



Aspects of hydromorphology of the Danube



***IAD, International Association
for Danube Research***

Dr. Ulrich Schwarz, Vienna



***FLUVIUS, Floodplain Ecology
and River Basin Management,
Consultant for Geography***



Content

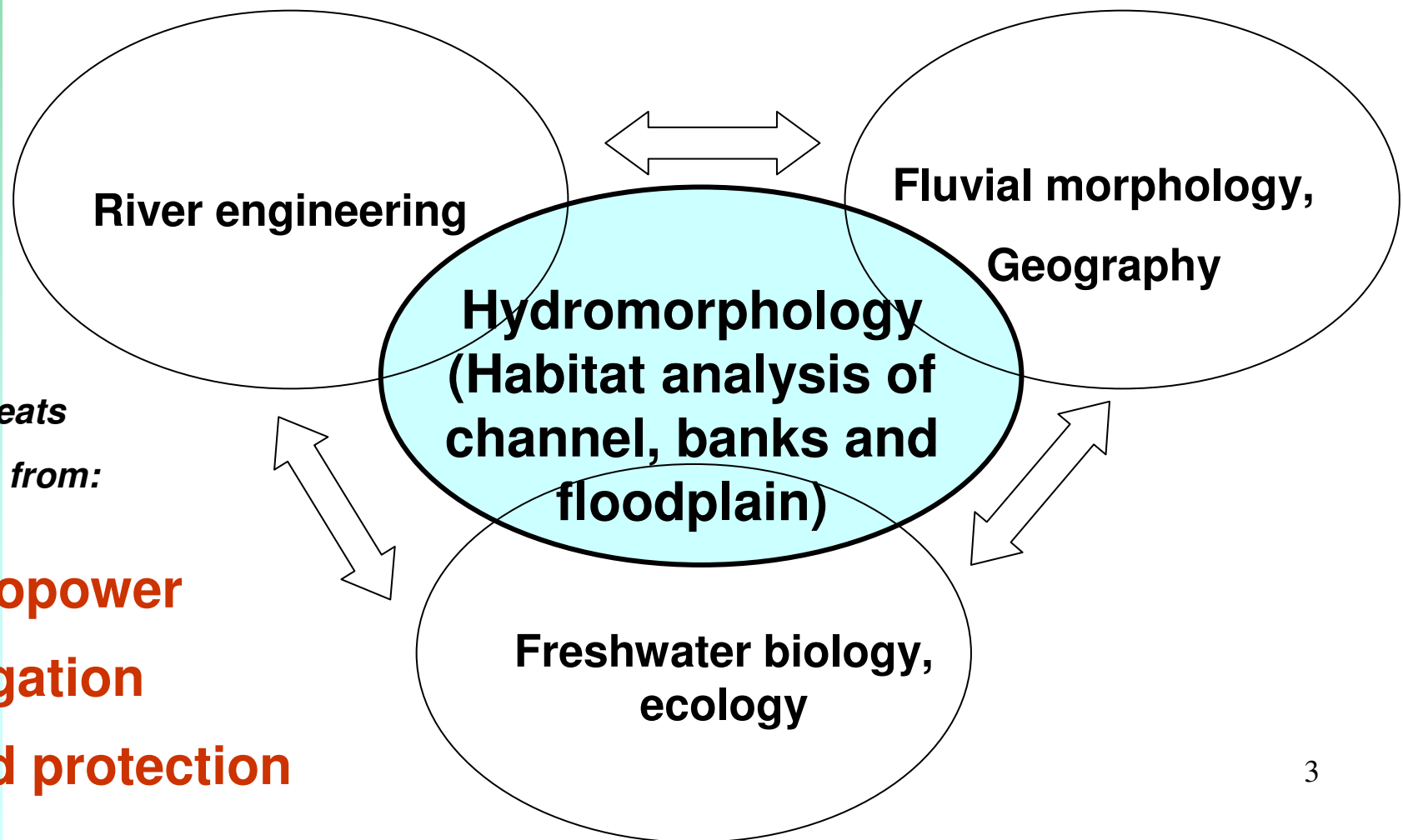
1. Introduction

2. Hydromorphological Inventories: Methodology, CEN Standards

3. Case studies for Drava and Danube ICPDR Joint Danube Survey2

4. Outlook, implications for the Danube

Introduction



*Key threats
coming from:*

Hydropower

Navigation

Flood protection

Methodological framework

- CEN Framework Standard 2004
- RHS (River Habitat Survey, GB), SEQ Physique (FR), LAWA/BafG/Kern (DE), Werth et al. (AT)
- WFD requirements: Quantity and dynamics of water flow, connection to ground water bodies, river continuity, river depth and width variation, structure and substrate of the river bed, structure of the riparian zone

Methodological framework (CEN)

1. **Water quality: Methods of biological sampling for all WFD relevant biological quality elements**
2. **Biological classification of rivers, lakes and marine ecosystems**
3. **Hydromorphological features of rivers and lakes, and degree of modification of river hydromorphology**
4. **Assuring the quality of biological and ecological assessments**

Main paramters based on the CEN Standard



Case study 1 Drava: Detailed hymo inventory

Inventory for large rivers
(regarding CEN standards and
WFD requirements), developed
for the IAD based on German
approaches for large rivers
(KERN, BfG, NRW/RPF)

Main parameter groups:

1. River channel
2. Banks and riparian zone
3. Floodplain

Five classes evaluation, colour-
ribbon map (scale
1:25.000),
data generalisation for
overview proposes

Hydromorphological Survey
Kopacki Rit (Danube, Drava)
Dissertation Ulrich Schwarz 2005

Edit GIS Stretch ID: DAL0001

I. START / EVALUATION

Surveyor Name: US
Date of Survey: 23.04.2004
River Name: Danube
GIS Stretch ID: DAL0001
Associated WFD Waterbody: CS_DB
Picture River No: Danube13
GIS Floodplain ID: DAL_FP_0001
Picture FP No: Danube13
WFD Typology:
Morph. River-Floodplain Reference Type: DonauSAT_4

Survey Type River/ Floodplain

Only river field survey
River survey with hydrological data
River survey with hydro. and remote sensing data
River and Floodplain field Survey
River and FP survey with hydrological data
River and FP survey with hydro. and RS data

II. RIVERBED

1. Location
Near natural area
Urban area 10-50%
Urban area > 50%

2. Valley Form
Narrow valley
Alluvial valley
Lowland

3. a) Discharge in m³/s or water level in cm with gauge name:
Bogojev 2600 m³/s

b) Daily mean water level dynamics in cm (only peak hydropower production):
0-50
50-100
100-1000
1000-5000
>5000

4. a) Channel width in m:
20-50
50-100
100-200
200-400
>400

b) Recent Floodplain Width in m:
0-50
50-100
100-250
250-500
500-1000
1000-5000
>5000

c) Morphological Floodplain Width in m:
0-100
100-1000
1000-10000
>10000

Remarks:
Pegel Bogojev

III. BANKS / RIPARIAN ZONE

Maps/ data sources (title, scale, source):
Historic maps, inland navigation maps, geo-morphologic maps, vegetation maps, aerial pictures, remote sensing data/ data about navigation structures, dredging, recent incision, water abstraction, flood level dynamics and capacities
1. Navigation Map 1: 10.000 2. Topo map 1: 25.000 3. Habitat map 1: 20.000 4. Landuse zones 1986-2001, IWP Danube Monography

IV. FLOODPLAIN

Evaluation

Status:
Evaluation Score RIVERBED: 3 3
Evaluation Score BANKS / RIPARIAN ZONE: 3.5 4
Evaluation Score FLOODPLAIN: 2.5 3
Total Value: 3 3

Range = Hydromorphological status
1.0 - 1.7 = 1 high, blue
1.8 - 2.5 = 2 good, green
2.6 - 3.4 = 3 moderate, yellow
3.5 - 4.2 = 4 poor, orange
4.3 - 5.0 = 5 bad, red

Explanation "Floodplain sections"
Baseline orthogonal to the floodplain axis:
(FPL1) (FPL2) (FPL3) (FPL4)
(FPL1) (FPL2) (FPL3) (FPL4)
(FPL1) (FPL2) (FPL3) (FPL4)

Save, Duplicate, Delete or Add new Record

Hydromorphological Survey
Kopacki Rit (Danube, Drava)
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Edit GIS Stretch ID: DAL0001

I. START / EVALUATION

1. PLANFORM: a) Sinuosity:
Reference Conditions:
absolutely straight (1.0)
straight (1.01-1.25)
slightly sinuous (1.26-1.5)
moderate sinuous (1.56-1.75)
meandering (>1.75)
Evaluation (pick up value from the matrix or mark by circle in the field): 2

b) Channel type:
parallel channels
braided
Evaluation: 1

c) Shortening:
none
10-30%
>30%
Evaluation: 2

3. a) Flow diversity / variation in depth:
extent of natural bank-verb features:
modification in width:
average score from III.4a
average score from III.2
score from III.1b
Evaluation: 4.1

b) Impounded reaches:
none
<10%
10-50%
>50%
Evaluation: 4

II. RIVERBED

2. RIVERBED FEATURES:
a) Bars, islands, riffles:
undisturbed
three or more
one
none
Explanation: % of channel width
% of channel width
% of channel width
Evaluation: 3

b) Accretion between groyves:
>20%
10-20%
5-10%
<5%
none
Explanation: % of channel width
% of channel width
% of channel width
Evaluation: 4

c) Large woody debris (LWD):
Explanation: LWD (length > 3m, diameter > 30 cm) per km
single channel:
multiple channel:
abundant (>20)
frequent (11-20)
occasional (6-10)
rare (1-5)
none
Evaluation: 4

4. a) Channel substrates:
undisturbed
addition of sediment
bed reinforcement, impoundment
groyves, parallel structures < 1/3 Wb
famey width < 1/3 Wb
famey width 1/3-2/3 Wb
famey width > 1/3 Wb
undisturbed
Evaluation: 4

b) Main Substrate grainsize:
Rock
Coarse (>600 mm)
Coarse gravel (200-600 mm)
Medium gravel (20-200 mm)
Fine gravel (2-20 mm)
Sand (0.2-0.6 mm)
Coarse silt (0.2-0.6 mm)
Silt/clay (<0.2 mm)
Organic
Evaluation: 4

5. a) Channel stabilization:
bed reinforcement
ground sills
pipeline crossing
impoundment
dredging, addition of sediment
no stabilization, profile stable
undisturbed
Evaluation: 4

b) Recent incision:
unknown
shallow (<6-10 mm/a)
deep (>10 mm/a)
none
Evaluation: 3

III. BANKS / RIPARIAN ZONE

6. a) Migration barriers longitudinal:
no structure for migration
fish ladder or elevator
by-pass migration or partial ramp
full ramp
no barrier
Evaluation: 4

b) Type barrier longitudinal:
dam hydropower, naviga
weir
camp
Evaluation: 4

c) Migration barriers lateral:
no structure for migration
HW inlet/outlet structure
MW inlet/outlet structure
MAWV ford structure
no barrier
Evaluation: 3

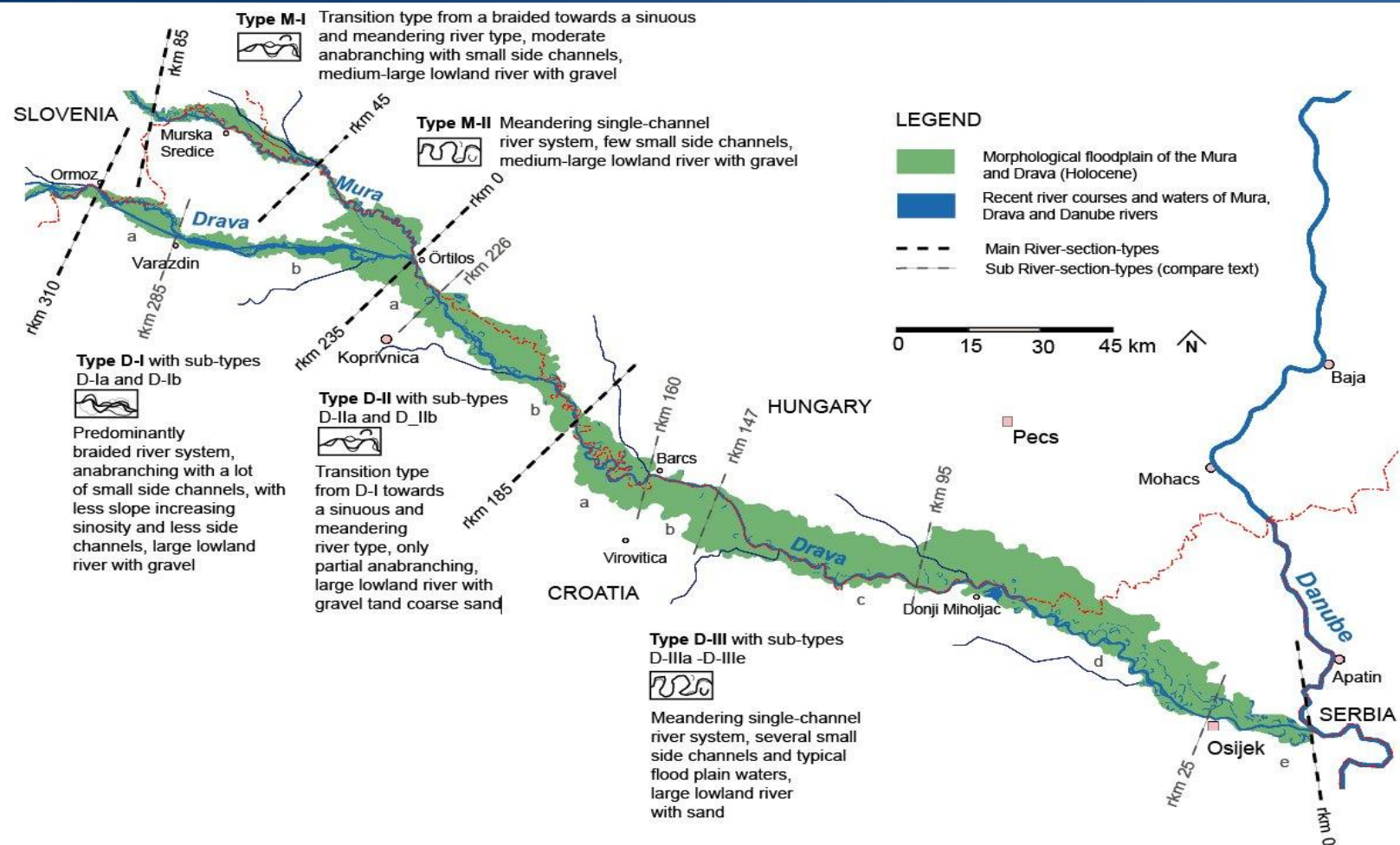
d) Type barrier lateral:
groyves, piling structure
reflective ribs/outlets
closed with boulder, gabion
artificial levee, maintenance
Evaluation: 3

7) River water abstraction:
<10%
10-50%
>50%
none
Evaluation: 3

IV. FLOODPLAIN

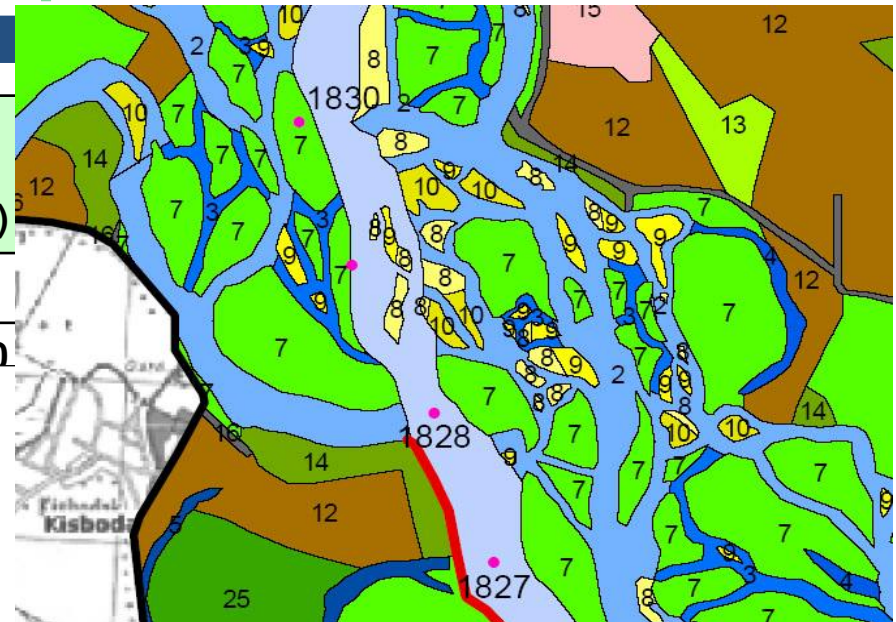
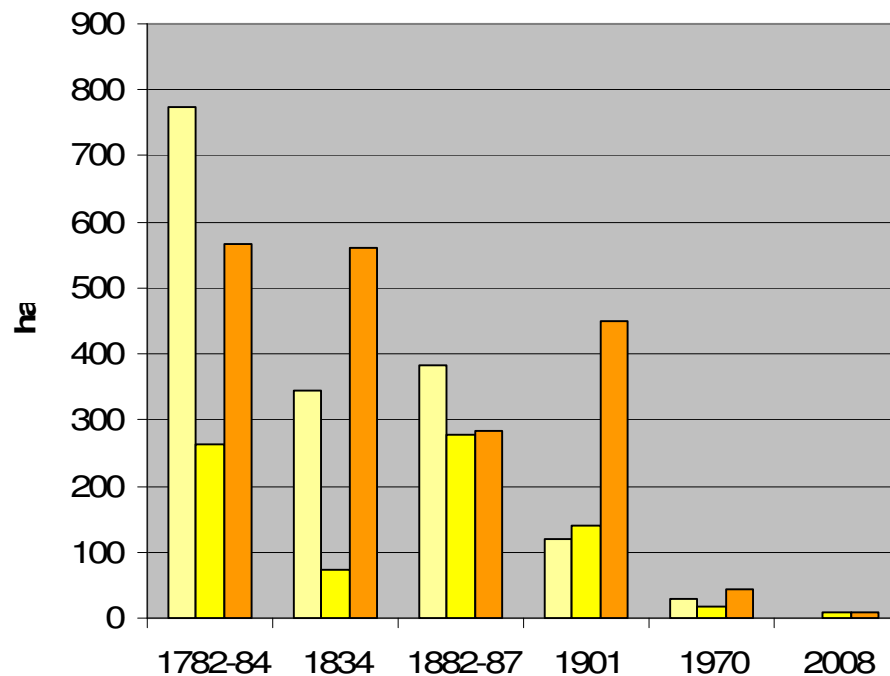
Evaluation Score RIVERBED: 3

Drava: Hymo reference conditions and typology



Fluvial morphological parameters

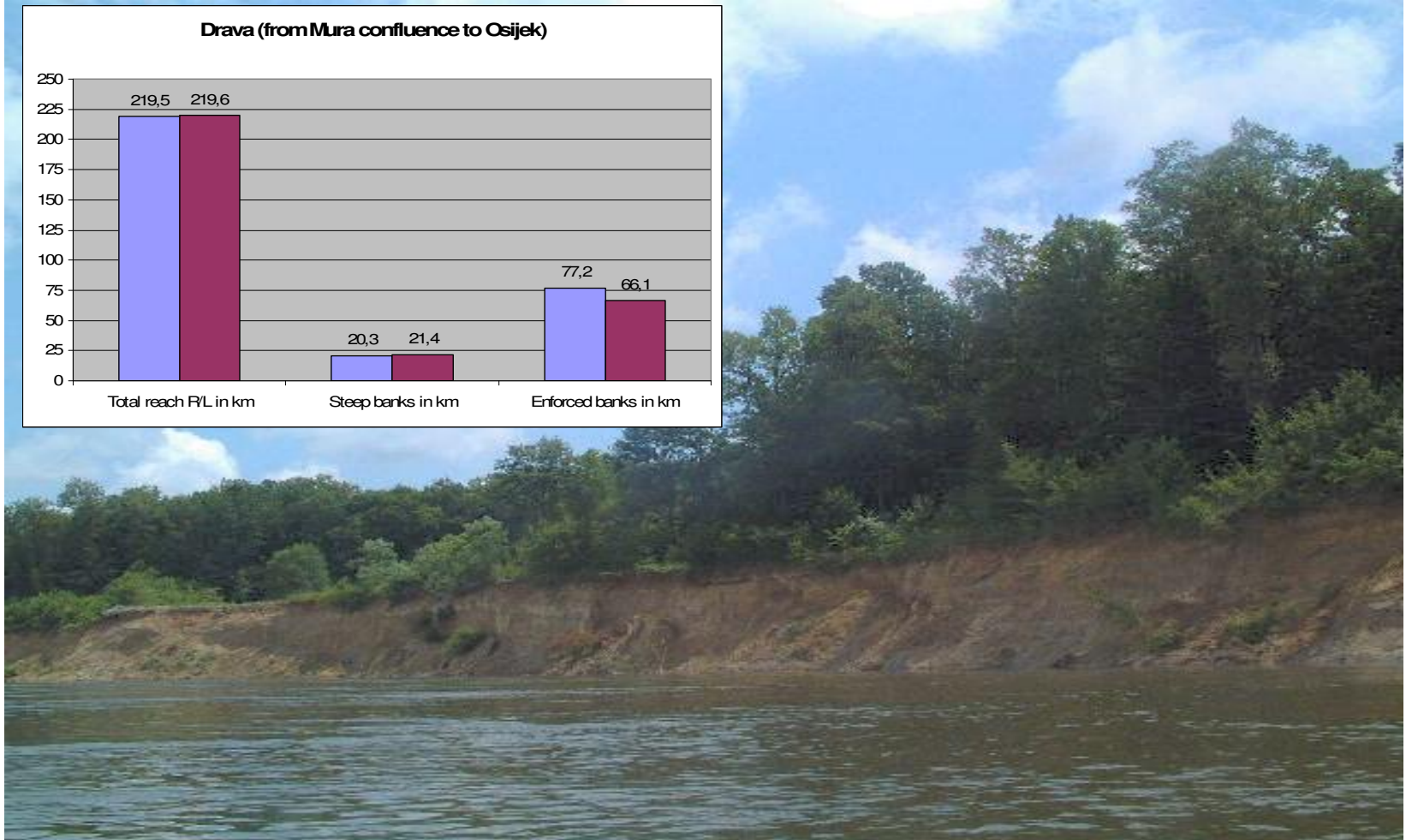
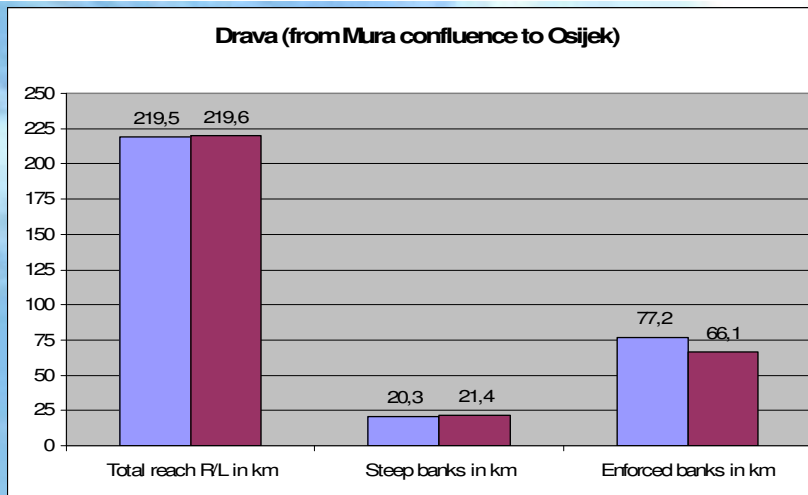
Parameter	Danube from Bezdan to Apatin (reference / recent)
Reach in km	43 / 24
Channel width in m	360-650 / 380-1.000



- Unvegetated bars
- Initial pioneer bars
- older pioneer stands

	2,5 / 1
	9 / 1
	II (10%) III (25%) IV (45%) V (20%) / I (50%) II (50%)
	9

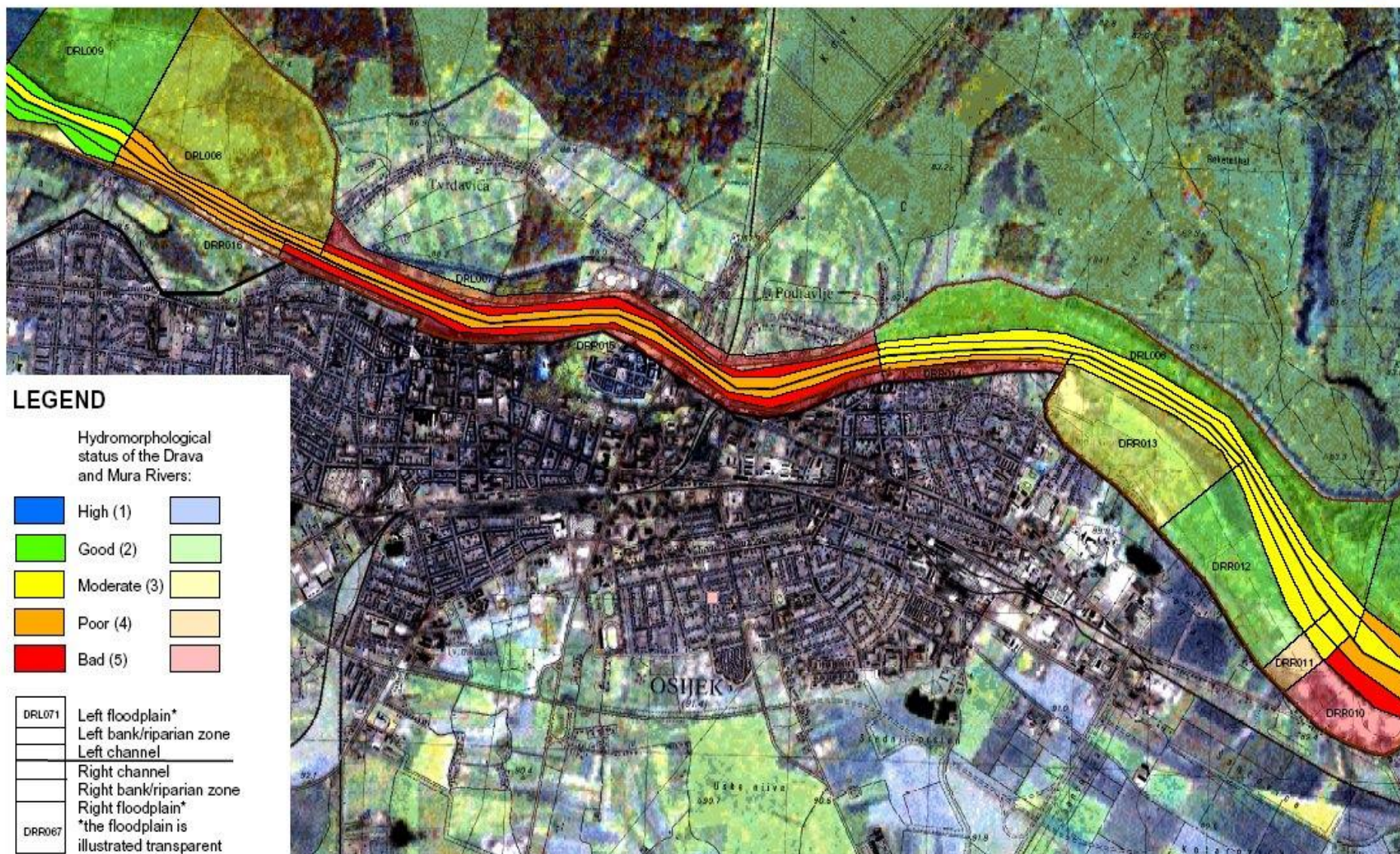
Drava: Evaluation example Lower Drava and Mura



Hydromorphological Status of the Drava and Mura Rivers

Drava 23

Product of:
IAD (International
Association for
Danube Research)



LEGEND

Hydromorphological
status of the Drava
and Mura Rivers:

	High (1)	
	Good (2)	
	Moderate (3)	
	Poor (4)	
	Bad (5)	

	DRL071	Left floodplain*
		Left bank/riparian zone
		Left channel
		Right channel
		Right bank/riparian zone
		Right floodplain*
	DRR067	*the floodplain is illustrated transparent

	Borders
	Morphological floodplain margin
	Flood protection dikes

0 0,5 1 2 3 Kilometers

Scale: 1 : 25,000
(in A3 landscape paper format)



Prepared by FLUVIUS, Vienna, August 2006



Drava: Overall assessment

- Main „drivers“ for the Drava: 1. Hydropower, 2. Flood defence, 3. Sediment extraction, 4. Navigation (Mura without navigation)

- Overall floodplain loss for the entire Drava and Mura: -75%

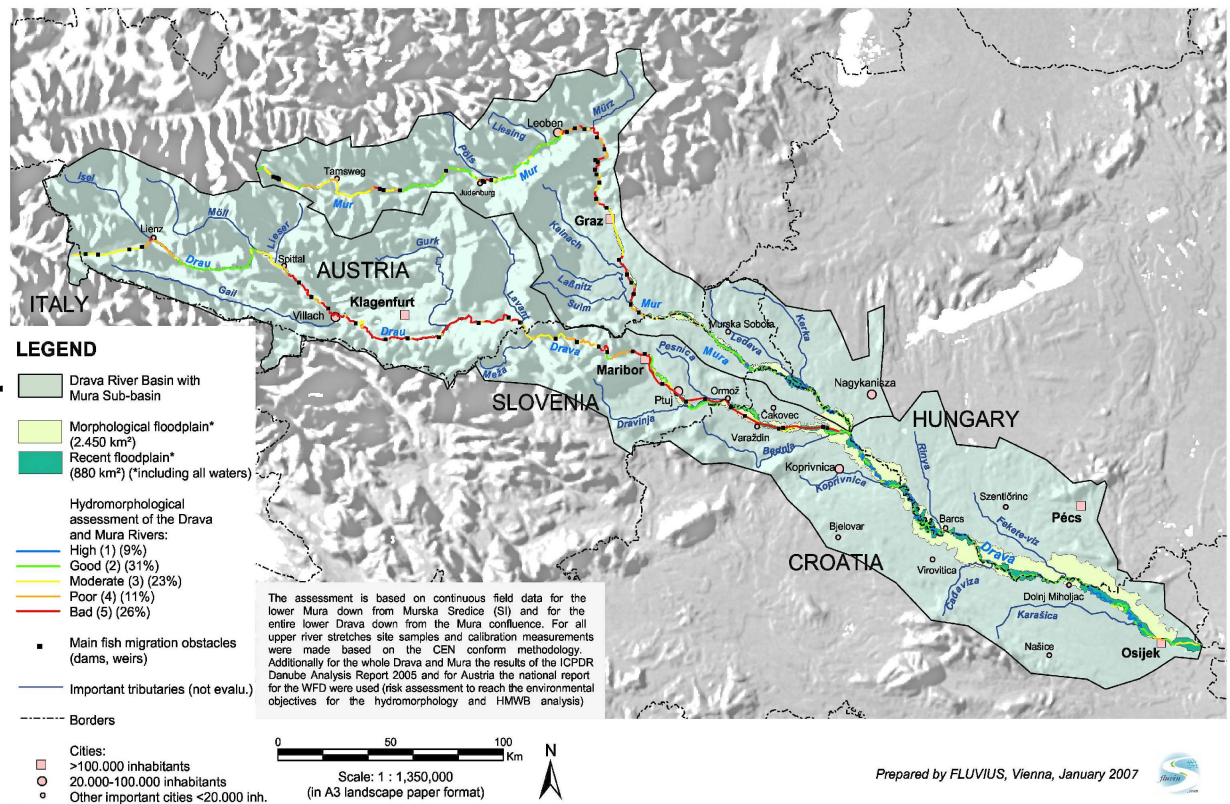
- Over 50 large dams

- Overall hydromorphological evaluation:

40% have class two or better (mostly along the lower stretches in Hungary and Croatia), 60% contributes to the classes 3-5 (over 26% are completely modified).

Hydromorphological Evaluation of the Drava and Mura Rivers
Overall evaluation

IAD (International
Association for
Danube Research)



Case Study 2 Danube: JDS2, longitudinal survey, site survey

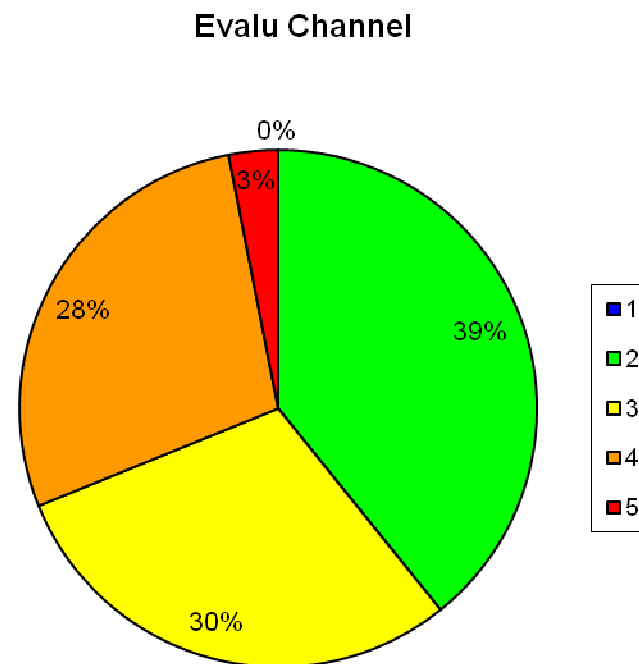
- Longitudinal survey: Homogenous stretches of about 50 km along a five class evaluation system according to SOP
- Site survey: Detailed JDS site characteristic according to SOP table without evaluation
- Inventory of dams, hydrological situation during the survey
- Additionally to the site survey fact sheets for all stations incl. tributaries were prepared
- Access database development and GIS integration (site coordinates, rkm and assessment stretches)

Danube: Longitudinal survey (focus)

- A total of 62 homogenous stretches along the Danube including the three delta branches (in total 2,584 rkm) were prepared.
- The mean length of each evaluation stretch is about 42 rkm, the smallest is 8rkm (strongly altered town stretch) and by far the longest 225 rkm (between Calafat and Svistov at the lower Danube).
- In general the length of homogenous segments increase for the lower Danube.

Danube: Classification channel

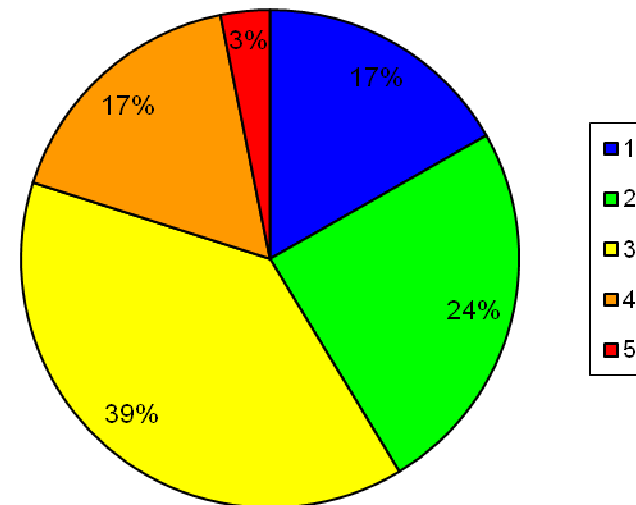
- **class 1: Channel nearly natural**
- **class 2: slightly modified**
- **class 3: moderately modified**
- **class 4: severely modified**
- **class 5: totally modified**



Danube Classification banks

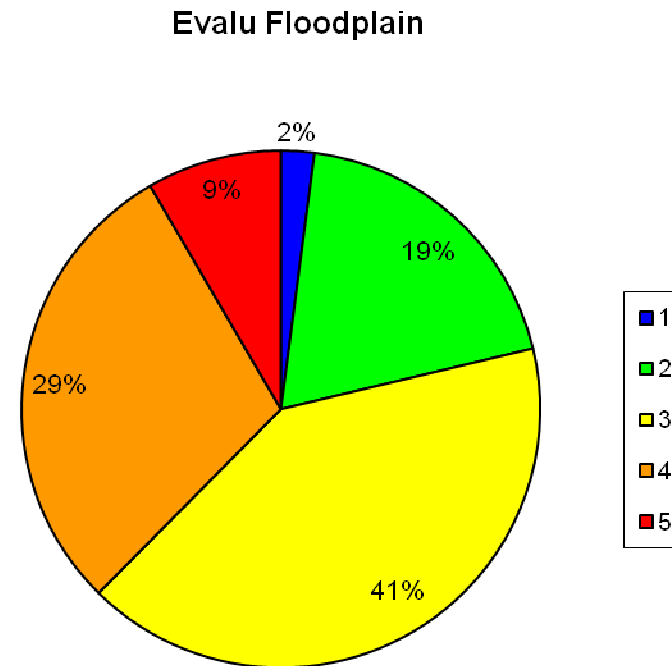
- **class 1: nearly natural banks**
- **class 2: reinforcement in small sections**
- **class 3: reinforcement in large sections**
- **class 4: continuous bank reinforcements**
- **class 5: totally modified banks**

Evalu Banks



Danube: Classification floodplain

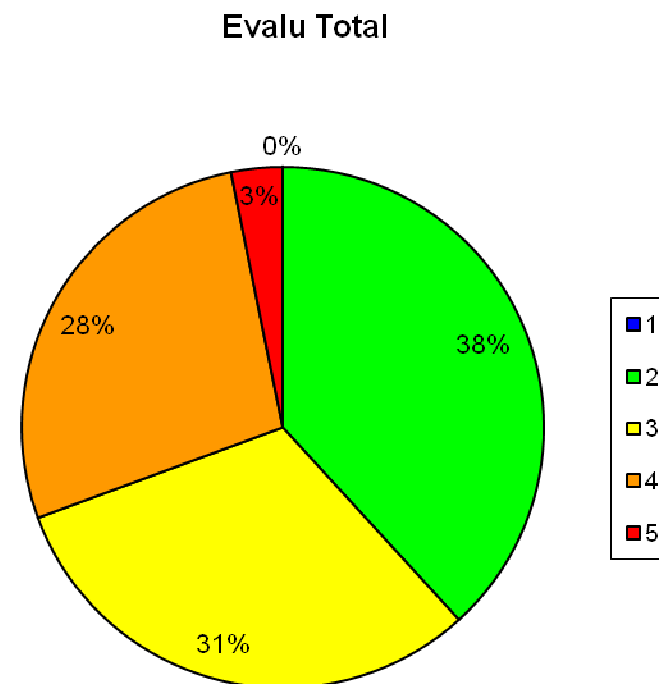
- class 1: Very high ecological value
- class 2: high ecological value
- class 3: moderate ecological value
- class 4: Low ecological value
- class 5: floodplain totally modified



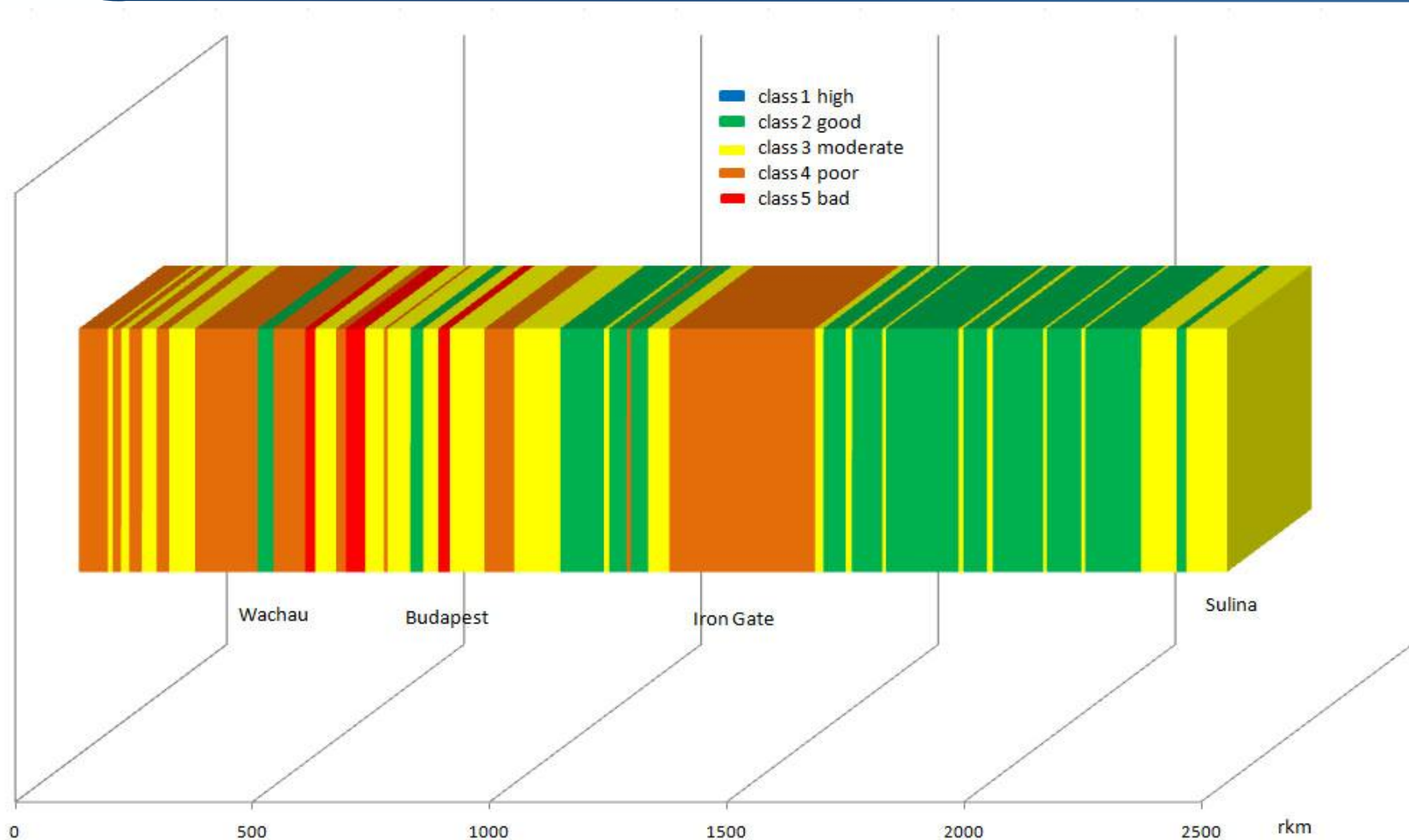
Danube: Total evaluation

Assessment according to WFD/CEN classes:

- class 1: High
- class 2: Good
- class 3: Moderate
- class 4: Poor
- class 5: Bad



Danube: Total evaluation



Outlook, implications for the Danube

- Harmonized approaches based on CEN standard are necessary
- Assessment of screening methods versus full inventories
- Morphological reference conditions should be more considered
- Hymo inventories would strongly support and post-validates the typological units and the water body delineation
- Would enable a transparent HMWB designation based on quantitative and qualitative hydromorphological data
- Would allows a precise development of tools for measures
- Ongoing projects involved: IAD Hymo study Mures, SEA Szigetköz (historical riparian landscape analysis)