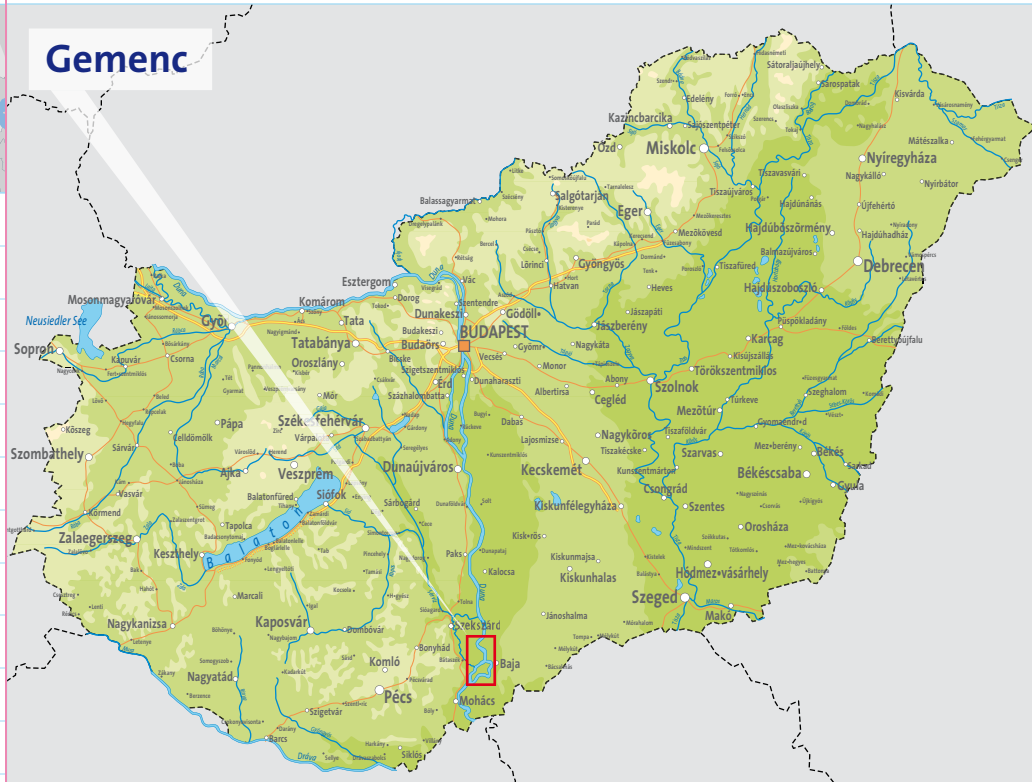




# Hungary



## Gemenc



### General

The Gemenc Protected Landscape Area is the widest floodplain zone in Hungary, situated on the right bank of the southern stretch of the main Danube stream, between the Sio channel and the city of Baja. The floodplain is characterised by several formerly active meander arm sections dissecting densely forested land, cut off the main stream or becoming isolated from it as a result of river training works. The Ven-Duna side arm is one of the shortest side arms connecting water bodies on the floodplain to the main Danube arm situated in the Gemenc floodplain.

### Natural dynamics, hydromorphological processes and ecology

Under natural conditions the Gemenc floodplain water bodies were characterised by flowing conditions and rheophilic fauna and flora, in which natural sedimentation processes conditioned the proactive decrease of water flow and related dynamic changes in environmental conditions.

The construction of water training works for river regulation along the Hungarian part of the Danube started in the middle of the 19<sup>th</sup> century. The main aim was to prevent extreme and destructive flow and flooding regimes, while improving the navigation conditions as additional purpose. The deepening of the Danube main

stream, the accelerated siltation and up-filling of old side arms and the lack of water flow during average and low water flow conditions resulted in partial isolation and individualisation of different parts of the floodplain water bodies.

The Ven-Duna arm had the additional problem of being closed by a perpendicular rock dam on its upper part, completely inhibiting the water flow during average and low discharge conditions in its lower stretch. The dam excluded the side arm from water transport, resulting in more water and better navigation conditions in the main Danube channel, especially during average and low water flow conditions. As a consequence, the Ven-Duna increasingly showed problems of water quantity and water quality, and the original rheophilous flora and fauna was replaced by biota typical for stagnant water types. Meanwhile, on the terrestrial floodplain original hard wood forests characterised mostly by *Quercus* species were replaced by artificial plantations of soft wood species, mostly *Populus taxa*. Additionally non-indigenous invader species like *Fraxinus pennsylvanica* and *Solidago serotina* entered the area.



#### **Measures executed**

In order to obtain knowledge and experience on possibilities to restore natural hydro-morphologic conditions and the connectivity between the river and floodplain zone, a small-scale case study river restoration intervention was designed for the Ven-Duna side arm. The main objective of the restoration project was to provide for a direct water flow connection of the side arm with the Danube main stream in order to restore the natural biodiversity and rheophilic communities typical for aquatic



floodplain landscapes. The technical intervention of re-opening the side arm, executed in 1998, was accompanied by an extensive scientific research & monitoring program carried out in the Ven-Duna side arm and the River Danube between 1997 and 2000. The scientific research provided an adequate in-depth understanding to evaluate the positive and negative environmental consequences of the river restoration pilot study. These results of the detailed investigations and documentations provide knowledge of high benefit for comparable river & floodplain restoration projects in Europe.

**Results**

Detailed physical and chemical monitoring performed to follow the hydromorphological, water quality and hydrobiological changes after the side arm rehabilitation activity being carried out in the Ven-Duna clearly showed that processes related to water flow were crucially important in determining the chemical and biological conditions in the Ven-Duna side arm.

Four years of monitoring showed changes in riverbed morphology upstream and downstream of the former rock dam. Restored high floods showed increased sediment transport, erosion and deposition. Biological monitoring revealed an increase in suitable habitats for rheophilous invertebrate and fish species. As such both species diversity as well as population numbers typical for dynamic water bodies increased, while stagnant water habitats and their species also remained. The deteriorated water quality in the side arm was restored completely following the opening of the rock dam. The study also showed that re-opening the side arm did not have negative impacts on the directional flow and navigational conditions in the Danube main stream.

As 4 years of monitoring maybe limited for understanding the complete processes of changes introduced by restoring the dynamic water flow pattern, it is worthwhile to continue the monitoring activities further in future, in order to follow long-term developments in the region.

