Conservation of Mura banks, Slovenia

Year of issue

2025

Summary

The BIOMURA project (LIFE06 NAT/SI/000066, 2006–2011) focused on conserving four Annex I habitat types along the Mura River in eastern Slovenia. Measures included reconnecting the main channel with side channels, securing adequate water intake at average and low flows, locally widening the riverbed, creating new side branches and backwaters, and sustainably maintaining alluvial forests. Works were implemented on the Bakovci–Mota reach and in villages such as Bunčani, Veržej, Melinci and others, with land purchase enabling habitat restoration. The project also established two information centres (Murska Sobota, Mota) and an educational trail in Veržej. These interventions improved hydromorphological processes, raised groundwater levels and enhanced habitats for riparian and endangered species, including amphibians, fish and birds. Funded by the LIFE programme, the Ministry of Environment and Spatial Planning, the Institute for Water of the Republic of Slovenia and partners, BIOMURA contributed to Natura 2000 site management and public awareness in the Pomurje region.

Photo Gallery







Location

46.59138, 16.17805

Project

NWRM

National ID

Slovenia_01

Sector

Hydromorphology

Installation Date

2011

Contact

REC

Overview

Location of the project

The bed of the river Mura flows through NE Slovenia, whose area lies between the villages of Bakovci, Dokležovje, Ižakovci, Melinci, Bunčani, Veržej, Krapje and Mota.

Country

Slovakia

NUTS2 Code

Bratislavský kraj

Sponge measures implemented in the case study

Reconnection of oxbow lakes and similar features

Natural bank stabilisation

Wetland restoration and management

Involved partners

Authority type	Authority name	Authority role	Comments	Authority responsibility
Research institute / University	Institute for water of the Republic of Slovenia	Initiation of the measure	—	Responsible
Architects / Engineers	Ingeeniring for Waters (IZVO)	Monitoring	Supervision in restoration	Supporting
Local water authority	Mura Water Management company (Mura VGP)	Implementation	—	Supporting
Research institute / University	Institute of the Republic of slovenia for Nature Protection (ZRSVN)	Other	Professional national Institution	Supporting

Authority type	Authority name	Authority role	Comments	Authority responsibility
Regional / sub-national water authority	Regional Development Agency Mura (PRA Mura)	Other	Responsible of some information actions	—
Other	Prleska Development Agency (PRA giz)	Other	Responsible of some information actions	Supporting
NGO	Society of Bird Research and nature conservation (DPPVN)	Other	Participation and support of some information actions	Supporting
NGO	World Wide Fund for Nature Austria (WWF Austria)	Monitoring	World Wide Conservation Organization; Participation and support of some information actions	Supporting

Documents

cs-si-01-final_version.pdf (1.06 MB)

Site Information

Climate Zone

Cool temperate moist

Temperature (°C)

15.00 °C

Runoff

350.00 mm

Elevation range

189

Vegetation class

alluvial riparian forests (floodplain forests)

WFD Ecological status

Good

WFD Chemical status

Failing to achieve good

Design and Implementation

Project scale

Meso

Project scale specifications

The area covered by the project has a surface of 15.2 km2 and is part of the Natura 2000. The area lies between the villages of Bakovci, Dokležovje, Ižakovci, Melinci, Bunčani, Veržej, Krapje and Mota.

Project area

4024

Size

8.30

Size unit

km

Factor constraints

The measures undertaken depended on the knowledge of natural processes and encroachments upon the river habitat made in the past.
Although the Mura River has been straightened and the meanders cut-across, leaving behind oxbows, parts of the old channel are still recharged by the river, precipitation and groundwater. The processes of more relaxed, less controlled dynamics of the water flow, with a more frequent and easily spotted bank erosion, natural sediment transport and deposition, frequent flooding, river branches and oxbows, are especially present downstream of Veržej. The Mura river space in Slovenia, and at the reach bordering Croatia, is therefore among the richest ecosystems in Slovenia.

Constraints

The biggest threat to this project is the project of hydropower stations construction on Mura river which is pushed by the investor Dravske elektrarne. In case of the future implementation of these power plants our best practice BIOMURA wills potentially be endangered or even destroyed and during the construction the water level was often too high, the work was interrupted for a few times.

Favourable preconditions

Former wetland with a high biodiversity value

Financing

Total cost

1991567.00 €

Total cost information

Land acquisition and value: 61800 € Thirteen purchase contracts for 26 parcels, 35663 m2 large.
Costs incurred from the start date to 31/10/2011

Costs investment

1975519.00 €

Costs investment information

Total budget

Costs land acquisition unit

€ (total value)

Economic costs other annual

9000.00 €

Financing authorities

Authority name	Type of funding	Comments	Financing share
European Union	EU-funds: LIFE+	LIFE Nature program	49%
Ministry of Environment and Physical Planning of Slovenia	National funds	—	34 %
Institute for Water of the Republic of Slovenia	National funds	—	11 %
Various other partners	Other	—	6 %

Compensations

No

Policy and Governance

Policy description

The reason for the project was high biodiversity value of the Mura
River in Slovenia. In 2004 a large part of it has been declared the
Natura 2000 site (SPA Mura SI5000010 and pSCA Mura SI3000215). It is crucial that proper water management and management of forest and agricultural areas are implemented to stop ecological deterioration and to support existing biodiversity value.
Intensive water use, activities in the river and riverside space and the change of land use in the Mura River catchment (chain of hydropower plants on the Mura in Austria, flood protection structures and facilities, water supply, management of agricultural land, urban development) have considerably altered the river space. Most of all, they affect the bed-load discharge and processes of self-formation of the river space in Slovenia. At the border between Slovenia and Austria, the river bed of the Mura River has deepened by as much as 1.5 m in the last decades (by 33 cm on average), and there is a trend of slow deepening of the river bottom downstream of Petanjci and change of hydrological features of the Mura wetlands. Flood events occur less often and the low flow periods are longer, resulting in the gradual drying-out of the alluvial forests along the Mura. The water dynamics in oxbows, side branches and on the ground is becoming less diverse. The creative power of water, needed for operation of such a habitat structure, is diminishing. With improper management of forest and agricultural areas the ecological habitat conditions of these wetlands are deteriorating.

Policy targets

Improved Biodiversity

Groundwater Recharge

Target remarks

The activities of the BIOMURA project aimed at improvement of growing conditions for 4 habitats from the Habitats Directive: Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris); Water courses of plain to montane levels with the Ranunculion fluitantis and CallitrichoBatrachion vegetation ; Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels; Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae).
The conservation of targeted species for more than a third of the Natura 2000 qualification species on the Mura river should be ensured. Targeted species from that Annex II to the Habitats Directive include: 1 butterfly species (Callimorpha quadripunctaria), 1 amphibian species (Bombina bombina), 1 dragonfly species (Ophiogomphus cecilia) and 5 fish species (Misgurnus fossilis, Rhodeus sericeus amarus, Gymnocephalus schraetzer, Umbra krameri, Aspius aspius). Also, it is assumed that the living conditions of 29 other species of birds, butterflies, dragonflies, amphibians, reptiles and mammals improved.

Policy pressure

Directive	Relevant pressure

WFD identified pressure	3.1 Abstraction – Agriculture
WFD identified pressure	3.2 Abstraction – Public Water Supply
WFD identified pressure	4.1.1 Physical alteration of channel/bed/riparian area/shore of water body for flood protection
WFD identified pressure	4.1.2 Physical alteration of channel/bed/riparian area/shore of water body for agriculture

Pressure remarks

Intensive water use, activities in the river and riverside space and the change of land use in the Mura River catchment (chain of hydropower plants on the Mura in Austria, flood protection structures and facilities, water supply, management of agricultural land, urban development) have considerably altered the river space.

Policy impact

Directive	Relevant impact
WFD identified pressure	Ecological status
WFD identified pressure	Alterations in discharge amount due to the uncontrolled water abstraction (e-flow)
Floods Directive identified pressure	Water body status

Requirement directive

Requirement directive	Specification
WFD-achievement of good ecological status	Good ecological status and international collaboration
Floods Directive-mitigating Flood Risk	Flood protection and good ecological status
The Birds and Habitat Directives	—

Policy challenges requirements

RBMP of Danube River District

Part of a wider plan

No

Public consultation

Yes

Consultation activities

Activity type	Comments
Workshops	3 local (15th May 2007 in Ljutomer, 30th November 2009 in Mota and 17th November 2010 in Doklezovje) and 2 regional (4th June 2007 in Muska Sobota and 12th October 2011 in Mota)
Biomura newsletter	10 Issues were published, 5 leaflets, DVD
Information Centre	Information centre with educational trail opened and 7 information pan

Has contractual arrangements

Yes

Contractual arrangements

Name
Agreement with the Ministry of the Environment and Spatial Planning

Impacts and Monitoring

Monitoring System

Monitoring requirements

monitoring of species and habitats was carried out during and after implementation by the Institute for Water of the Republic of Slovenia (IzVRS) and the Institute for Nature Conservation (ZRSVN)

Monitoring parameters

The BIOMURA project monitored key biodiversity indicators to assess the success of restoration. Parameters included the presence, abundance, and breeding success of target bird species (Annex I Birds Directive), amphibian populations in restored and created backwaters, and fish community composition in reconnected side channels. Habitat structure, vegetation composition in floodplain forests, and the physical condition of newly excavated side branches and backwaters were also assessed. The monitoring aimed to detect changes in habitat quality, connectivity between the main river and side arms, and the response of priority species to hydromorphological improvements.

Maintenance

Maintenance requirements

sustainable maintenance of alluvial forests and side channels was part of the project, including periodic clearing of vegetation and debris in side arms, and preservation of newly created habitats

Impact Assessment Methodology

Performance impact assessment method

Catchment outlet

Performance impact estimation information

Monitoring after many prior field inspections

Socio-economic Impacts

Direct benefits information

Conservation of natural values and biodiversity will sustain if not enhance ground and surface water regimes in their dynamic character and connectivity.

Ancillary benefits information

Wetland ecosystem services such are fish stocks, groundwater for human consumption, wood stocks and biomass will become even more important for local and regional community. Restoration and rehabilitation works in the project area are offering job opportunities for local people and providing long-term opportunities for creation of trails, observation facilities, information center, education points and paths. Development of a sustainable tourism is an option and source of local employment and income increase in the Pomurje region in the future. The project has also become a strong counterpart to the idea of electricity production on the Mura River upstream.

Biophysical impacts: Hydrology

Information on increased water storage

Increase in the volume of retained water due to the connectivity between the main river and side channels and introduction of higher river morphological structure in the river bed (erosion banks, gravel bars, river islands) and flood forest.

Information on Restoring hydraulic connection

Connection of the main channel of the Mura River with side channels and abandoned oxbows with the main channel of Mura. Creation of favourable conditions to meet the needs of wetland and river ecology, which enables high biodiversity of the river Mura.
e.g., a 550 m new branch connected to the Besnica side arm; two chutes (drče) were built on the Mura; ~260 m of bank protection was removed near Bakovci to allow lateral widening; several backwaters (mrtvice) were deepened/created.

Information on reducing flood risks quantity

Local widening of the channel leaving space for flooding

Biophysical impacts: Biodiversity

Improved biodiversity

Yes

Information on improved biodiversity

Fish. 18 species documented in Besnica (out of ~40 native species in the Mura); presence of several threatened species (e.g., Rhodeus sericeus amarus, Leuciscus souffia [“navadna nežica”], Romanogobio vladykovi [“beloplavuti globoček”]—Slovene common names as listed). Side arms favor lentic/slow-water assemblages; strictly rheophilic targets remain in the main channel.
Amphibians. 11 species recorded 2007–2011; all renatured branches became important spawning sites, with immediate response (egg-mass counts, pairs, and individuals tracked at Bunčani, Veržej, Dokležovje).
Birds & forests. Very high densities of Middle Spotted Woodpecker and Collared Flycatcher in willow-dominated stands; actions expected to promote kingfisher, sand martin, and little ringed plover via eroding banks and gravel bars. (Qualitative/relative; no numeric densities given.)

Biophysical impacts: Water & Soil Quality

Water quality overall improvements

N/A info

Soil quality overall improvements

N/A info

Biophysical impacts: Others

Ecosystem impact climate regulation

Not relevant for the specific application

Lessons Learned

Key lessons

One of the main lessons from BIOMURA is that restoring connectivity between the main river channel and its side arms can quickly generate ecological benefits. The excavation of new branches, reconnection of old meanders, and removal of bank protection created diverse hydraulic conditions that were rapidly colonised by amphibians, fish, and riparian vegetation. This confirms the effectiveness of targeted hydromorphological interventions for biodiversity recovery in regulated lowland rivers.

Another lesson is the importance of land acquisition in enabling restoration. Purchasing key parcels along the Mura allowed works to proceed without conflicting with agricultural land use, and secured the long-term management of restored habitats. Without this, maintaining restored structures and forest stands would have been much more challenging.

The project also demonstrated that a good knowledge and coordination of the tasks of each stakeholder is essential for completing works without serious problems. BIOMURA benefited from good organisation, mutual respect between partners, and joint engagement in preparing outreach materials such as a film, workshops, and field visits. This partnership model is considered successful and should be further developed in other environmental projects in Slovenia.

Thanks to the project, the local community recognised that nature is important and that both the European Commission and national authorities care about their Mura. Public engagement through information centres and educational trails fostered this connection, which is crucial for sustaining support in the long term.

Finally, BIOMURA highlighted the limits of local restoration in the face of larger-scale pressures. While side arms were rewatered and habitats improved locally, long-term issues such as regional groundwater decline and sediment deficit, driven by upstream regulation, remain unresolved. This underlines that site-level actions need to be integrated into basin-wide management to achieve lasting hydrological improvements.

Barriers

Barrier type	Barrier role	Comments
Existing technical standards	Main barrier	Small delay due to one permission of contruction in the stone riffle implementation.

Drivers

Driver type	Driver role	Comments

Legal obligations	Main driver	Habitats Directive and Birds Directive

Success factors

Success factor type	Success factor role	Comments
Attitude of relevant stakeholders	Main factor	Good organization between stakeholders and assigned activities
Successful coordination between authorities	Main factor	—

Transferability

The BIOMURA approach is transferable to other regulated lowland rivers where side arms can be reconnected and habitats restored. Success depends on securing land rights, ensuring stakeholder coordination, and combining ecological works with community engagement. Care is needed to address wider basin-scale pressures (e.g. sediment deficit, groundwater decline) so local gains are not undermined by upstream or regional impacts.

Basin characteristics influence

The bed of the river Mura that flows through NE Slovenia is well preserved, especially in the middle and lower stream, where it is characterized by embankment erosion, deposition of the sand, flooding and side-channels.

Sources

Sources

BIOMURA

BIOMURA - Conservation of biodiversity of the Mura river in Slovenia

Case study: Biomura LIFE06NAT/SI/000066

BIOMURA

Primeri sonaravnega urejanja površinskih voda