экологических наук Словацкой академии наук в районе тяготения выше всего размещенного члена системы гидротехнических сооружений — Грушов-Дунакилити (Hrušov-Dunakiliti).