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Ecological and restoration potential of the Lower Danube floodplains Problems and perspectives

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ABSTRACT: On the Lower Danube between the Iron Gate and the Danube Delta, large floodplain areas has been cut off from the regularly flood and transformed into agricultural lands, fish pounds and plantations of hybrid poplar in the sixties of the 20th century. From the former area of .796100 ha submitted to regularly floods only about one fourths (241300 ha) remained supposed to the river dynamics. Although these transformations, a high ecological potential with functioning ecosystems, habitats and characteristic biodiversity remained, most on numerous Danube islands of middle and smaller size. This ecological potential, evaluated following different criteria as high, forms the base for a possible repopulation with site typical species of the transformed floodplain areas, if their hydrological conditions would be restored and the floodplain reconnected to the river dynamics. The restoration potential of the area has been evaluated as well and a number of important areas designated to be taken into account for ecological restoration. The opportunities for restoration and the problems are analysed. The ecological restoration can be a good alternative for the local people, giving the possibility to use in a sustainable way the natural resources in the area. The success of restoration is based on the possibility to harmonize ecological and socio-economical interests for the benefit of the local people and communities.

KEYWORDS: functions of floodplains, site typical biodiversity, significant species, bioindicators, ecological potential, restoration potential,

Introduction/Background information

The Lower Danube from downstream the Iron Gate to the Danube Delta is characterised as a typical lowland river stretch with large floodplain area, which in their natural state included large floodplain lakes, wetlands, small streams and natural levees with floodplain forests. In the sixties of the last century large area of floodplains along the Lower Danube 552800 ha i.e. 72% was cut off from the river dynamics and transformed into agricultural lands, fishponds and area for hybrid poplar plantations. With the disconnection from the river dynamics and the loss of floodplain areas a loss or strong reduction of there important functions took place. These are hydrological functions including water retention, self-purification, groundwater supply, biogeochemical functions such us nutrient retention and recycling as well as ecological functions between them the important function as habitat for plants and animals (spawning, feeding, nesting etc.), as reservoir of biodiversity, storage for genetic resources, as biocorridor and area with high bioproductivity (SCHNEIDER 2002).

The main factor controlling the floodplain ecosystem is the fluctuation of the water level which itself depends on changing discharge. Duration, height, seasonal occurrence and frequency of floods determine all ecological changes in floodplains and are also responsible

for the creation of a great number of microhabitats, for the biodiversity and their dynamics, especially in the ecotone area, which include the features of both aquatic and terrestrial life communities. Due to the strong interdependence between the river and its floodplain - including also the islands in the riverbed - and the existing complex framework of effects (see Dister 1985, 1995), the biodiversity is counted in floodplains in general as very high.

Also the general climatic and hydrological factors along the Danube affect the biocoenoses of the Danube floodplains on the river banks and also the islands in different ways, explaining the differences as for its species composition, communities and zonation along the whole river and also on the river stretches of the Lower Danube (Schneider 2003a). Despite their dependency on dynamic floodplain factors the different stretches are also subject to the influence of immediately adjacent areas. With respect to geomorphological, climatic, vegetation cover and general biogeographic aspects of Danube adjacent areas, the Lower Danube have with all their common characteristics in structure and species composition also some differences in the course from west to east. Near to the Iron Gate there are some submediterranian-illyric influences. The transition to the balcanic-moesic area is fluid and cannot be considered as a strict limit. There are differing points of view as to this delimitation (Borza 1960, Borza & Boscaiu 1965, Calinescu 1969). On this stretch the Danube is characterized by submediterranean, even though balkanic influenced climate, with more distinct dryness than in the illyric section. The area from approximately downstream the mouth of the Olt river can be considered as the pontic-danubian section, which is characterized by the gradually increasing influence of the continental climate, which is reflected by its vegetation and fauna.

The numerous Danube islands with undisturbed habitats or habitats with small intervention by man, which haven't changed the natural equilibrium of the floodplains ecosystem, are playing an important role as reservoirs of biodiversity and genetic pools. Guarding a diversity of natural processes and habitats, as well as an important site typical biodiversity along ecological gradients, all depending from the water level dynamics, they are highly valuable and taken into account for the evaluation of the degree of naturalness and ecological value, as well as for the ecological and the restoration potential.

In the frame of a large project concerning the evaluation of wetlands and floodplain areas in the Danube River Basin (WWF Danube Carpathian Programme & WWF-Auen-Institut 1999, Weller 1999, Günther-Diringer 2001) a general evaluation of the ecological and the restoration potential have been realised. These basic data has been completed during new investigations for the Lower Danube stretch and in the same time the methods has been improved including a more detailed analysis (Günther-Diringer, 2003).

Methods and basics for evaluation

To evaluate the recent and historical floodplain area along the Lower Danube investigations had to be carried out to record the selected floodplain areas. First investigations were concentrated on the following fields:

- Historical maps: for delineation of the morphological floodplain and recording of the former floodplain areas;
- Current topographical maps: to record the recent floodplain areas, topographical maps at the scale 1:50 000 to 1:200 000 with registered dyking systems have been studied;
- Thematic maps including pedological data, geomorphological information and geology;

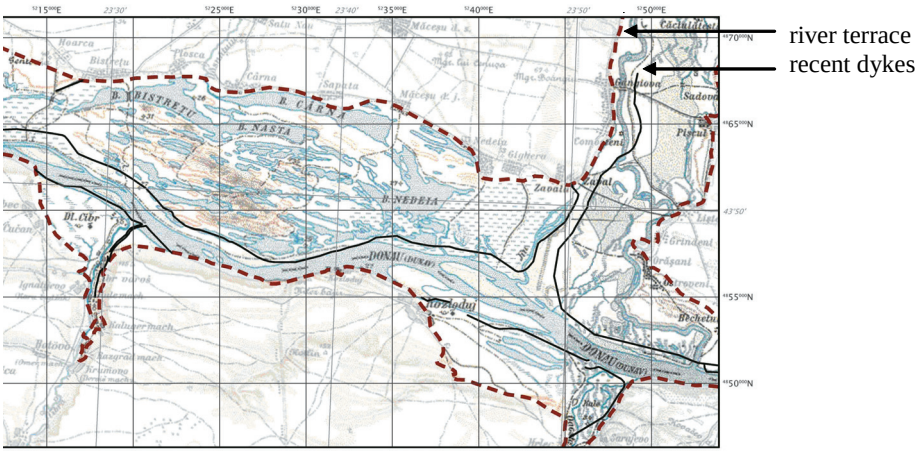

Fig. 1: Danube section (Danube-km 720 – 680) at the beginning of the last century, overlaid with the recent dyke lines for orientation purposes.

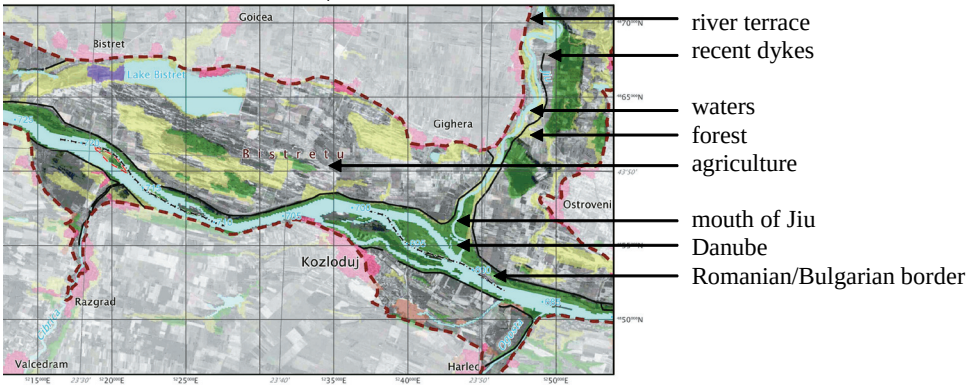

Fig. 2: Same Danube section with recent landuse information (based on satellite images (1997 and CROINE-LandCover-data)

- Study of digital data (CORINE-Landcover data) as well as adequate satellite images (IRS-1C WiFS) to obtain the necessary land use data for the recording of the floodplain area structure;
- Hydrological data for the Lower Danube stretch;
- Landsat-satellite images for important sections at the Middle and Lower Danube.

On the base of the historical and recent maps the limit between recent and morphological floodplain could be recorded. On this basis the delineation of the investigation area has been fixed.

To evaluate the floodplain areas with respect to their ecological value and the restoration potential, they had to be divided into different sections. There are different possibilities to realize the necessary segmentation. At every significant change of the width of the floodplains, which based on hydrological and morphological conditions, a section was created. To use

the floodplains width method for segmentation, the width of the recent and morphological floodplain had to be classified into different widths for each side of the river: 0,1 – 0,5 km; 0,5 – 1 km; 1 – 2,5 km; 2,5 – 5 km; larger than 5 km. Floodplains smaller than 0,1 km were smaller than the level of detail of the input data and were not evaluated.

To substantiate the ecological value, investigation on existing data as well as field works on different points of the river stretch have been carried out. The existence of characteristic, site typical plant and animal species serves as indicators of dynamics (water level fluctuation, substrate dynamics), nutrient dynamics, sedimentation, water quality, development states of vegetation, animal settlements and others. Using these bioindicators a determination of the habitats site quality and the degree of naturalness, of changes and of man-caused alterations was possible.

For the chose of the most significant species selection criteria has been worked out. These criteria are:

1. The species have to show characteristic floodplain habitat conditions and qualities;
2. The chosen bioindicator species are autochthonous on the Lower Danube area;
3. The bioindicator species basically occur in floodplains (but they do not have to be exclusively bound to them) and are present in typical species combinations;
4. The occurrence of bioindicator species will not be falsified through artificial stocks or plantations, e.g. fish stocks or plantation of species that are not characteristic of the sites;
5. Taxonomically the bioindicator species are distinctly defined and may be reliably determined;
6. The species are of biogeographical importance for the Lower Danube area.

In addition to these criteria, for the evaluation of ecological potential have been included also the species with protection status by national and international laws and species listed on annexes of international agreements.

Bioindicators have been chosen in the first step from the higher plants, butterflies, fish and birds. In addition to these species .the most characteristic, floodplain typical plant communities have been also taken into account for evaluation. As the plant species and site typical communities gives the structure of the habitats with many niches for animals, they are considered as base for the evaluation and are presented below.

In the cross section of the floodplain and also in the longitudinal section of the Lower Danube, the occurrence of certain species implies the presence of habitats with a varying hydrological and morphological dynamics (Schneider 2003a). Among these are on the Lower Danube the tamarisk (*Tamarix ramosissima*). It is typical on fine-grained substrates, partly with a low salt content as a consequence of the continental climate, a high evaporation and the salinization coming along with it. Black poplar (*Populs nigra*), White willow (*Salix alba*), other willow species such as the Purple willow (*Salix purpurea*), the Almond-leaved willow (*Salix triandra*) and the willow *Salix fragilis* play an important role as bioindicators for dynamic habitats. These species require very specific germination conditions that only exist on vegetation-free protosoils brought up by the river dynamics, if these are sufficiently moist at the moment of the seed rain. If theses conditions are given, a large-scale succession may take place. Whereas the black poplar may be found on dynamic medium/coarse-grained substrates, the white willow (*Salix alba*) occurs on more fine grained substrates and is typical for the large river course of the Lower Danube (Schneider 2003b).

Ephemeral, short leaving pioneer species such as *Limosella aquatica*, Cyperus species (Cyperus flavescens, C. fuscus, michelianus), Crypsis schoenoides are characteristic of

fine-grained floodplain soils where falling water levels (below the mean water level) leave free areas in the minor riverbed for a short term (2-3 months). They may grow in great number and form what is characteristic for the Danube typical stands. Due to the water level, their development is not guaranteed in every year.

The ecological conditions for near-natural hardwood floodplain forests, mainly of the lower and middle hardwood floodplain level, may, even though only partly, be supported by the presence of the narrow leaved ash (*Fraxinus angustifolia*). It is characteristic of the warm summer floodplain habitats. In the eastern part of the Lower Danube stretch occurs the pontic-danubain ash (*Fraxinus pallisae*). On the same hardwood floodplain forest levels, which on the Lower Danube as a typical lowland river occupies in general only small area, oak species as *Quercus robur* and Balkanic oak (*Quercus pedunculiflora*) occurs. These area with oak and ash are important from the ecological as well as from the biogeographical point of view and represents the most complex parts of the communities characteristic for floodplains.

The narrow leaved ash is attended frequently by summer snowflake (*Leucojum aestivum*). It characterizes wet to periodically wet and periodically flooded habitats of the lower hardwood floodplain and transitory habitats of the softwood forest. This species also appears in flooded meadows and indicates potential floodplain forest habitats. In areas outside the floodplain, the summer snowflake can be found on habitats that have been temporary flooded by high groundwater levels.

On the Lower Danube (also on the Middle Danube) the Wild vine (*Vitis sylvestris*) is characteristic of structured floodplain forests, that naturally occur along water courses and flood channels. In certain cases the species is also an indicator for human intervention in the forest through clearing and does thus not really serve as an indicator only for natural, but for more or less near natural floodplain forests.

Another characteristic species of structured near natural floodplain forests and bushes on the lower and middle hardwood forest level of the Lower Danube is the Greek liana (*Periploca graeca*).This species is also important from the biogeographical point of view, reaching the northern limit of their repartition on the Lower Danube and the Danube Delta. The species is often accompanied by the pontic-mediteranian liana *Cynanchum acutum*

Characteristic is also the occurrence of species, typical for river valleys, accompanying in particular the edges of floodplain forests. The border of white willow softwood stands is marked by the tall herbaceous plant *Senecio paludosus*. The edges of black poplar stands and also the small patches of hardwood forests with elm, ash and oak are the site of *Veronica longifolia.* This species is also characteristic for floodplain meadows where occurs also the clematis (*Clematis integrifolia*). Both are typical for flooded, moderately eutrophic and extensively used floodplain meadows.

The existing wetland communities with reeds and water bodies with macrophytes are also significant for the evaluation of ecological and restoration potential, being the core zones for recolonisation of neighbouring area.

Evaluation of the ecological potential

The evaluation of the ecological potential occurred on the base of a floodplain segmentation, both for the right and left river bank and for the recent and former floodplain.

For a closer characterization of the obtained sections, the CORINE land use data represent the only available database covering the whole are of the lower Danube (and most

of the Eastern European Countries). Further surface-covering data were available from the mapping of the recent and morphological floodplains. The following data were available and could be directly integrated in the evaluation.

1. type of floodplains (recent flooded; controlled flooded; former floodplains (not fooded)
2. width of the recent and morphological floodplains (weighted by the width classes described above)
3. landuse: forest, waters, wetlands, grassland (meadows and pastures), extensive agriculture, farmland, settlements/ constructions

In addition to these data, existing data for habitats as well as characteristic species repartition were used. Field investigations on different Danube islands and floodplains on the right and left bank of the Danube and on some of the islands demonstrated, that valuable ecological potential still exist in particular on the islands with natural hydro- and morphodynamics (creating a mosaic of microhabitats and macrohabitats) as well as dynamic of vegetation and fauna (WWF-Auen-Institut 2004).This potential is more evident, if we compare natural and near natural parts with these transformed by man.

Fig. 3: Lower Danube islands in the area of "Balta Ialomitei" near Seimeni.

In comparison with the islands, the river banks are supposed to more interventions. Natural small water bodies, streams ("gârla"), depressions are rare and also the area of natural floodplain forests, the area of hybrid poplar plantations being very high. Only small parts, which are located in particular near to the mouth of tributaries, such as the Jiu (fig. 2) and the Olt rivers, remained more or less natural. All together, the islands

and the small parts with high ecological potential on the river banks forms the centres which are important not only for conservation of biodiversity, but also in the case of ecological restoration of transformed islands and floodplain areas.

Evaluation of the restoration potential

For restoration purposes only the area of former floodplains were evaluated. The most significant factor speaking against restoration of floodplains are settlements or other constructions inside the former floodplains. The occurrence of this factor, analyzed with GIS-functionality brought a negative evaluation for restoration purposes. Other factors which increased the evaluation were:

- connected areas,
- former floodplain structures (old water courses, depressions with wetland vegetation),
- surrounding recent floodplains for transportation of seeds and drift-material after reconnecting the restoration area to the hydrological regime of the Danube.

Other important factors have to be considered by detailed analysis of the evaluated floodplain section, such as:

- property structure
- landuse conditions
- regional and national political decision makers
- economical evaluation including abiotic and biotic components (silviculture, fishing, gravel extraction), natural functions and values of floodplains, including utility and non utility values, as well as cost/benefit evaluation for the existing use and the future restored area, including an analysis of nutrient reduction capacity of the areas.

Using the mentioned criteria for evaluation, on the Lower Danube a number of large area such us Bistret-Nedeia-Macesu/Balta Bistretu, Balta Potelu, Suhaia, Greaca, Island Calarasi-Raul are proposed for restoration and would be supposed to a more detailed analysis.

Conclusions

Despite of the loss of floodplains (“balta” area), the Lower Danube represents together with the natural river banks and the numerous Danube islands (“ostroave”) a valuable river stretch including a high bio-ecological potential which constitutes a reservoir of biodiversity for the whole network of the Lower Danube Green Corridor. In the same time this potential, being in particular high on the undisturbed or less disturbed islands, constitues also the base for ecological restoration. As centres with high biodioversity and as gene pools they are important also for the repopulation of the areas to be restored if these areas are reconnected to the river dynamics (hydrological and morphological dynamics) and reincluded in the natural network of functioning floodplains. The reconnection to the river dynamics and the restoration of the ecological functions and through them of the natural resources of floodplains such as fishing grounds, reed resources, grazing, landscape with esthetical value can be with great benefit for the local people. The restoration with all their different aspects, resources and values can be also a good alternative for the agricultural lands which can be used only with high costs for pumping and irrigation.

References

1. Borza, Al. (1960): Provinciile floristice ale R. P. Române.- in: Monografia geografica a R. P. R., vol. I , p.549
2. Borza, Al. & N. Boscaiu (1965): Introducere in studiul covorului vegetal.- Editura Academiei Bucuresti
3. Calinescu, R. (Edit.) (1969): Biogeografia României (Biogeography of Romania). Cap, Viata in Dunare, in zona ei inundabila si in Delta (Chap. The life in the Danube, in the flooded area and the Delta), pp. 253-267- Edit. Stiintifica, Bucuresti
4. Dister, E. (1985):Auenlebensräume und Retentionsfunktion.- In: Die Zukunft der ostbayerischen Donaulandschaft, Laufener Seminarbeiträge ANL, Laufen/Salzach 3: 74-90
5. Dister, E. (1995): Die Ökologie der Flußauen und ihre Beeinträchtigung durch den Verkehrswasserbau.- das 2. Elbe-Colloquium: 56-64, Hrsg. Michael Otto-Stiftung für Umweltschutz, Edition Arcum
6. Günther-Diringer, D. (2001): Evaluation of wetlands and floodplain areas in the Danube river basin.- Conference on river restoration, Wageningen, The Netherlands 2000, Proceedings: 91-94
7. Günther-Diringer, D. (2003): Aufbau eines online-Flussauenbewertungssystemes großer Flüsse Mitteleuropas Rhein, Elbe, Oder und Donau.- Dissertation, Naturwissenschaftliche Fakultät der Universität Salzburg
8. Schneider, E. (2002): The ecological functions of the Danubian floodplains and their restoration with special regard to the Lower Danube.- Large Rivers, 13, 1-2, Arch. Hydrobiol. Suppl. 141/1-2: 129-149
9. Schneider, E. (2003a): Organisation longitudinale des for□ts alluviales, le cas du Danube.- in: Piégay, H., G. Pautou & Ch. Ruffinoni :Les for□ts riveraines des cours d'eau, écologie, fonctions et gestion des ripisylves de l'Europe, chap.13 : 272-285, Institut pour le developpement forestier, Paris
10. Schneider, E. (2003b): Formation and evolution of natural softwood stands with respect to water dynamics. Examples from the Loire, Rhine, Elbe and Danube rivers.- Kanitzia Journal of Botany, **11**: 67-84, Szombathély
11. Weller, Ph. (1999): Restoration of Danube Floodplains.- Danube Watch. The Magazine of the Environmental Programme for the Danube River Basin, 1: 7-8
12. WWF-Auen-Institut (2004): Lower Danube Green Corridor Atlas.- First edition, Rastatt
13. WWF Danube-Carpathian-Programme & WWF-Auen-Institut/WWF Germay (1999): Evaluation of wetlands and floodplain areas in the Danube river basin.- Programme Coordination Unit UNDP/GEF Assistance. Danube pollution reduction programme, Final report

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