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CONVERGES European Riparian Ecosystems

Riparian habitat quality evaluation in the Czech Republic – development of a new methodological approach

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COST Action CONVERGES – European Riparian Ecosystems

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Presentation outline

- Progress in ongoing project SMART2Envi
  - Methodological aspects
  - Development of terrain form for mapping
  - First results (work in progress)
- Ecosystem functions and services of riparian ecosystems
- Next steps…

Project background

Small watercourses and riparian ecosystem management to mitigate the impacts of environmental change (SMART2Envi)

- Project funded by the Czech Ministry of Education, Youth and Sports
- Duration: 07/2018–10/2021
- Main aims:
  - to identify the major stressors of riparian ecosystems and related functions performed,
  - to develop a tool for assessing these ecosystems,
  - to develop and disseminate knowledge regarding the importance of small watercourses and riparian habitats,
  - to establish (continue) a cooperation with the CONVERGES Action members ☺

Who cares about the riparian zone?

ands

entre, 2019

Riparian zone and its spatial extent

Stream order according to Strahler (1957)	Average width of the riparian zone [m] in			
	Agricultural landscape	Forest-agricultural landscape	Forest landscape	Urbanised landscape*
I.	< 2.0	< 2.0	< 2.0	< 1.0
II.	< 2.0	< 2.5	< 2.5	< 1.0
III.	< 3.0	< 3.5	< 4.0	< 1.5
IV.	< 3.5	< 5.0	< 4.5	< 2.0
V.	< 5.5	< 7.5	< 7.0	< 2.5
VI.	< 8.0	< 10.0	< 9.0	< 3.5
VII.	< 10.0	< 13.0	< 12.0	< 5.0
VIII.	< 11.0	< 15.0	< 14.0	< 6.0

* In case the riparian zone is not completely degraded

Source: own survey

List of indicators

Identification data of the river/stream surveyed

General characteristics (for purposes of determining the weights of indicators)

W 1 Stream segment location within the watershed (weight for 1.2, 3.1, 3.2 and 3.5 indicators)

W 2 Naturalness of stream banks (weight for 1.1 indicator)

1 Morphometric characteristics of the riverbed and riparian zone

1.1 Average slope of the river banks in the segment [W2]

1.2 Average channel incision in the segment [W1]

1.3 River banks-forming material

1.4 River banks stability

2 Hydrological regime of the river/stream

2.1 Frequency of flooding into the inundation area

2.2 Potential for flooding in the inundation area

2.3 Discharge control measures

List of indicators II

3 Biotic characteristic of riparian zone

3.1 Average width of the riparian vegetation zone (in comparison with approx. annual discharge level) [W1]

3.2 Woody vegetation coverage of the riparian zone [W1]

3.3 Vegetation structure of the riparian zone

3.4 Connectivity (close proximity) of the riparian zone with fluvial ecosystem (floodplain forest, wetland)

3.5 Number of vegetation floors developed in the riparian zone [W1]

3.6 Tree species diversity in the riparian zone

3.7 Share of non-native tree species

3.8 Ecological stability of areas beyond the riparian zone

3.9 Prevailing habitat types in riparian zone [%]

Prevailing habitat types in riparian zone

The following characteristics based on HVM methodology (Seják et al. 2003) are taken into account for each habitat type:

- Habitat naturalness
- Diversity of structures of the habitat
- Habitat vulnerability

Unvegetated river gravel banks (M4.1)
River gravel banks with Myricaria germanica (M4.2)
River gravel banks with Calamagrostis pseudophragmites (M4.3)
Petasites fringes of montane brooks (M5)
Muddy river banks (M6)
Herbaceous fringes of lowland rivers (M7)
Willow scrub of loamy and sandy river banks (K2.1)
Willow scrub of river gravel banks (K2.2)
Alder carrs (L1)
Montane grey alder galleries (L2.1)
Ash-alder alluvial forests (L2.2)
Hardwood forests of lowland rivers (L2.3)
Willow-poplar forests of lowland rivers (L2.4)
Bog spruce forests (L9.2)
Unnatural canalized rivers/streams (X1.2)
Rivers/streams distant to nature (XV2)

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RHQI field form

Methodology for assessing the ecological state of riparian zone – RHQI

Riparian Habitat Quality Index

CzechGlobe

FIELD EVALUATION FORM

Note: It is recommended to read the instructions in the Manual for evaluation methodology before completing this form.

Name of river/stream:	*Date of mapping:*
River segment ID:	*Name of surveyor:*
River kilometrage [r. km]:	

W 1 Localization of the river segment within a basin (weight for 1.2, 3.1, 3.2 and 3.5 indicators)		
River segment is located in the headwater area (production zone in terms of sediment movement)		1.0
Segment is located in the transfer zone (sediment supply is approximately the same as sediment output)		1.5
Segment is located in deposition /lowland zone (sink for most sediment eroded in production zone)		2.0

W 2 River banks naturalness (weight for 1.1 indicator)		
Natural materials of the river banks and bed prevails in the whole segment		1.0
< 25 % of the segment is formed by unnatural materials (of anthropogenic nature)		1.3
25-75 % of the segment is formed by unnatural materials		1.6
> 75 % of the segment is formed by unnatural materials		2.0

1.1 Average slope of the banks in the segment [W2]			1.2 Average channel incision in the segment [W1]		
< 10°		0.0	< 1 m		0.0
10°–30°		0.3	1–2 m		0.3
30°–45°		0.7	2–4 m		0.7
> 45°		1.0	> 4 m		1.0

1.3 River banks-forming material			1.4 River banks stability		
Completely natural banks		0.0	Occurence of small river banks erosion (up to 5 m in length)		0.0
Occasional occurrence of artificial material (concrete, prefabricated elements, grass or stone paving) in less than 10 % of the river segment		0.2			
Occasional occurrence of artificial material in 10–50 % of the river segment length		0.3	Occurence of large river banks erosion (more than 5 m)		0.1
Occurrence of artificial but permeable material (grass or stone paving) in more than 50 % of the river segment length		0.5			
Occurrence of artificial impermeable material (concrete blocks) in more than 50 % of the river segment length		1.0	Stable banks without any erosion		0.2

2.1 Frequency of flooding in the inundation area			2.2 Potential of flooding in the inundation area		
Flooding is frequent (e.g. signs of floods in the inundation area, minimal channel incision, etc.)		0.1	There is a polder or water retention area designed to flood capturing		0.1
Flooding is potentially possible (channel incision is low), but no signs of floods are evident		0.5	There is an area where flood capturing is theoretically possible without causing significant damage (arable land, pasture, meadow, forest)		0.2
Flooding is almost impossible (e.g. due to significant channel incision, riverbed clearly designed to 100 year flow or more, etc.)		1.0	There is no area for flood capturing in the inundation area		1.0

2.3 Flow regulation		
There is no any water reservoir on the stream above the segment (hydrological regime is not affected)		0.0
There is periodic consumption or discharge of large quantities of water from / into the channel (e.g. for the needs of industry, land irrigation, artificial snow production, etc.)		0.2
One or more water reservoirs are located on the stream above the given segment		0.3

3.1 Average vegetation zone width (from approx. annual flow level) [W1]			3.2 Riparian zone cover by woody vegetation [W1]		
Vegetation zone is not maintained at all [*do not fill other indicators when selected this option!*]		1.0	> 80 % of the riparian zone is covered with woody plants		0.1
< 50 % of the water level width in a given segment		0.5	50–80 % of the riparian zone is covered with woody plants		0.4
50–100 % of the water level width		0.3	10–50 % covered with woody plants		0.7
100–150 % of the water level width		0.1	<10 % covered with woody plants		1.0
> 150 % of the water level width		0.0			

3.3 Vegetation structure in the riparian zone		
There is no vegetation in the riparian zone (natural and anthropogenic banks)		1.0
Riparian zone is formed by grassland		0.9
→ Grass is present in more than 75 % of the segment length		-0.2
There are shrubs (together with herbaceous undergrowth)		0.5
→ Shrubs with herbaceous undergrowth are present in more than 75 % of the segment length		-0.2
There are trees (with herbaceous undergrowth)		0.5
→ Trees with herbaceous undergrowth are present in more than 75 % of the segment length		-0.2
There is a mosaic of trees, shrubs and herbaceous undergrowth		0.2
→ Trees, shrubs and herbaceous undergrowth are present in more than 75 % of the segment length		-0.2

3.4 Connectivity (close proximity) of the riparian zone with a fluvially conditioned ecosystem (floodplain forest, wetland)			3.5 Number of vegetation levels developed in the riparian zone [W1]		
> 80 % of the segment length		0.3	1 level		0.7
80–50 %		0.2	2 levels		0.3
50–20 %		0.1	3 levels		0.0
< 20 %		0.0	No vegetation in the segment		1.0

3.6 Tree species diversity in the riparian zone			3.7 Representation of non-native tree species		
< 3 tree species		0.7	No non-native tree species		0.0
4–6 tree species		0.3	< 25 % of the riparian zone coverage		0.3
> 6 tree species		0.0	25–75 % of the riparian zone coverage		0.7
No trees in the segment		1.0	> 75 % of the riparian zone coverage		1.0

3.8 Prevailing nature of land-use type beyond the riparian zone			3.9 Prevailing habitat types in the riparian zone [%]*	
Ecologically stable areas (forest, meadow, pasture)		0.0	Unvegetated river gravel banks (M4.1)	
			River gravel banks with *Myricaria germanica* (M4.2)	
			River gravel banks with *Calamagrostis pseudophragmites* (M4.3)	
Mosaic of ecologically stable and unstable areas (e.g. scattered buildings in the landscape)		0.5	*Petasites* fringes of montane brooks (M5)	
Ecologically unstable areas (arable land, built-up areas)		1.0	Muddy river banks (M6)	
			Herbaceous fringes of lowland rivers (M7)	
			Willow scrub of loamy and sandy river banks (K2.1)	
Notes:			Willow scrub of river gravel banks (K2.2)	
			Alder carrs (L1)	
			Montane grey alder galleries (L2.1)	
			Ash-alder alluvial forests (L2.2)	
			Hardwood forests of lowland rivers (L2.3)	
			Willow-poplar forests of lowland rivers (L2.4)	
			Bog spruce forests (L9.2)	
* *The approximate percentage of individual habitats in the given river/stream segment is filled in.*			Unnatural canalized rivers/streams (X1.2)	
			Rivers/streams distant to nature (XV2)	

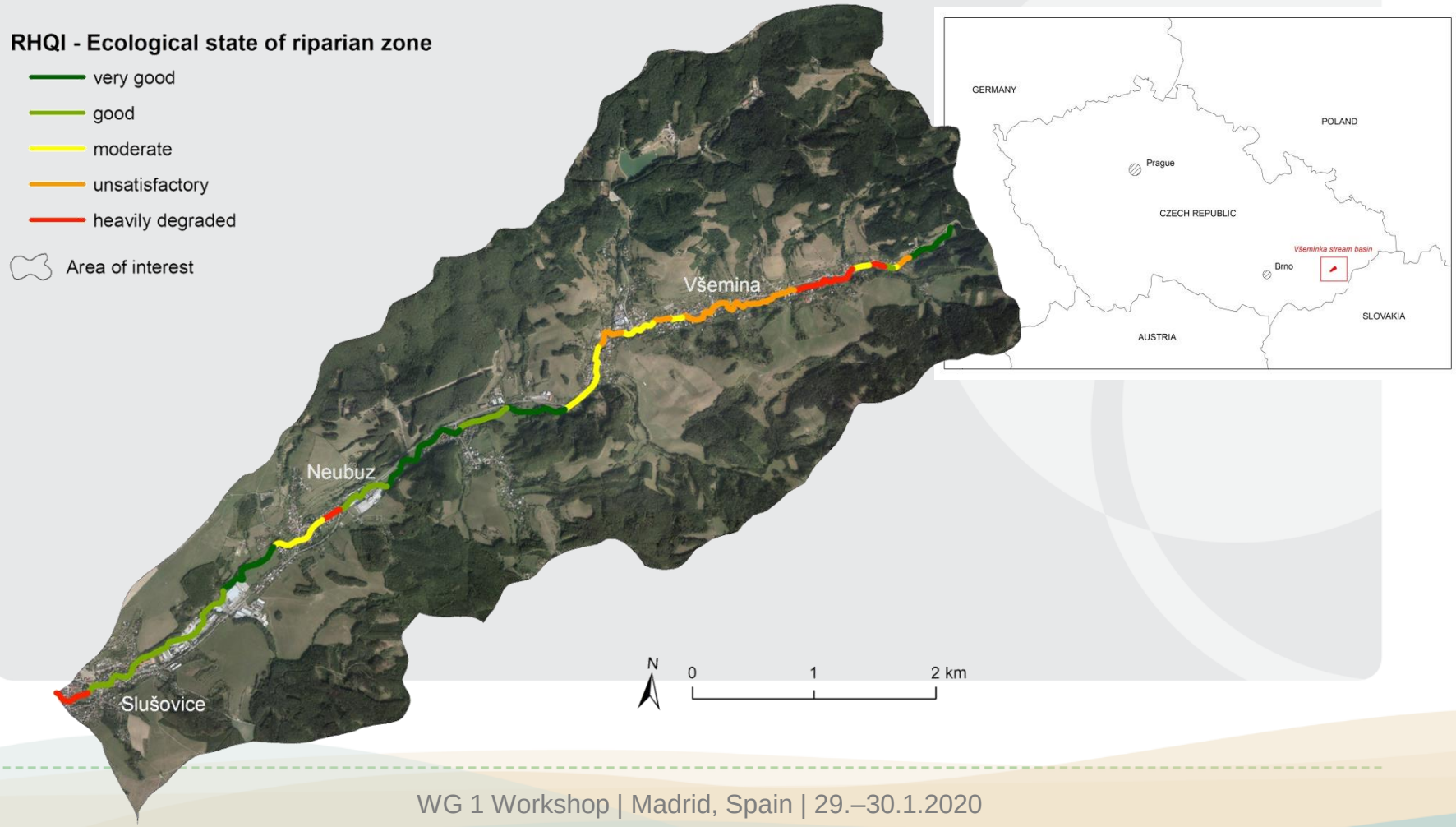
Principle of the final value calculation

- „scoring“ principle – each indicator is assigned a certain value
- multiplication of the values by weights [W1, W2]
- final information (RHQI) is the sum of all values
- necessary comparison against the potential possible status of riparian zone under given conditions (will be obtained using software)

Potential natural state of riparian zones

- Potential state prevailed before the human influence (industrial revolution)
- Expected indicators for determining:
  - potential vegetation cover
  - historical morphological state of river network
  - share of non-permeable surfaces in the basin (built-up areas, …)
  - riparian zone spatial extent (field survey data)

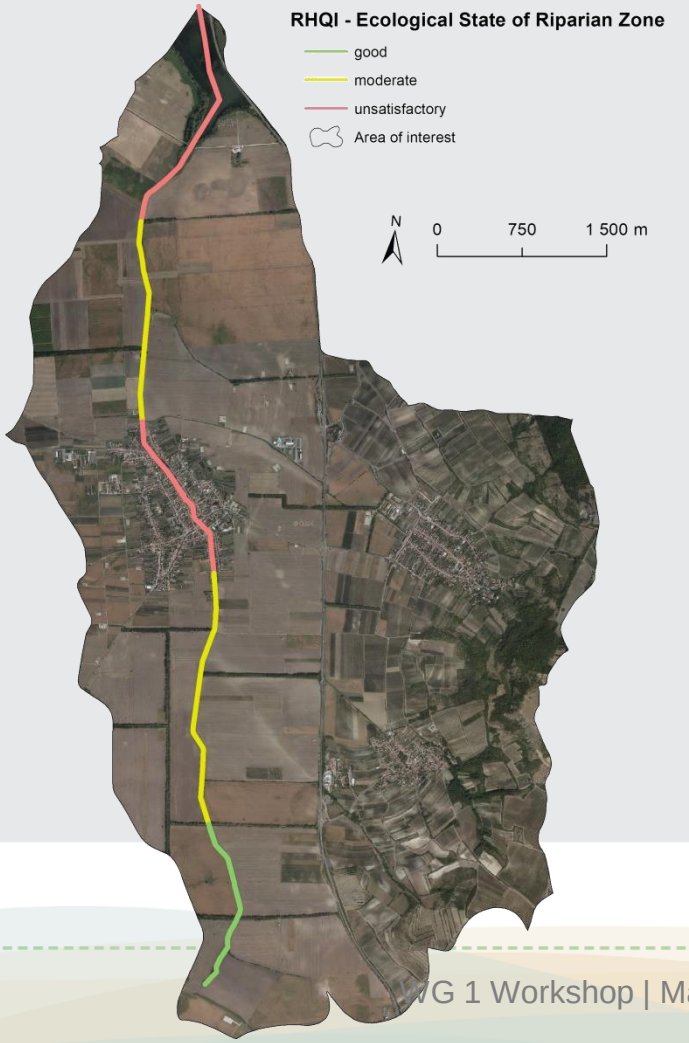
Case study area I. – Všeminka stream basin

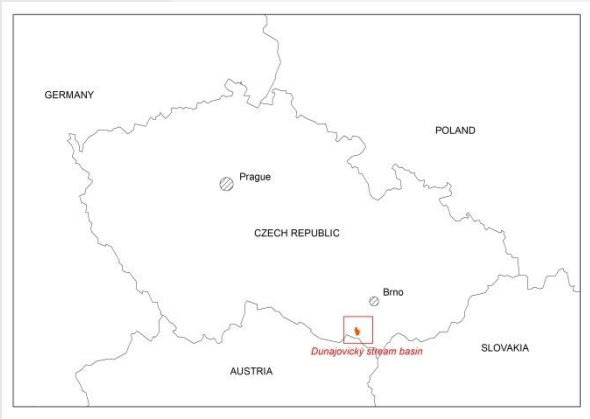


Case study area I. – Všeminka stream basin

Segment No.	Hydromorph. characteristics	Hydrological regime	Biotic characteristics of riparian zone	Total value
VS 01	0.10	0.70	2.10	**2.90**
VS 02	1.92	2.00	6.20	**10.12**
VS 03	3.00	2.00	4.00	**9.00**
VS 04	1.34	2.20	2.70	**6.24**
VS 05	4.25	2.00	7.55	**13.80**
VS 06	2.07	2.00	4.45	**8.52**
VS 07	3.15	2.20	6.80	**12.15**
VS 08	3.65	2.20	5.10	**10.95**
VS 09	3.05	2.20	5.50	**10.75**
VS 10	4.25	2.00	3.90	**10.15**
VS 11	1.56	2.00	3.50	**7.06**
VS 12	3.65	2.00	4.85	**10.50**
VS 13	2.55	2.20	3.95	**8.70**
VS 14	3.65	2.20	4.70	**10.55**
VS 15	2.67	2.00	3.50	**8.17**
VS 16	2.85	2.00	2.30	**7.15**
VS 17	0.85	0.30	1.55	**2.70**
VS 18	1.85	0.30	1.55	**3.70**
VS 19	1.96	0.30	1.00	**3.26**
VS 20	3.10	2.00	2.00	**7.10**
VS 21	4.25	2.00	10.40	**16.65**
VS 22	3.95	1.50	5.00	**10.45**
VS 23	3.70	2.00	4.90	**10.60**
VS 24	2.10	1.50	1.10	**4.70**
VS 25	2.61	1.50	2.50	**6.61**
VS 26	2.90	2.00	2.10	**7.00**
VS 27	4.60	2.00	10.40	**17.00**
VS 28	2.42	2.00	2.70	**7.12**

Case study area II. – Dunajovický stream basin





Case study area II. – Dunajovický stream basin

Segment No.	Hydromorph. characteristics	Hydrological regime	Biotic characteristics of riparian zone	**Total value**
DN 01	1.91	1.2	7.7	**10.81**
DN 02	3.2	1.2	5.6	**10**
DN 03	3.02	1.2	4.5	**8.72**
DN 04	3.3	1.4	5.14	**9.84**
DN 05	3.3	2.2	4.7	**10.2**
DN 06	3.15	1.2	4.2	**8.55**
DN 07	2.07	0.7	3.75	**6.52**
DN 08	1.97	0.7	3.75	**6.42**
DN 09	1.82	0.7	3.7	**6.22**

„Secondary“ riparian zone formation

- temporary phenomenon in the riverbed
- formed on gravel/ sand/ pebble bars
- undesirable for water management authorities in urban areas
- ecological / hydrological importance
- to be consider when evaluating ecological status?

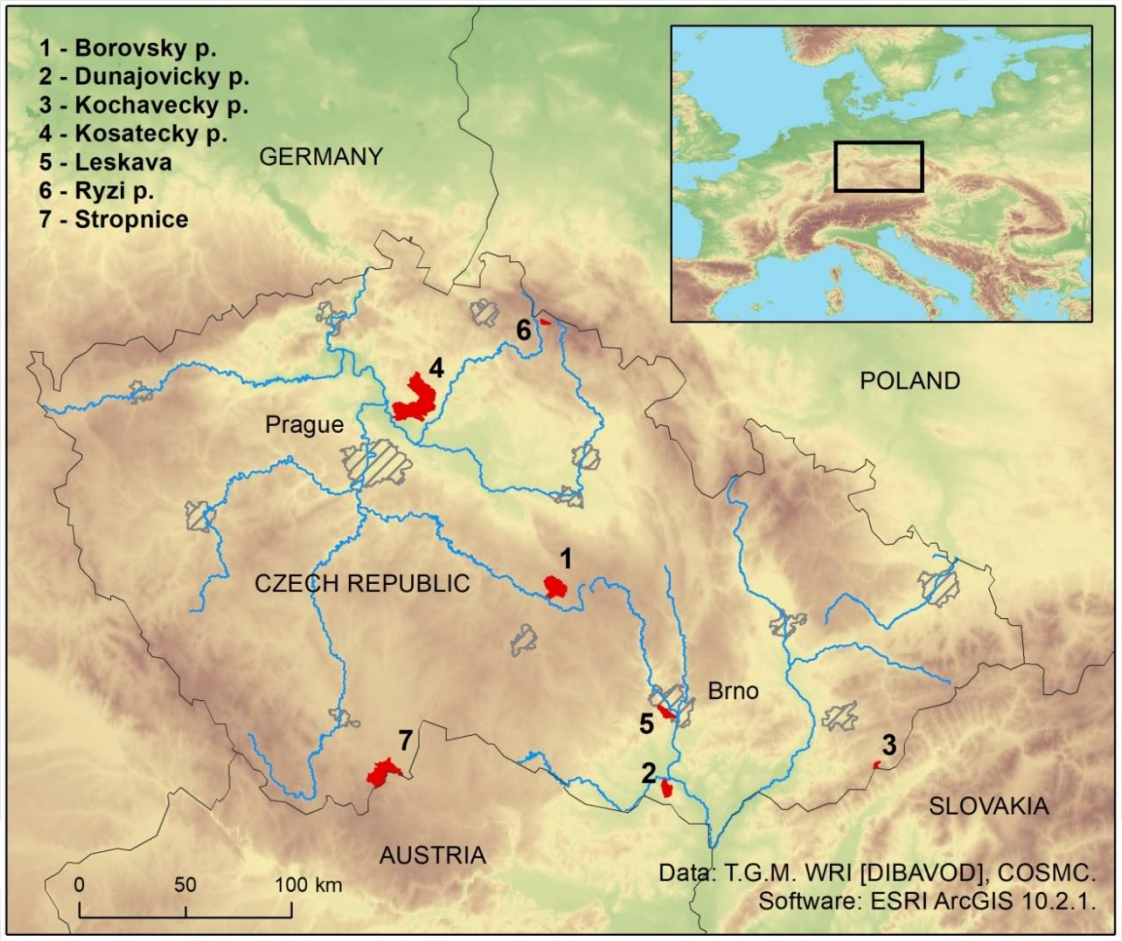
Ecosystem services of small streams and riparian zones

- Main aims of the study:
  - to find out which ecosystem services are provided by small watercourses and its riparian zones;
  - what is the quality of these services in terms of benefits for human society;
  - which hydromorphological characteristics affect the ecosystem services provided.

Ecosystem services of small streams and riparian zones

- **Quantification of selected ecosystem services**:
  - provision of service water (amount of water withdrawals)
  - drinking water provision (water quality, water withdrawals)
  - energy (energy from hydropower plants)
  - flood protection (floodplain extent, soil water retention)
  - climate regulation (vegetation cover, terrain properties)
  - habitat service (migration barriers – weirs, dams, …)
  - aesthetics & recreation (recreational facilities, hiking trails)

Ecosystem services of small streams and riparian zones



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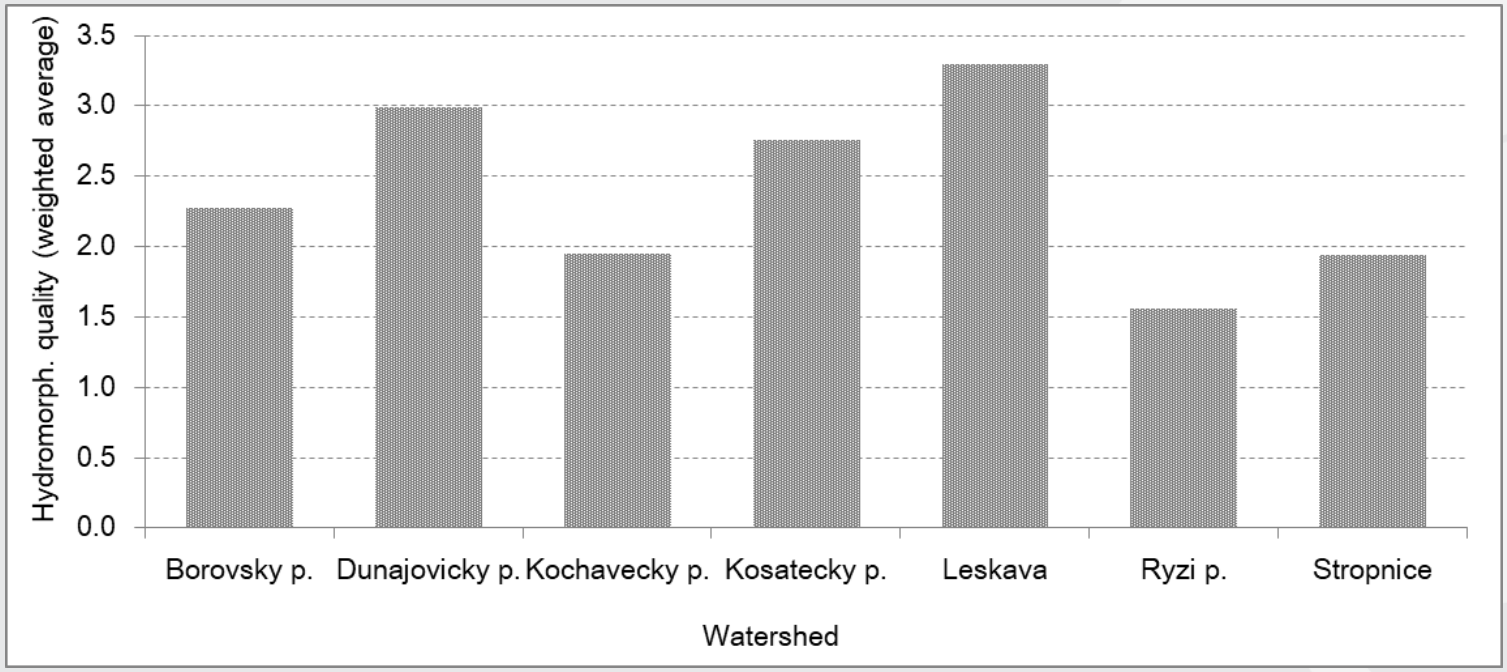
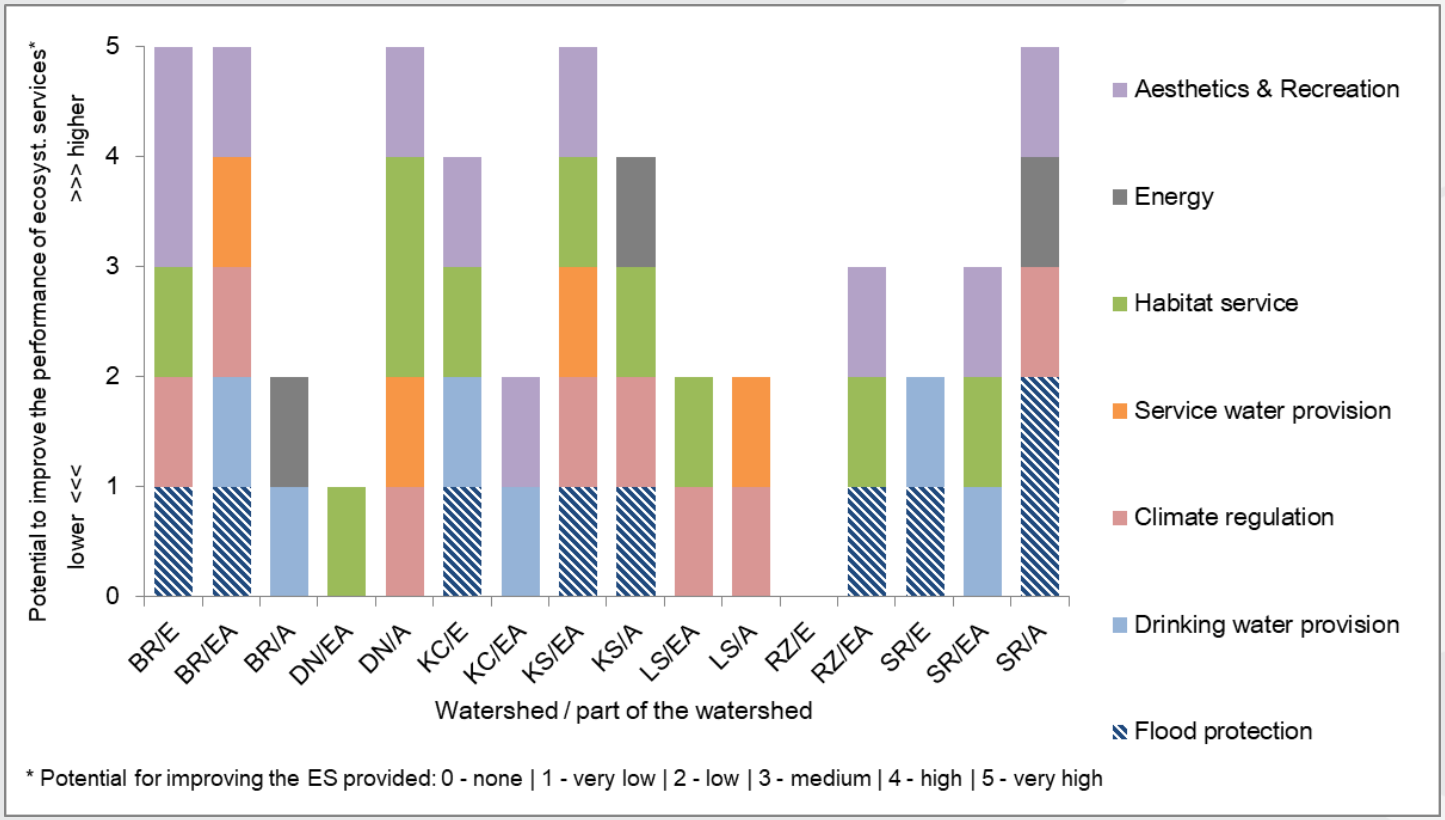
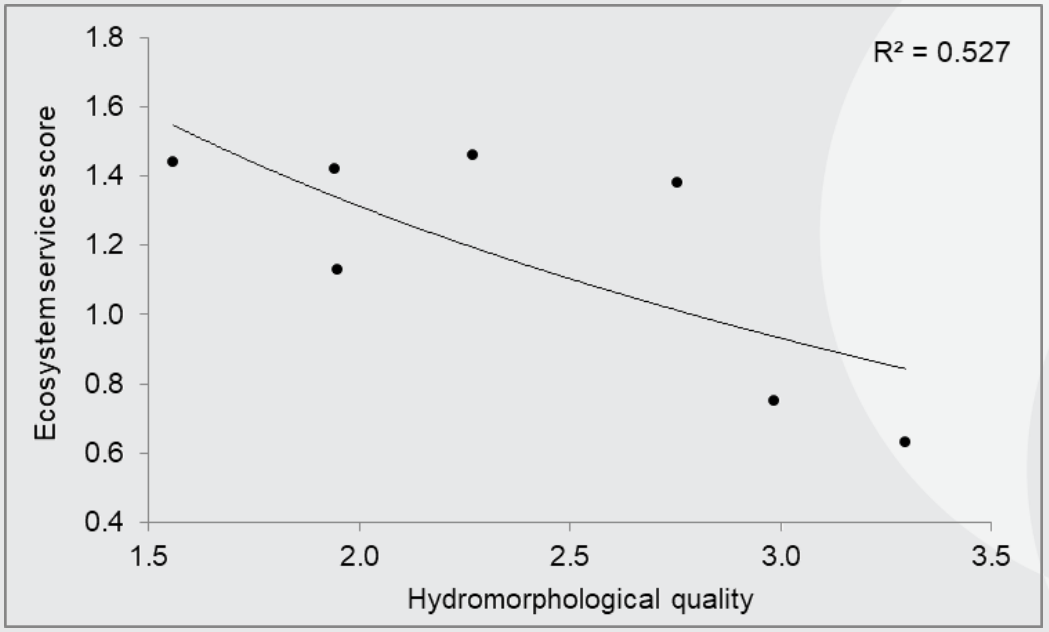
Ecosystem services of small streams and riparian zones



Potential for performing the ecosystem services



Ecosystem functions of small streams and riparian zone



Riparian habitat quality index – next steps

- software for determination of the potential (reference) ecological status of riparian zone (under development)
- → to increase the efficiency of evaluation process
- experimental aplication of the RHQI methodology at selected locations in abroad (Bulgaria, …)
- comparison with existing approaches

Thank you for attention.

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