DANUBE BACKWATERS AND THEIR RESPONSE TO ANTHROPOGENIC ALTERATION

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Abstract

Ecological conditions and species richness of biotic communities were studied in the floodplains of two relatively comparable sections of the river Danube in Austria: (a) an unaltered section near Hainburg (downstream from Wien), but where the construction of a power plant had been proposed, and (b) an altered section near Altenwörth (upstream from Wein), where a power plant has already been constructed. The observed differences in sedimentation rate, chemical composition of water, and species composition of flora and fauna are only partly due to differences in the quality of inflowing surface water and upwelling groundwater. Most of the differences reflect the different degrees of human impact upon the two sites. The unaltered site (a) is much richer in species and requires conservation as a unique example of a riverine landscape in Europe. The proposed power plant therefore must not be built there.

INTRODUCTION

The European riverine landscape has suffered severe loss by regulation of the majority of streams and their use for power stations. The Rhine, once flowed through about 1,000 km^2 of alluvial forests and associated floodplain features, such as evorsion, lateral, lateral levee lakes and oxbows. The Rhine is at present bordered by less than 75 km^2 of alluvial forests. Similarly, the riverine landscape of the Danube has been greatly reduced by the regulation of the river during the second half of the last century, by the construction of power plants, and by land reclamation (Löffler et al. 1976). The last portion of alluvial landscape - and at the same time the largest in Europe of some 80 km^2 - extends between Wien and the Austrian-Czechoslovakian frontier and is now threatened by the planned construction of a power station near Altenwörth (Fig. 1). This selection was made since both localities belong to the Pannonian Province and have similar climatic conditions (Fig. 1).

Apart from the power station, the complete separation of the Danube from the alluvial plain above Altenwörth, which prevents major changes of water level in the plain and rinsing of alluvial gravel from below, is the only important feature that differs from the undisturbed site east of Wien. Here, the Danube still exerts its functions associated with each inundation, such as:

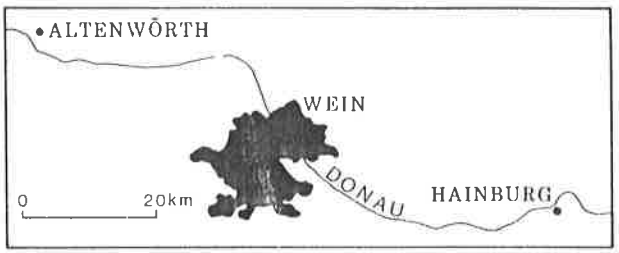

Figure 1. Location of Altenwörth Wein and Hainburg on the Donau River.

. erosion effects within the alluvial plain with a possible formation of evorsion lakes, ie. lakes and pools created by a strong turbulent water flow
. flushing of the water system of the alluvial plain, inhibiting the silting of most water bodies forming this system (on sites with a rapid water flow)
. sedimentation of suspended matter of the Danube and along with it fertilization of the alluvial plain with nutrients such as

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N and P (on sites with a slow water flow, ie. mainly above the average watermark of the alluvial water bodies
. prevention of the growth of the macrophytic vegetation in those channels of the alluvial plain which are exposed to frequent flushing
. removal of large quantities of aquatic organisms and dramatic changes in the physical and chemical parameters of the water.

On the other hand, a long-term low level of the Danube may result in the alluvial water system drying out with all its consequences such as high decomposition rate of organic matter. In the alluvial plain up-stream from Altenwörth most of these processes can no longer be observed, or they are at least considerably reduced. The Danube is allowed to inundate only from a flow rate of 5,800 m^3s^{-1} upwards, a flow rate which has been rare since the power station was opened in 1977. But even then the amount of inundating of the alluvial plain meets the requirements for its proper ecological functioning on extremely rare conditions so that the original condition of the water system cannot be sustained. The purpose of this paper is to compare the two sections of the Danube, Hainburg and Altenwörth.

COMPARATIVE DESCRIPTION OF THE DANUBE ALLUVIAL PLAINS NEAR HAINBURG AND ALTENWÖRTH.

1. Sedimentation: Within the flood zone of the alluvial plain near Hainburg, the sediment accumulation is generally small. Bodies of water exposed to frequent flushing caused by inundation by the Danube show no significant sedimentation; in other bodies of water the sediment depth surpasses 50 cm only at six sites of a total of 32 sites investigated. The accumulated, predominantly inorganic, sediment exhibited traces of sapropelization only in a few cases. In contrast to this, bodies of water north of the Danube near Altenwörth have become partly dry while in those still existing 50% of the 20 sites inspected have a sediment layer deeper than 50 cm and at three sites its depth exceeds 100 cm. Even in the channels which, before the construction of the water works, belonged to the flooded portion of the river Kamp, accumulation of sediment in the order of 10 cm was recorded. This corresponds to a sedimentation rate of more than 1 cm yr^{-1}. Moreover, the sediment profiles of most of the aquatic sites exhibited sapropelic layers; in dry or almost dry water bodies , on the other hand, the sediments showed signs of terrestrial soil formation. This indicates that, apart from infrequent flooding, the fluctuations of groundwater levels are reduced and no longer provide conditions for the formation of subhydric soils.

2. Chemical properties: Chemical data from both sites are listed in Table 1. No inundation occurred in either section of the alluvial plain during the time of our investigations in 1983 and 1984. In general, sampling stations near Altenwörth were less acid. More sampling stations near Hainburg generally had a higher conductivity than the main stream of the Danube, obviously caused by the groundwater which is enriched with ions from the local soil and subsoil. In contrast to this, the river Kamp, which drains the igneous rock area of the "Waldviertel", exerts its influence on most of the existing bodies of water north of the Danube near Altenwörth, and therefore lower conductivity values than in the river Danube itself are typical of the alluvial water system there. Higher conductivities have been found only in artificial gravel pits and the Krems River, which serve as discharge areas to the river.

Table 1. Summary of water chemistry data for two areas along the Danube. The data are frequencies for 15 sites sampled in each area. Values with an * are based on a sample size of 14 rather than 15.

	Altenwörth	Hainburg
pH		
6.5-7.5	33.3	71.5
7.5-7.8	20.0	21.4
7.8-9.2	46.7	7.1
Conductivity (µS)		
200-300	60.0	26.7
301-400	40.0	20.0
401-500	0.0	20.0
501-700	0.0	33.3
Total Phosphorus (µg l^{-1})		
15-100	33.3	50.0
101-150	20.0	28.6
151-320	40 0	14.3
321-600	6.7	7.1
Total Nitrogen (µg l^{-1})		
50-100	0.0	7.1
101-200	6.7	0.0
201-400	13.3	0.0
401-700	60.0	28.6
701-1400	20.0	64.3

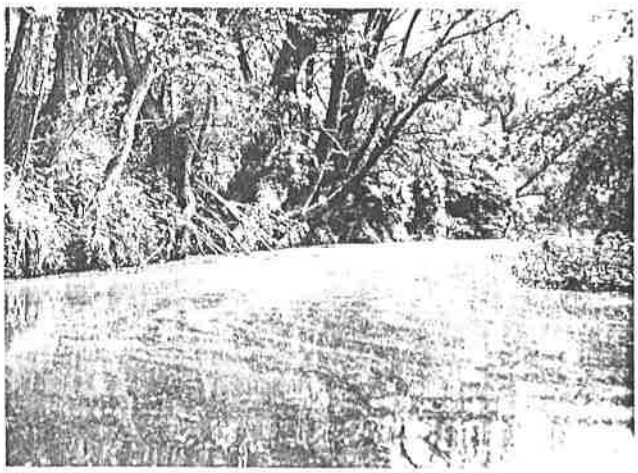

Figure 2. Photographs of wetland areas near Stapfenreuth along the Danube. The upper photograph is a typical aspect of the Rosskoffarm near Stapfenreuth with Phragmites in the background and Nuphar in the foreground. The bottom photograph shows an area dominated by Salix alba.

Total phosphorus and nitrogen concentrations were similar in both sections and they can exceed 500µg l^{-1} and 2,000µg l^{-1}, respectively. Concentrations exceeding 2,000µg l^{-1} of NO_3 have, however, been found only in the water system influenced by the River Kamp near Altenwörth.

3. Macrophytic vegetation and algae: Typical wetland habitats are shown in Fig. 2. About 20 common macrophyte species were found in waterbodies of the alluvial plain near Altenwörth in 1983. Approximately half occurred in man-made gravel pits (Kusel oral comm.). In contrast, almost 60 species occurred near Hainburg. Several, such as Potamogeton acutifolius, Ranunculus rionii, Veronica catenata, and Stratiotes alioides are rare in Austria and Central Europe. The greater diversity is undoubtedly related to the presence of a greater diversity of wetland habitats in the unaltered areas.

As to the algae, the waters of both sites are predominated by bluegreens, such as Anabaena flos-aquae, flagellates (Eudorina, Pandorina), dinoflagellates (Peridinium) and diatoms (Synedra acus, Fragilaria crotonesis, Asterionella). One of the latter, Melosira binderana, is typical of the Danube and occurs near Hainburg in bodies of water frequently flooded and near Altenwörth only in the former river bed of the Danube (Kusel oral comm.).

4. Zooplankton and benthic invertebrates: Differences in zooplankton of both sites can be defined. There are, however, indications that the diversity of the site near Hainburg is much greater than near Altenwörth.

With respect to the benthic fauna there is no doubt that its variety in the Hainburg area exceeds that at Altenwörth. Besides the crustaceans typical of macrophyte beds of the Danube, such as Corophium sp. and Limnomysis benedeni, which increasingly invade the upper part of the river because of the construction of dams and power plants, a wealth of rare species occurs in the waters near Hainburg.

The site near Altenwörth, in contrast, is inhabited by common organisms. Among crustaceans, Dunhevedia crassa and Physocypria fadeewi, so far not known from Austria, may be mentioned, and among other aquatic invertebrates (e.g. 27 species of Odonata, 55 species of Coleoptera) about 40 species are endangered in Austria, or even in the whole of Central Europe. Thus the dragon-fly Aeschna viridis needs Stratiotes alioides for its

reproduction and because of the rarity of this plant, it has a very limited distribution in Austria. On the other hand, the unique diversity of molluscs (35 species) in the backwaters near Hainburg, which is not surpassed by any other site in Austria, offers valuable food resources to fish and spawning facilities to the Bitterling (Rhodeus sericeus). In contrast to the area near Hainburg, the waters of the alluvial plain of Altenwörth have a mollusc fauna comprising only 16 common species. Analysis of cores will provide further information about the mollusc diversity before the construction of the power plant.

An even greater discrepancy between the backwaters of Hainburg and Altenwörth has been found with respect to the spawning places of amphibians, mainly frogs of the genera Rana, Bombina and Bufo. The number of such sites is more than ten times greater in the area of Hainburg than near Altenwörth. This is partly due to the re-shaping of old backwaters and new gravel pits with steep banks: such sites are not easily accessible to these animals.

Similarly, the differences between the fish faunas at the two sites is obvious (Merwald 1981). In contrast to the waters of Hainburg, where thirty fish species were observed, only four occurred near Altenwörth at the time of our investigation. The only exception is the former river bed of the Danube which, at the time of our investigation, was still connected down-stream with the river and not yet influenced by any power plant. About 15 species occurred here. Since then a new power plant has been opened, north of Wien (Greifenstein), and it will be of interest to learn about the changes after this most recent impact. The reasons for the poverty of ichthyofauna in the other backwaters is obviously connected with

- lack of benthic zones with gravel
- poor development and low species variety of macrophytes
- separation of the majority of backwaters from the Danube.

CONCLUSIONS

Summarizing the results of this comparison, it seems necessary to emphasize the lack of proper technologies connected with the construction of power plants in open plains, which would correspond to the needs of the alluvial aquatic ecosystems. Obviously, the complete sealing of the river, which prevents groundwater fluctuations in the alluvial palin and thus the flushing of the gravel layer form below, together with the absence of inundations, results in an ecological impoverishment of backwaters. Therefore, it seems irresponsible to expose the unique riverine area of the alluvial plain between Wien and Hainburg to such an impact, since it represents the last large area of a riverine landscape in Europe.

REFERENCES

Löffler, H. et al., 1976: Limnologische Untersuchungen am Eberschnuttwasser-Gutachten im Auftrag der Stadt Wien, Austria. 80 p.

Löffler, H. et al., 1983: Limnologische Untersuchung zur Standortfrage de Donaukraftwertkes Hainburg/Deutsch Altenburg - Gutachten im Auftrag des Bundesministeriums für Land und Forstwirtschaft. 110 p.

Merwald, F. 1981: Die Veranderung der Fish-fauna eines Donau-Augrabens in fünfzig Jahren. ÖKO-L 3/1: 19-23