Interreg
EUROPEAN UNION
Danube Transnational Programme
lifelineMDD

River Training structures and historical mapping

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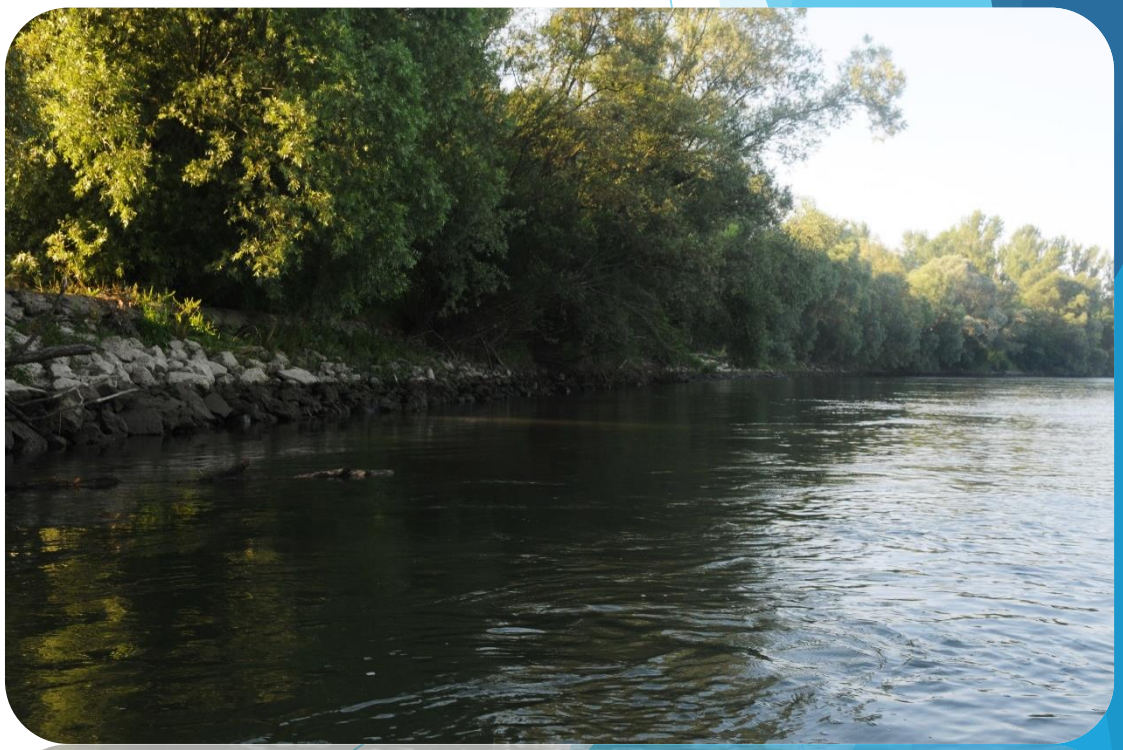
Dr. Ulrich Schwarz, Vienna

FLUVIUS
Floodplain Ecology and River Basin Management

Murstromkarte, Steiermärkisches Landesarchiv



Ivan Darko Grlica

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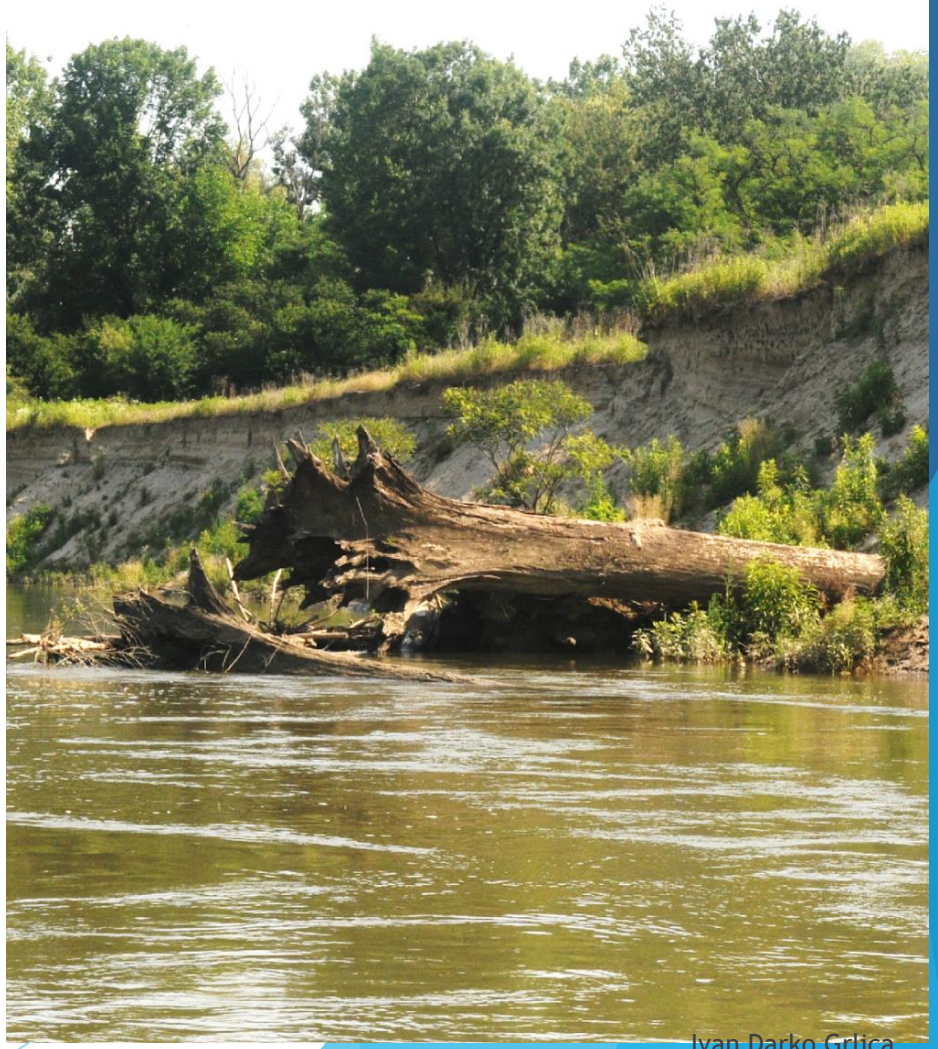
1. Introduction

- *Task 1: Mapping of river training structures: Bank reinforcements, groynes, ramps, dams and flood dykes.*
- *Task 2: Historical mapping of river corridors: Waterbodies (main channel, side channels, oxbows), islands, bars, riparian forests and wetlands within the active floodplain.*



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2. Approach

- *River training structures: National data collections and navigation maps for the Danube are the base for the detailed high resolution satellite image analysis.*
- *Historical situation is based mainly on 2nd K&K Military survey ~1860, complemented by earlier spots to show the situation prior to major meander cut offs (1815); for upper Mura using the "Murstromkarte" which has a better spatial resolution and for Danube the Pasetti map including more details as well. For comparison the overall landscape mapping of 2013 (WWF) was available.*

Mapped features and data

- *Structures (bank reinforcements, groynes, barriers, dykes): Position, type and status (age/functionality (new, old, overgrown, collapsed), bank connection or not), height in relation to vegetation line and for dams/ramps.*
- *Historical mapping: Main channel and side channels (only those with clear distinction from main channel), gravel/sand bars and islands, riparian wood (mostly softwood), floodplain swamps (channel remnants and succession on mud, depressions and reed beds), oxbows, grasslands (mostly pastures), arable land and settlements.*

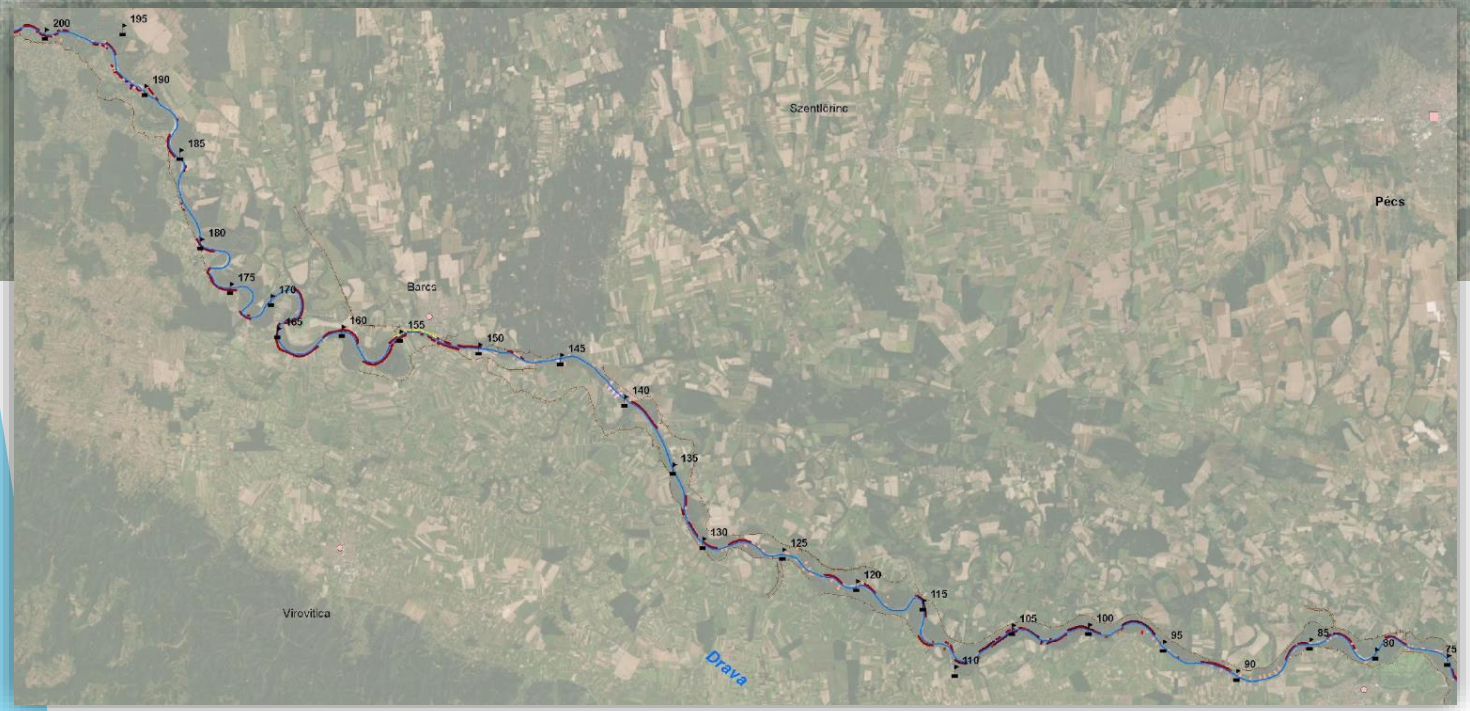
River training structures

Bank reinforcements (1), groynes (2, 3), transversal fills (4) and flood dyke (5) at Drava to protect infrastructure such as bridges and settlements (Arno Mohl).

Disconnected T-Groyne in Danube for water way transport to stabilize fairway (Wolfgang Kraier).

3. Training structures (preliminary results)

- *Roughly 1,800 single structures at all.*
- *In total 3 major hydropower dams, 2 sluices (DTD canal) and 35 ramps as well as 26 ground sills (most in the Ormož hydropower reservoir and HPP residual water stretches).*
- *Length of banks with stabilization measures (rip-rap) summing up to 590 km. Additionally 146 km concrete banks in harbors, settlements and hydropower reservoirs.*
- *The length of flood dykes summing up to 1,200 km.*
- *The total length of all groynes (some 450) comprises 67 km*
- *Over 60 transversal fills (side channel cut-offs).*



- Dam
- Ground sill
- Ramp
- Rip-rap
- Rip-rap old
- Rip-rap collapsed
- Groyne
- Groyne overgrown
- Groyne disconnected
- Groyne collapsed
- T-groyne
- T-groyne overgrown
- T-groyne disconnected
- T-groyne collapsed
- Transversal fill
- Transversal fill collapsed
- Reservoir hydropower
- Harbour wall
- Settlement wall
- Flood dyke

Example HR-RS reach

For the total count of the 138 km long common HR-RS TBR MDD reach we identified:

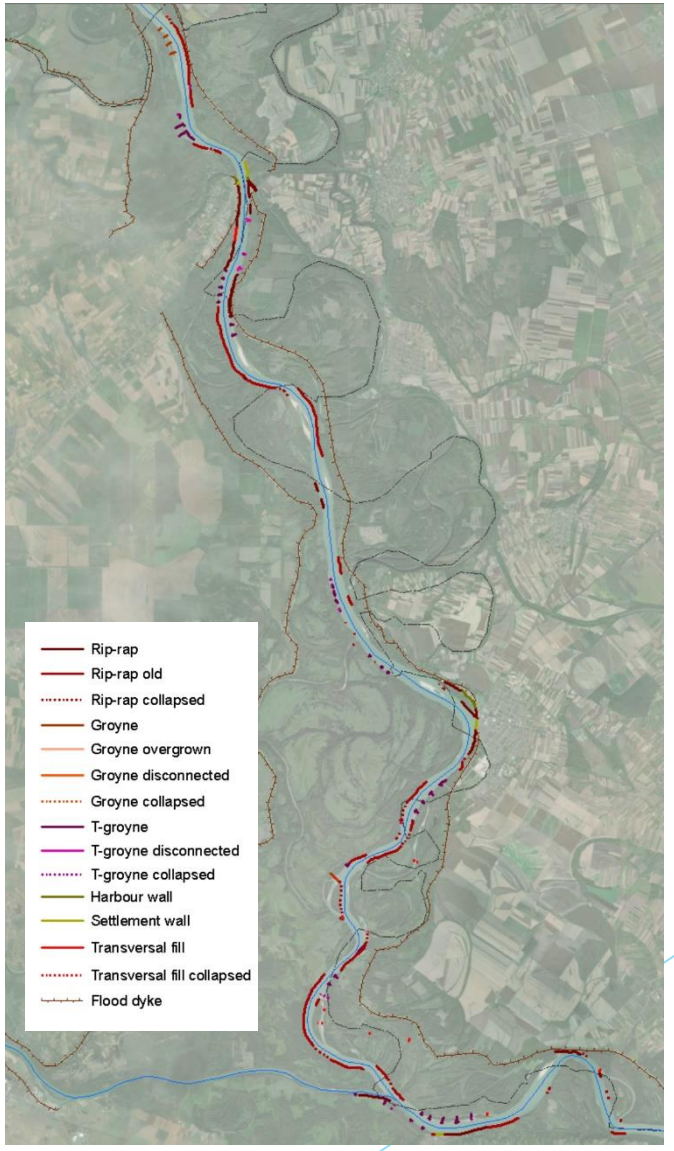
64 groynes (mostly T-groynes, in total 15,5 km long),

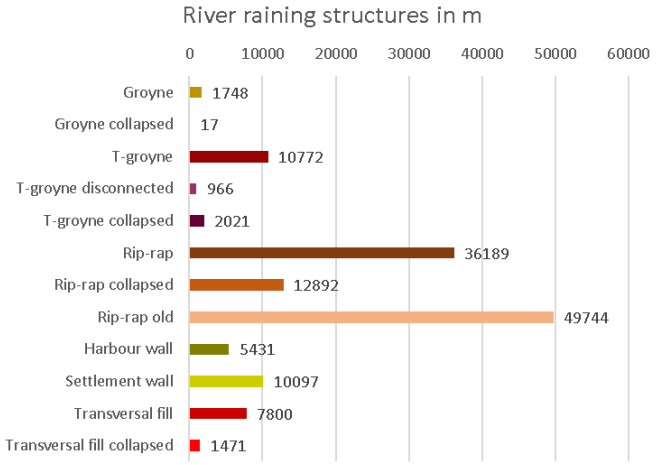
98,8 km rip-rap (roughly 35% of all banks),

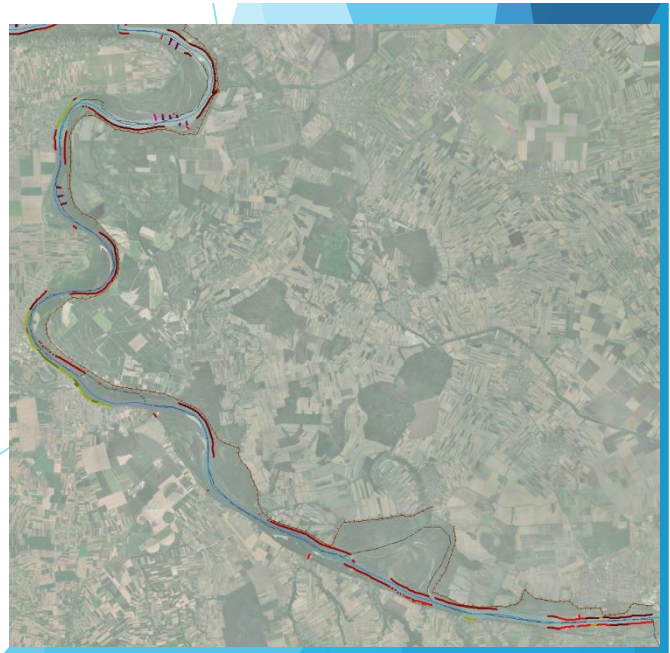
25 transversal fills with 9,3 km in total (side channel closures),

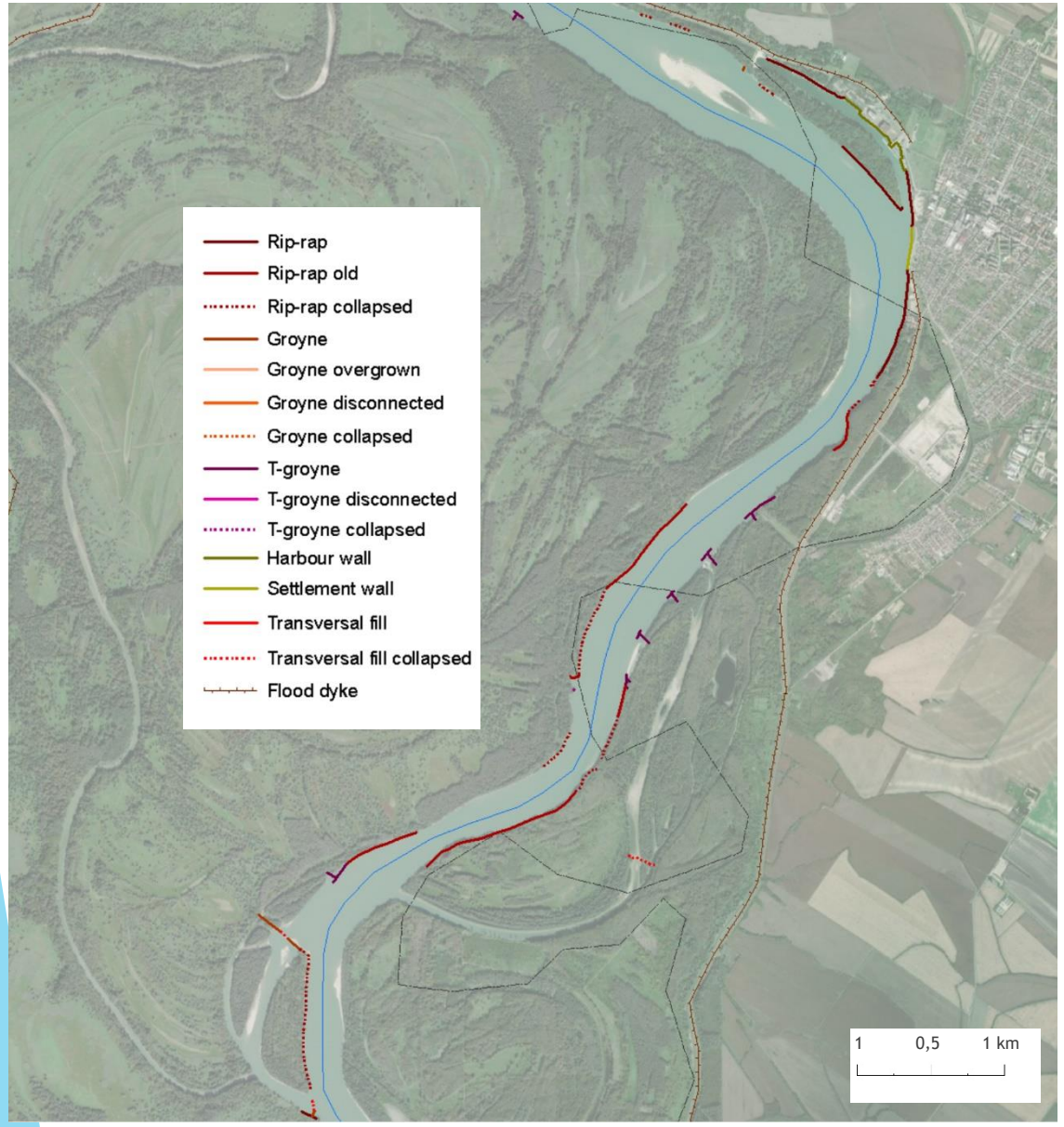
192 km flood dyke and

15,5 km harbor and city wall





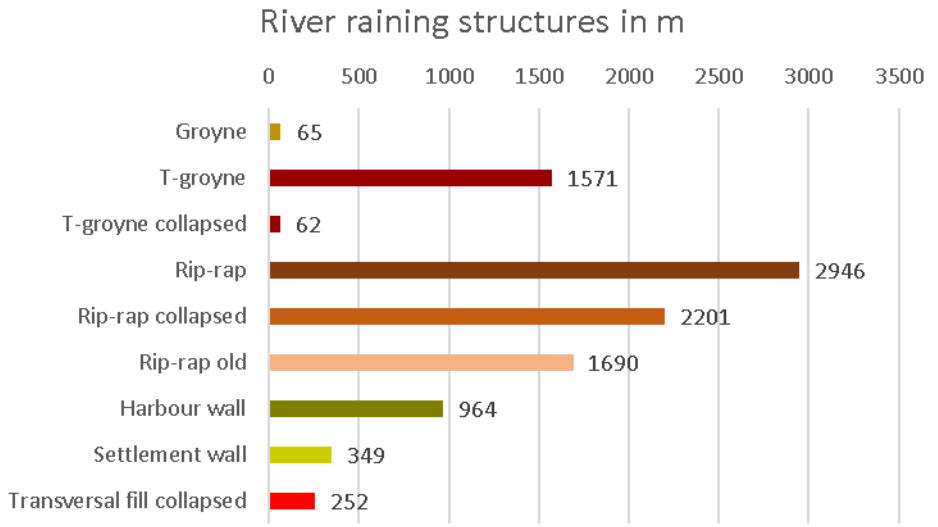




Example Danube near Apatin (rkm 1395-1405):

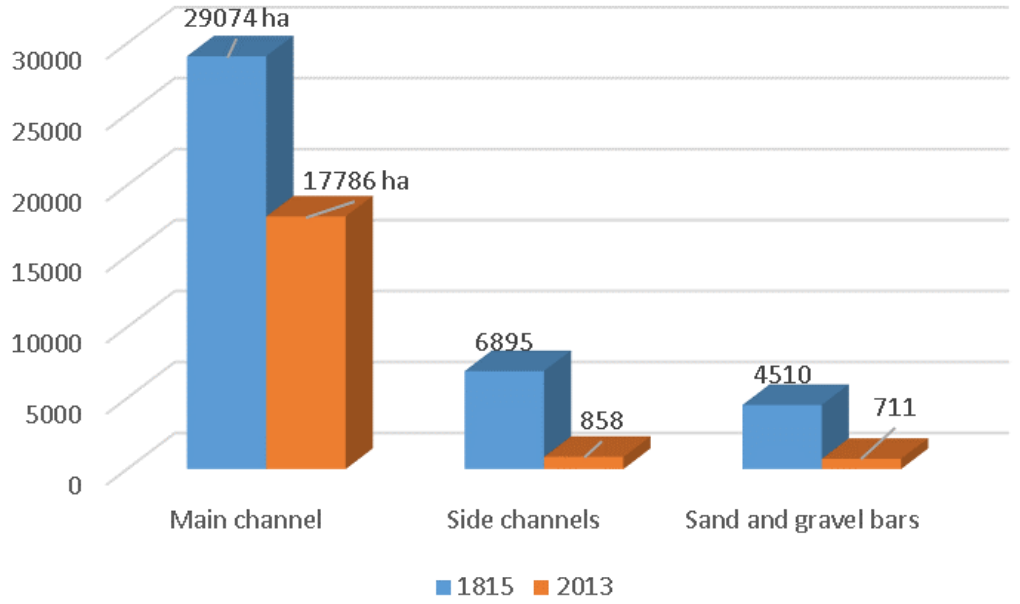
Total length: 10 km
Bank length including side branches: 24 km
Flood dyke length both sides: 27,2 km
Total bank stabilization (rip-rap, bank wall): 8,15 km
Number of groynes (with total length): 7 (1,7 km)
Transversal fill (side-channel): 0,25 km

All together roughly 10 km of bank length or 42% are stabilized by training structures.



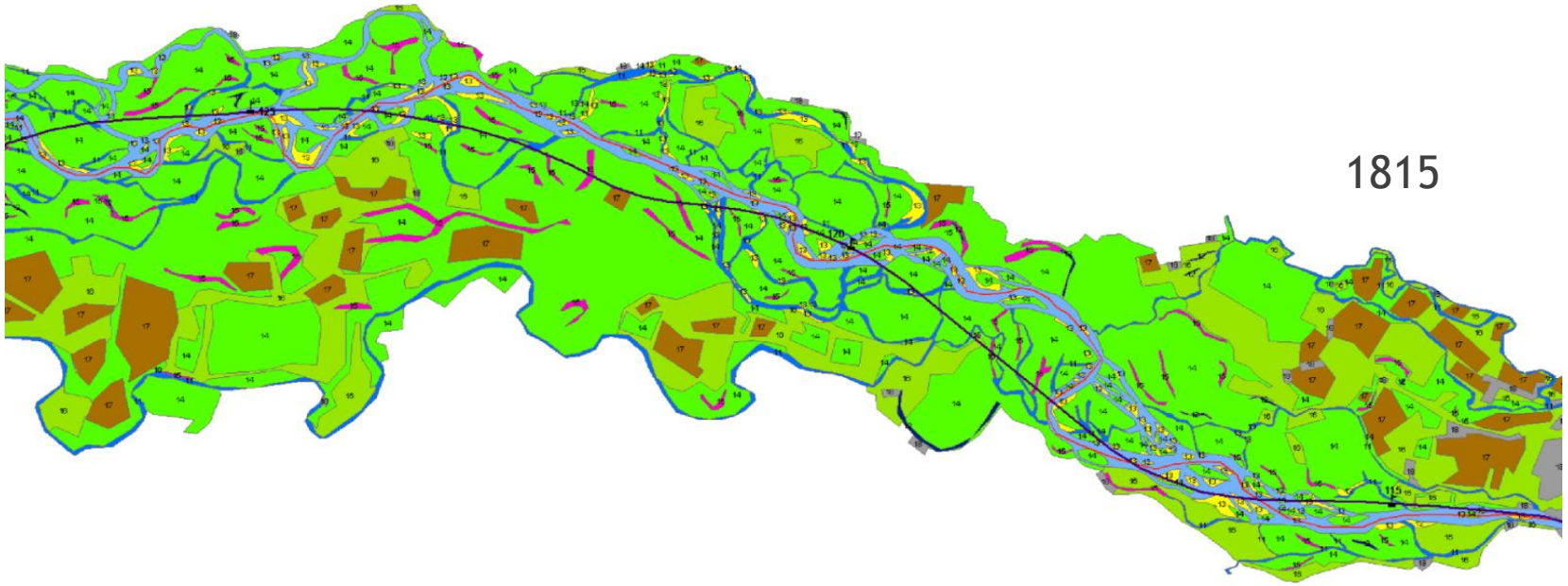
4. Historical mapping 1815-2013 (preliminary results)

- *Total mapped area:150,000 ha including the entire current active floodplain.*
- *The area of total river water bodies is reduced for 48% (-39% for main and 88% for side channels).*



- *The area of gravel an sand bars dropped from 4,500 ha to 710 ha, a reduction of 84%.*
- *The number of islands and oxbows is reduced for some 53% and 42% respectively.*

Upper Mura

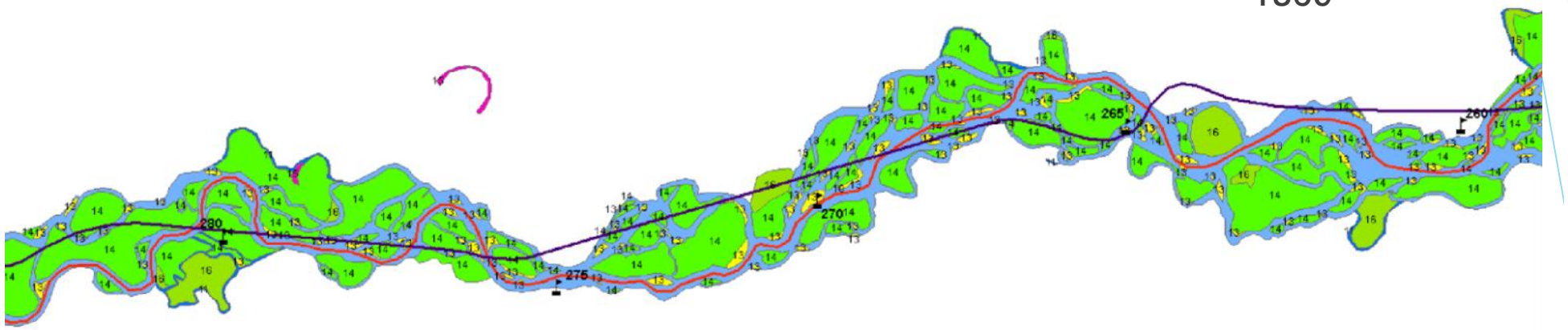


10 Main channel
11 Side channels
12 Oxbows
13 Sand and gravel bars
14 Riparian forest, mainly softwood
15 Reed, floodplain swamps
16 Grassland, mainly pasture
17 Arable fields inside active floodplain
18 Settlements and Infrastructure

Both maps include the river centerlines for the past and today; map colors of 2013 are 50% transparent but equal)

Upper Drava

1860



2013

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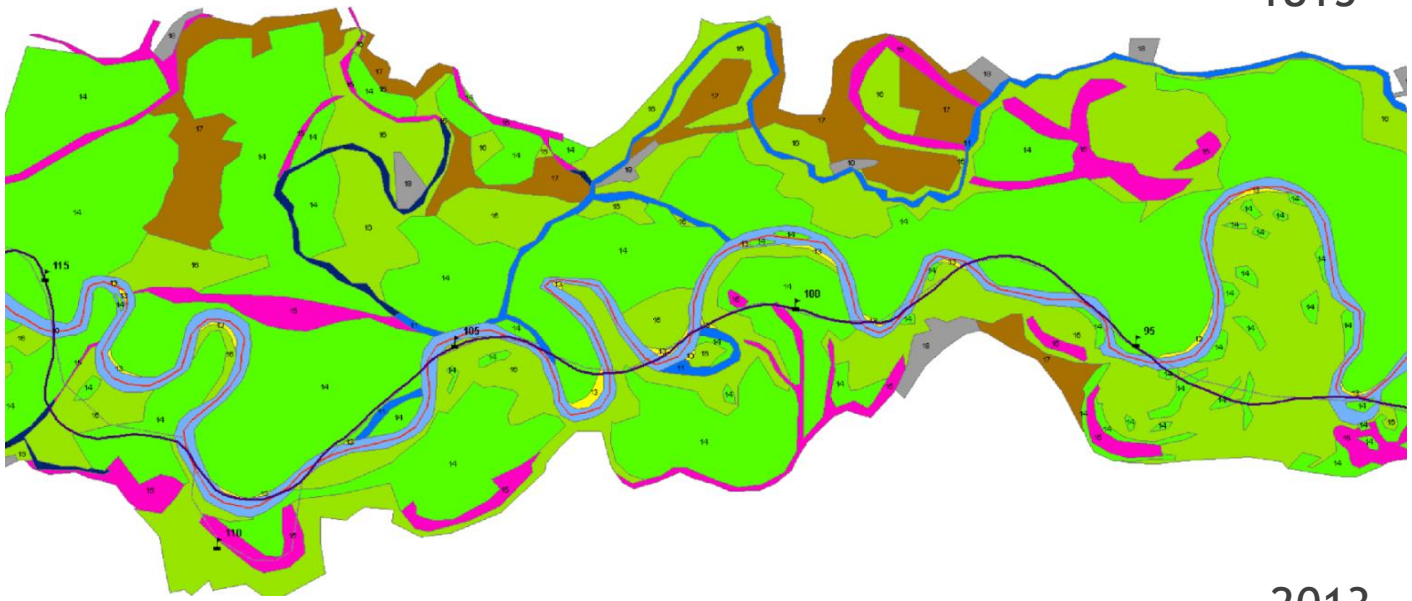
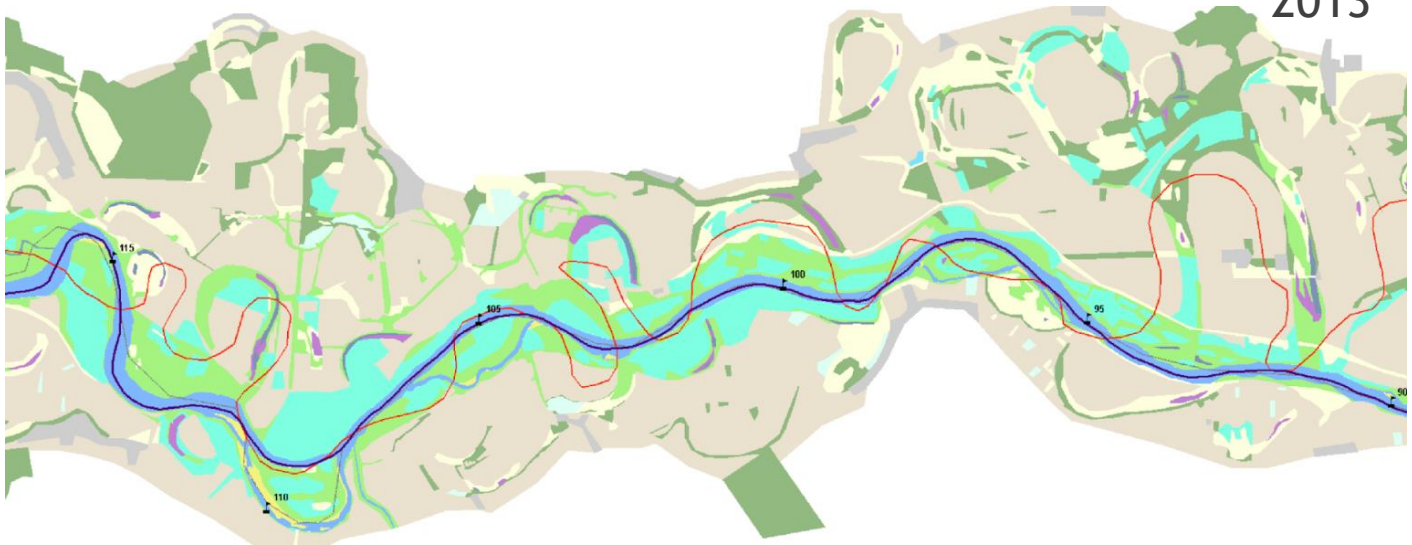
Lower Drava

1815



2013



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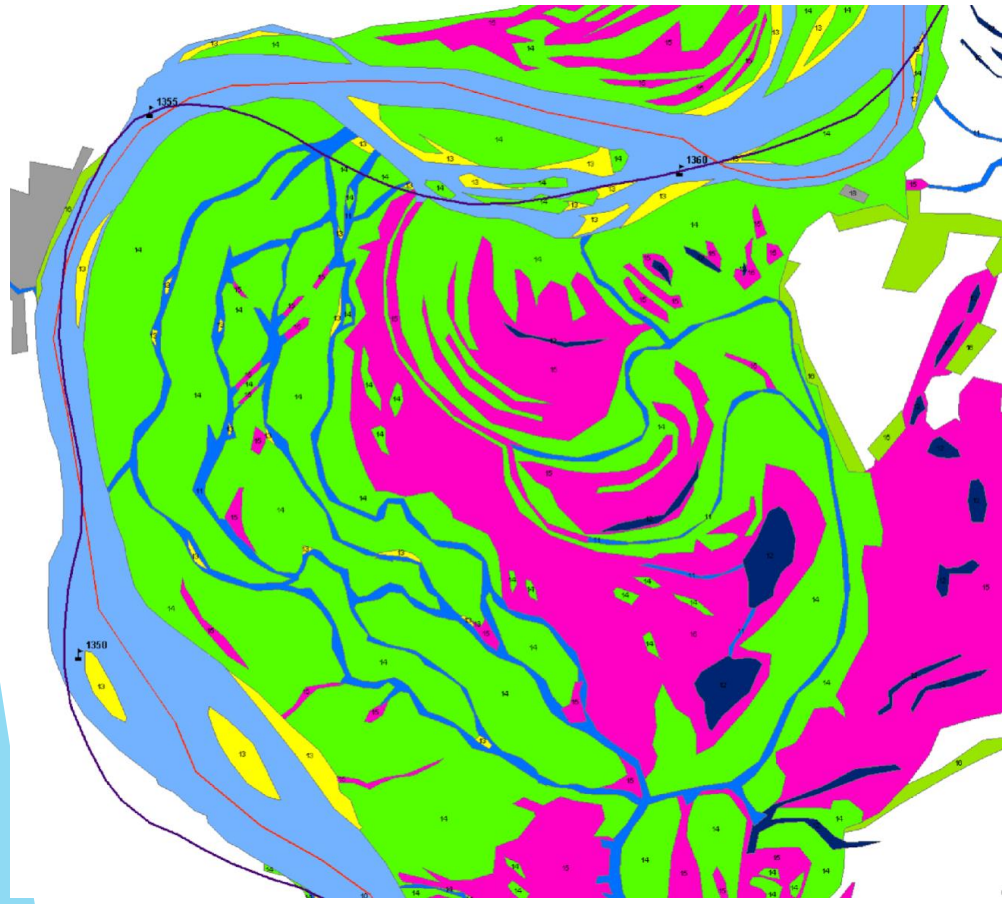
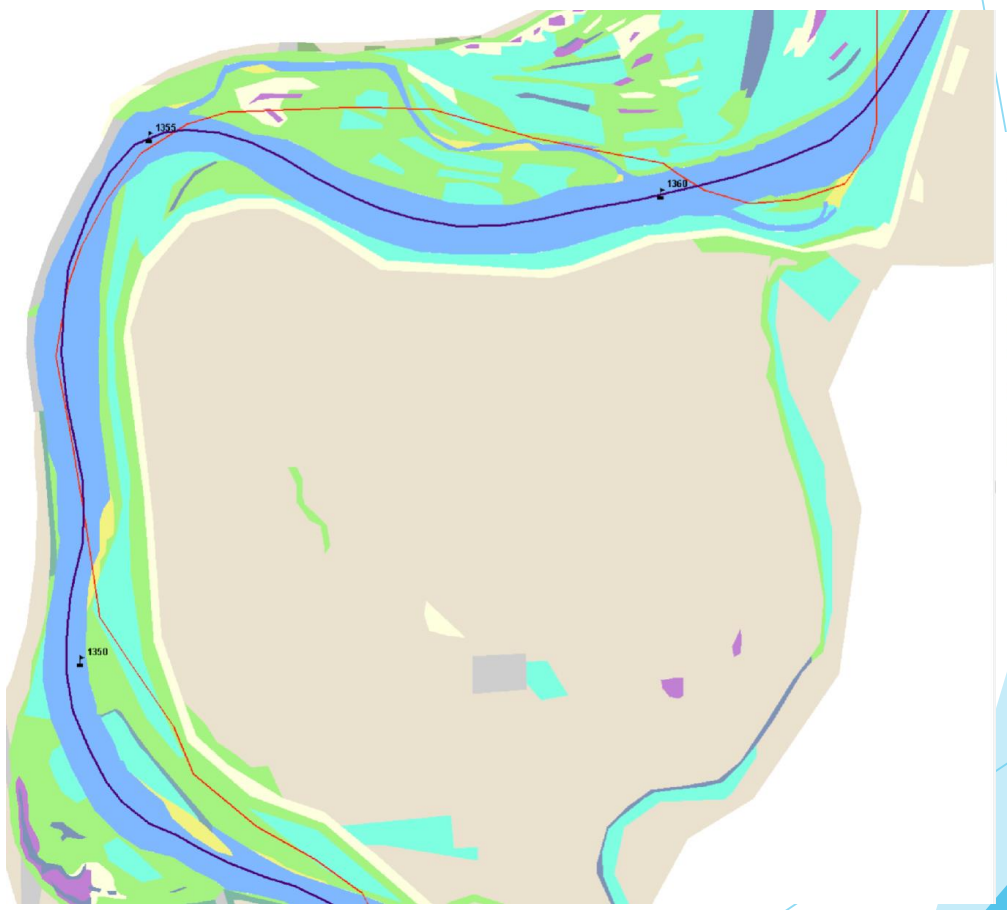
Lower Danube



1855



2013

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4. Next steps and conclusions

- *Analysis for each river and the main section types (identification of stretches with more or less regulation and different regulation type composition).*
- *Training structures support the assessment of sediment balance/morphology (e.g. for Danube: Even a slight channel incision causing a reduction of flooding in Kopački Rit and other floodplain areas).*
- *Data from historical mapping will be used for morphological development: Comparison of width variability, sinuosity, gravel and sand bars.*

Conclusions

- *First time seamless inventory of training structures indicate already a rather high density, however less in comparison with most upstream reaches/countries. Removal of structures is highly recommended to reduce further channel incision and enhance the lateral connectivity to the floodplain.*
- *First time seamless historical mapping for the entire river corridor. Better estimation of loss and potential.*
- *Strong background data for future synthesis and*

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Thank You!