

# Changes of habitat types through several decades in the Danube region in Serbia - The case of Veliko ratno ostrvo island near Belgrade

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## Introduction

Wetlands are considered to be the world's most valuable and productive environments. Therefore, the remaining wetlands of the Danube basin as unique ecosystems have great significance.

The important role of the wetlands in flood control, soil and sediment stabilization, water quality improvement and maintenance of biodiversity in the Danube River Basin has been well documented in a number of studies and reports. However, during the last two centuries, more than 80% of wetlands and floodplain areas within the Danube basin have disappeared (WWF, 1999).

Having in mind the importance of aquatic habitats, the main goal of this contemporary research was the surveillance of habitat type changes along the Danube course in Serbia during several decades using the multitemporal remote sensed data. This paper presents the part of the investigation, focused on the island "Veliko ratno ostrvo" in the city of Belgrade.

Habitat mapping represents a fundamental tool in the methodologies applied by ecologists, environmental managers and conservationists. Habitat maps can form the basis of site management plans, can be used to identify conservation priorities at country or regional level, and can provide the basis for detecting habitat and successional change (Cherrill. & McClean, 1999). Many biologists prefer to use aerial photography for wetlands mapping because it is in familiar picture form, and it can be easily interpreted (Jensen et al., 1986).

## Methods

Aerial photographs of the study site were available for 1984 (panchromatic) and 2000 (panchromatic and color orthophotographs), provided by the "Geo Institute", Belgrade, Serbia.

Habitat boundaries were determined from aerial photographs by photo interpretation. The procedure of photo interpretation comprised the following steps: scanning of aerial photographs (1000 dpi), rectification with 30 control points distributed along the whole area of the rectified photographs, using the first order polynome for transformation and nearest neighbor rectification method (Caloz & Collet, 2001), visualization of distinct habitat types and on screen digitalization using Manifold software (Manifold System, CDA International Ltd.). The same software was used for GIS analysis of habitat changes.

Habitat types were defined according to the list of Habitats of Serbia (Lakušić et al., 2005) which is consistent with revised edition of the European Nature Information System (EUNIS) Habitat Classification (Davies et al., 2004). The used nomenclature served as classification keys that provided the link between ecologically defined habitats and the classes distinguishable on aerial photographs.

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## Results and Discussion

The river island “Veliko ratno ostrvo” lies at the confluence of two rivers, the Sava and the Danube (between 1172 and 1169 river-km), in the vicinity of the center of the urban zone of Belgrade. The island and the waters around it are not only the residence of numerous rare species including endangered birds, but also a morphologically and geologically extremely interesting area. In addition, during summer it is one of the Belgrade's picnic places, due to the beach on its northern side.

The position of the island “Veliko ratno ostrvo” is one of the features which determined its extrinsic deltoid shape. The confluence provokes turbulent water movement that influenced specific deposition and distribution of sediments, and, consequently, the shape of the island. For the same reason, the size and contours of the island are changing very fast, even in the past twenty years which were analyzed in this study.

The island “Veliko ratno ostrvo” is periodically flooded. The range of flood duration in the lowest parts of the island is from 20 to 365 days per year.

Figure 1. shows habitat maps, as well as the list of present habitat types of the island Veliko ratno ostrvo for the years 1984 and 2000.

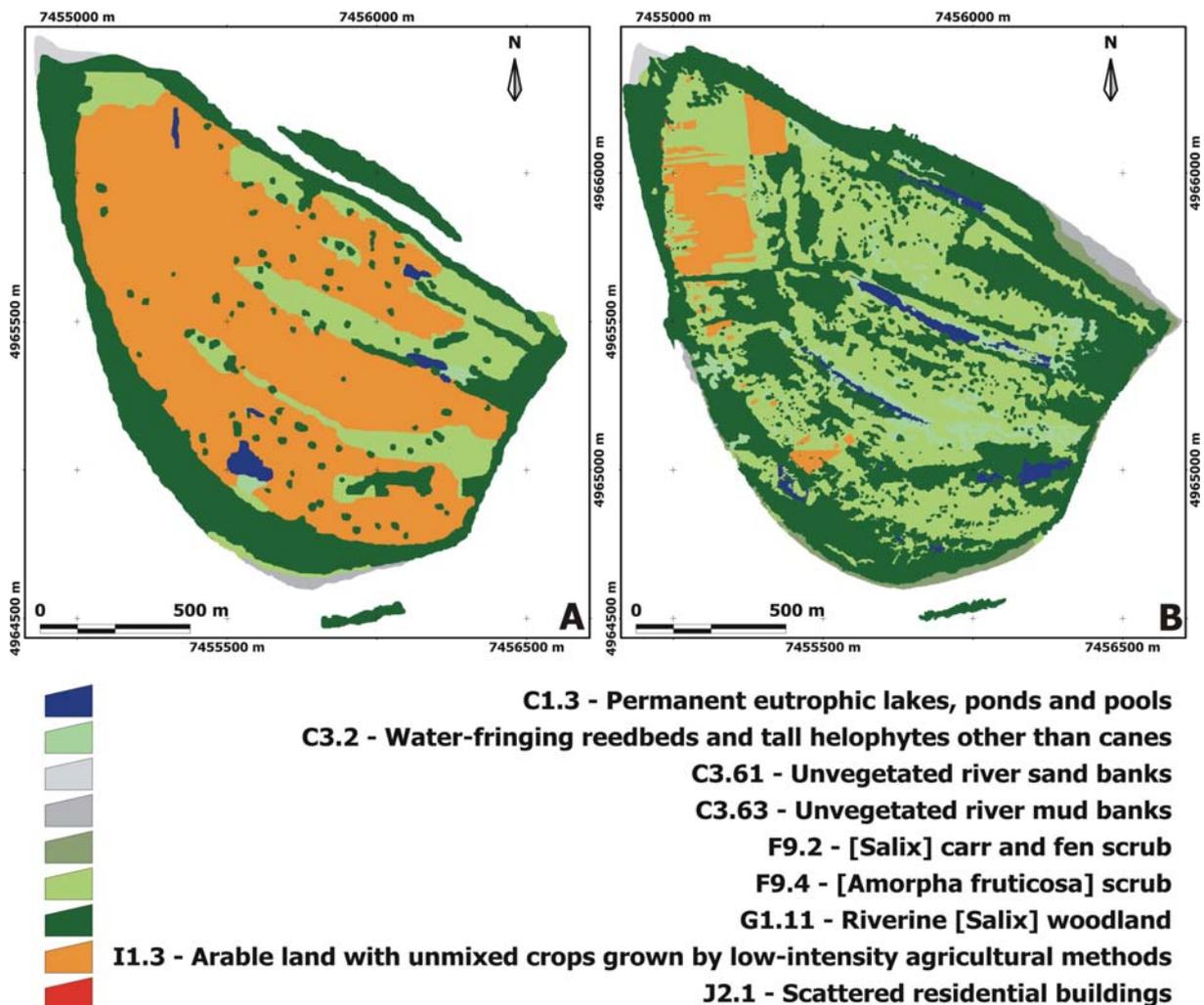


Fig.1 Habitat maps of the island Veliko ratno ostrvo for the year 1984 (A) and the year 2000 (B)

Twenty years ago, 53.2% of the island were agricultural areas (I1.3 - Arable land with unmixed crops grown by low-intensity agricultural methods), followed by 28.4% of willow

and poplar forest (G1.11 - Riverine [*Salix*] woodland). In early 80s, *Amorpha fruticosa* scrub (F9.4) had covered 15.9% of the island. This habitat type was not originally recognized by EUNIS Habitat Classification (Davies et al., 2004). However, due to the rapid expansion of this invasive species, it was introduced to the list of Habitats of Serbia by Lakušić et al. (2005). Permanent eutrophic lakes, ponds and pools (C1.3) which can be found in microdepressions had occupied 1.2% of the island. The rest of the habitat types (C3.2 - Water-fringing reedbeds and tall helophytes other than canes, C3.61 - Unvegetated river sand banks and C3.63 - Unvegetated river mud banks) had comprised less than 1% of the island's surface.

Today, the situation is quite different. In spite of the anthropogenic pressure, the island "Veliko ratno ostrvo" is returning to the more natural condition. Namely, only 6.0% of the island's surface is used for agriculture (I1.3). The other portion of agricultural areas was abandoned and conquered by other habitat types, mainly *Amorpha fruticosa* scrub (F9.4), *Amorpha fruticosa* is spreading rapidly and now occupies 36.8% of the island. Willow and poplar forest (G1.11) occupies a part of abandoned arable land, covering nowadays 44.3% of the surface. Moreover, the augmentation is perceived for reedbeds (C3.2 - Water-fringing reedbeds and tall helophytes other than canes) and willow scrubs (F9.2 - [*Salix*] carr and fen scrub). At the present time, reedbeds and willow scrubs, which were absent in early 80s, cover 5.0% and 2.0% of the island, respectively. Besides microdepressions which are occupied with permanent eutrophic lakes, ponds and pools (C1.3), remaining habitat types (C3.61 - Unvegetated river sand banks, C3.63 - Unvegetated river mud banks and J2.1 - Scattered residential buildings) cover negligible portion of the island's surface.

In the year 2005, the island "Veliko ratno ostrvo" was designated as a Landscape of outstanding qualities by the Assembly of the City of Belgrade in order to protect picturesque landscapes, as well as the habitats of rare and threatened species and representative morphological and geological features.

## Summary

Having in mind the importance of remaining wetlands and floodplains of the Danube basin, the main objective of this contemporary research was the surveillance of habitat type changes along the Danube course in Serbia during several decades by multitemporal remote sensed data.

This paper presents the part of investigations focused on the island "Veliko ratno ostrvo" situated at the confluence of the Sava and the Danube rivers, in the urban zone of Belgrade. The surveillance of habitat type changes was done according to the analysis of aerial photographs from 1984 and 2000. The nomenclature used in this study is the list of Habitats of Serbia which is consistent with EUNIS Habitat Classification.

The results are incorporated in GIS, spatially analyzed and presented in cartographic form. They demonstrated the amelioration of ecological conditions, despite the anthropogenic pressure. Considering the fact that the island has been protected since 2005, the further amelioration can be expected.

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