

Genesis and typology of riparian and fluvial landforms of the Kopački Rit within the Danube floodplain corridor in Croatia and Serbia

Ulrich Schwarz¹

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Introduction

The Kopački Rit at the confluence of the Drava into the Danube river and the adjacent floodplain areas along the middle course of the Danube build a recent floodplain corridor of more than 100.000 ha only in Croatia and Serbia. The Kopački Rit in particular is characterized by long enduring flood events during the early summer months, extensive soft woods and swampy vegetation patterns which form a mosaic of high dynamic shallow floodplain lakes, muddy pioneer stands, a typical ridge and swale floodplain relief with flood channels and oxbows as well as large reed stands and succession areas. Next to the Danube Delta the area is the second most important spawning ground along the entire Danube and hosts over 290 bird species over the year.

Methods

In a first step a landscape structure analysis (habitat mapping) based on multispectral and multisensorial remote sensing data and field surveys with following historical comparisons and a hydromorphological inventory of the Danube and the Drava were carried out. Since 2000 vegetation surveys were done for the most important habitat units such as the different kinds of soft wood and pioneer vegetation on mud. Due to the large area of over 25.600 ha and the partly difficult accessibility (border area to Serbia, some mine fields) a satellite classification and segmentation (Landsat TM, low water scene to survey and include all pioneer habitats) was planned from the beginning. Additionally 10 years old black & white aerial pictures and CORONA images from 1962 were used to analyse the vegetation development within the recent decades.

In a second step a digital elevation model (DEM) was used to calculate the flood levels and to determinate the flooded area for different water stages and flood events.

In a third step all visible riparian and fluvial landforms based on the structural inventory in combination with the floodplain relief information of the DEM were surveyed. In the final analysis the collected landforms were ordered along a flooding gradient including additional parameters such as vegetation, size, planform and genesis to propose a fluvial landforms typology for the research area. Parallel to the development of the typology, attention was given to the genesis of selected typical landforms in particularly all forms depending on the meander morphology and the natural bank walls along the main rivers. The genesis of the unique shallow floodplain lakes in the Kopački Rit - which still exist only in a small number on the lower Danube in Romania- is one of the most challenging tasks.

Selected results

In this chapter only results for the habitat mapping and the basic fluvial landform types will be discussed.

Habitat mapping:

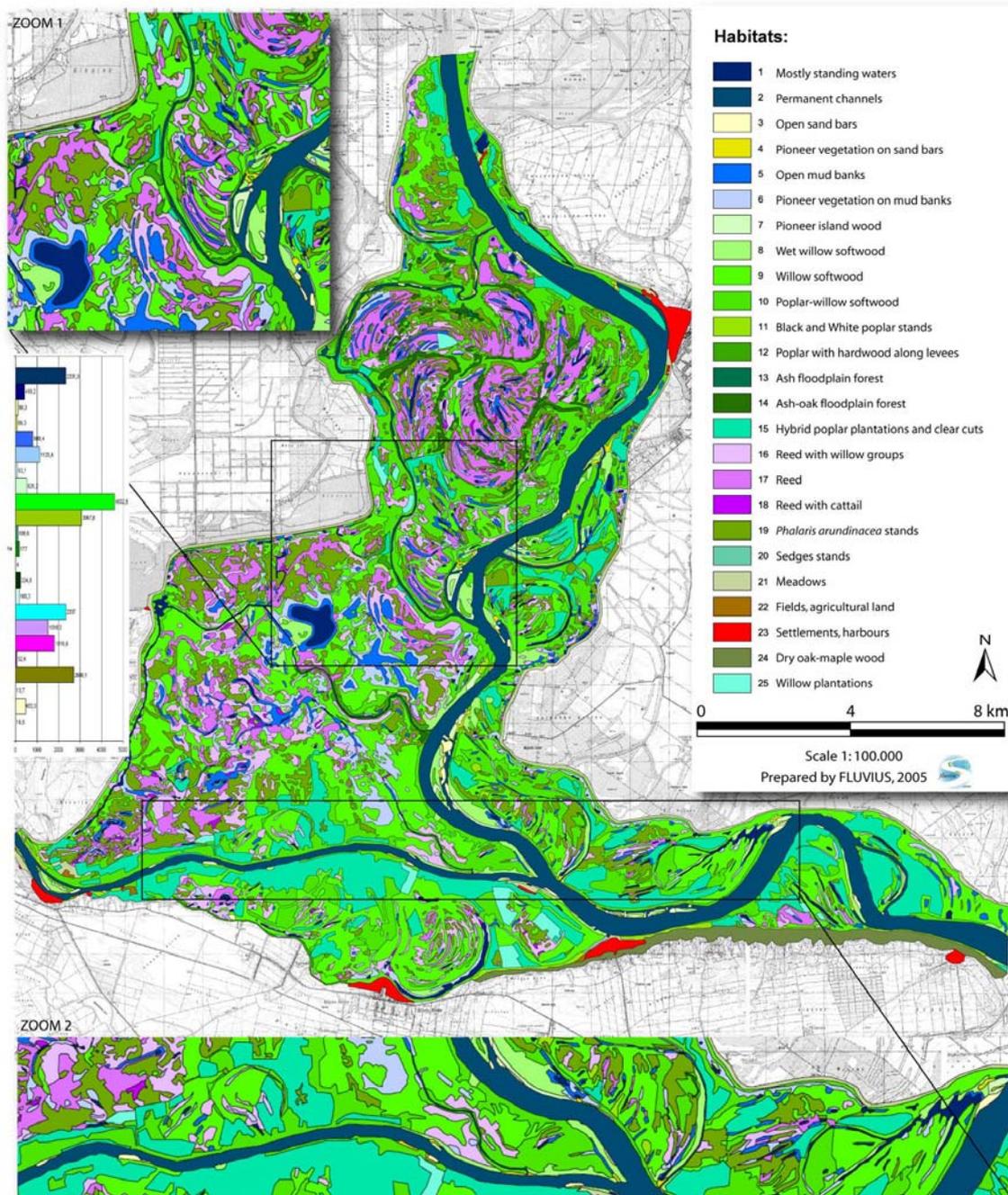
¹ *FLUVIUS*, Floodplain Ecology and River Basin Management, Gärtnergasse 4/3 1030 Vienna Austria, +43 699 10 591384, www.fluvius.com

A total of 23 habitat classes along a flooding gradient were determined. The main groups contribute to the running (10 %) and standing water bodies (2 %), sandy and muddy pioneer habitats (9 %), soft woods and other forests (50 %), different reed and succession areas (17 %) as well as large areas with flood grass (*Phalaridetum arundinaceae*, 12%). Significant is the high amount of dynamic muddy pioneer habitats which are flooded over long periods. Figure 1 illustrates the habitat distribution.

Figure 1: Habitat types and distribution of the Kopački Rit

Habitat mapping Kopački Rit

Danube river km 1.367- 1.409, Drava river km 0-15



Similar to other floodplains of the region typical succession stadiums and annual vegetation on the pioneer stands on mud or sand can be observed as described by Rademakers (1990) for the Hungarian Gemenc floodplain.

The comparison with historical maps and data material (1880-1997) shows less alterations as expected for the last 120 years: mainly the wood coverage increased from 34 to 50% at the expense of reed and muddy pioneer stands. Large pastures at the margin of the floodplain limited the wood development and were partly converted to flood grass stands. The intensive poplar forestations start in the 1960ties. Due to the strong regulation of the Drava in the South typical sandy pioneer stands decreased. However compared with many Western European floodplains the overall proportion of the main habitat groups has not changed considerably. One reason is the reduced riverbed incision in the confluence area based on the very small slope and the relatively unmodified Danube reach along the protected area over 30 km.

Fluvial landform types:

The habitat survey allows a first analysis of the main structure of the riparian system with two main morphological units: A northern part with the typical ridge and swale relief based on recent meander sequences with neck and chute cut-offs and a southern part between the Drava and Danube confluence with a typical bottom and depression character featuring the characteristic very dynamic shallow floodplain lakes.

The main types of riparian landforms can be ordered along a flood gradient according to Schwarz (2005) based on the typology of Ward et al. (2002):

1. Permanent channels (main channel, short side channels, long side channels connected often with other backwaters and secondary side channels)
2. Periodic channels with different connectivity (up- and downstream)
3. Temporary channels with different connectivity (up- and downstream)
4. Permanent standing waters (oxbows of different size, shallow floodplain lakes of different size and connectivity)
5. Periodic standing waters (shallow floodplain lakes of different size and connectivity)
6. Temporary standing waters (of different size)
7. Bank walls and ridges as highest areas in the floodplain
8. Floodplain vegetation and succession in depressions and former channels

Different genetic groups were subdivided such as forms belonging to the recent meander belt with radial flood swales, former confluences of the Drava river with huge shallow swales and floodplain lakes, typical deep oxbows of the Danube or Drava depending on size and structure, rapid shifting truncated meanders of the Danube along the steep bank in the South, forms of relatively flat and homogenous swampy areas between large bi-furcations or reaches with a high anabranching potential.

Summary

The Kopački Rit (protected since 1964) hosts still a great number of different fluvial and riparian landforms which provide diverse habitats and in contrast to comparable sites in Western and Central Europe the structure and vitality of the floodplain are still under near-natural conditions given by the hydrological dynamic of the Danube and Drava. The habitat map is the base for the understanding of the genesis and typology of the riparian landforms. A digital elevation and flood model supports a precise characterisation of the lower floodplain relief and reconstruction of former channels. Additionally the overall historical evaluation of the river course development gives the framework for the identification of different types of channels and bank wall sequences providing the habitats for different succession stadiums. In particularly the specific confluence situation and lateral shift of the Drava and Danube together with the permanent dynamic of flooding and drying up must be seen as the most important components to preserve and restore the unique fluvial system.

References

RADEMAKERS, J. G. M. (1990): Vegetationsökologische Untersuchung im Donau-Auwaldgebiet von Gemenc, Südungarn. RIZA-NOTA 90.078, Lelystad.

SCHWARZ, U. (2005): Landschaftsökologische Charakterisierung des Kopački Rit unter besonderer Berücksichtigung von Flusslandschaftsformen sowie deren Genese und Typologie. Dissertation am Institut für Geographie, Universität Wien.

WARD, J.V., Tockner, K., Arscott, D.B. & Claret, C. 2002: Riverine landscape diversity. In *Freshwater Biology* Vol. 47 (2002), pp. 517-539.