



Twinning Project

Implementation of the Water
Framework Directive in Croatia

European Union Twinning Project Implementation of the WFD in Croatia

Development of biological assessment systems for rivers and lakes – benthic macroinvertebrates

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Surface water quality monitoring in Croatia

- continuous monitoring in Republic of Croatia started in the 1950'
- Water quality monitoring is mainly based on physico-chemical parameters
- since 2000 water quality assessment is significantly improved
- sampling and assessment of water quality is done in accordance with Croatian (HRN) or international norms (ISO-EN) in authorized laboratories.



**Biological surface water quality determinants being monitored according to
Water Classification Act (“National Gazette” , NN 77/98) are:**

Saprobic index (Pantle – Buck),
Extended Biotic Index and
Trophy status (lakes)

Bioindicator system that is currently in use in Croatia:

Wegl (1983)

Analysed communities:
Benthic macroinvertebrates
Periphyton
Bioseston

HRIS - national bioindicator system (2005)



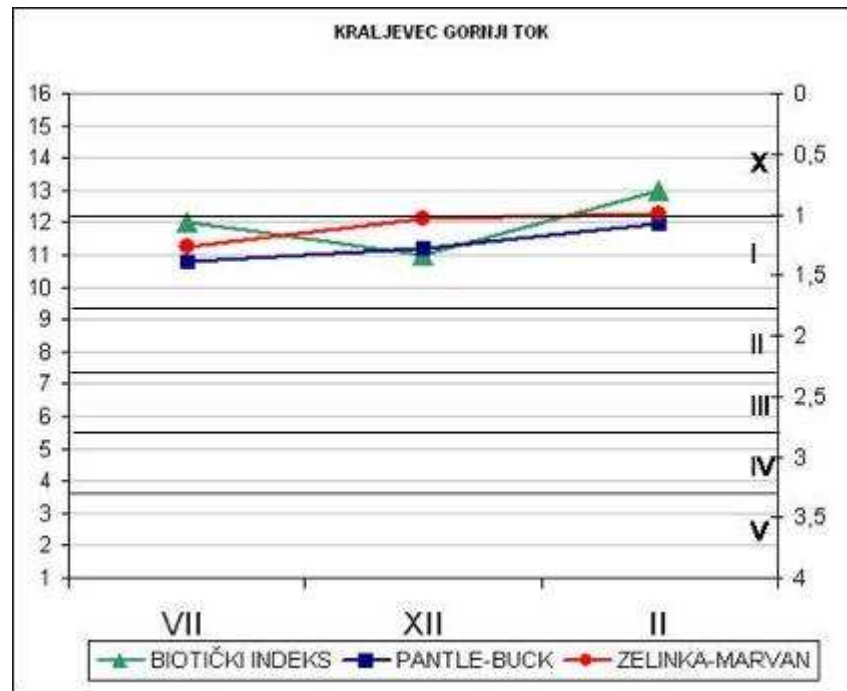
Limit values of S.I., EBI and Trophic status

Classification in five water quality classes according to limit values of the parameters.

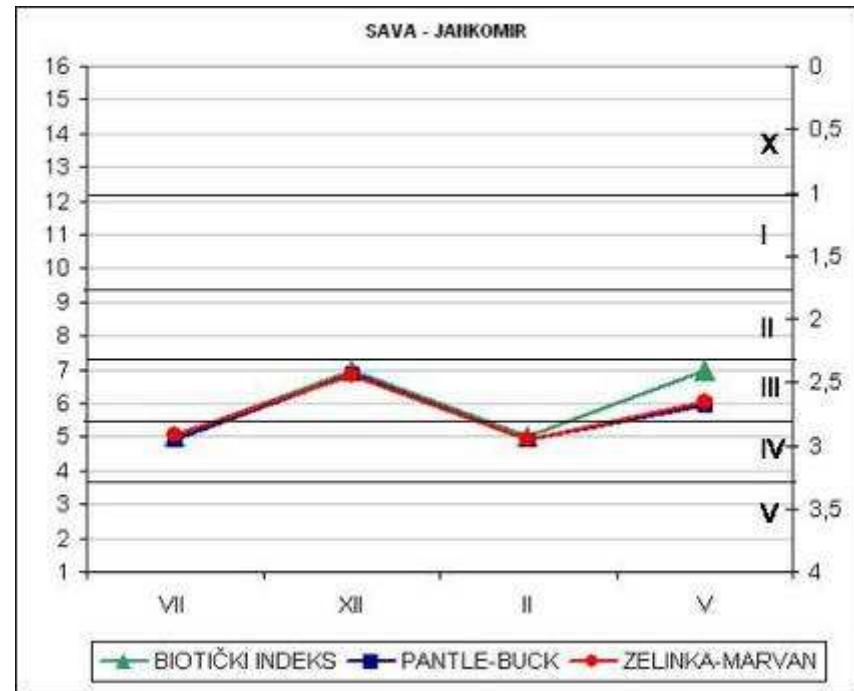
Biological determinands			
Saprobic index	Biotic index	Trophy status	Water Quality class
1,0-1,8	>10	oligotrophic	I
1,8-2,3	8-9	mezotrophic	II
2,3-2,7	6-7	moderately eutrophic	III
2,7-3,2	4-5	eutrophic	IV
3,2-4,0	<4	hypertrophic	V



Comparison of water quality indices



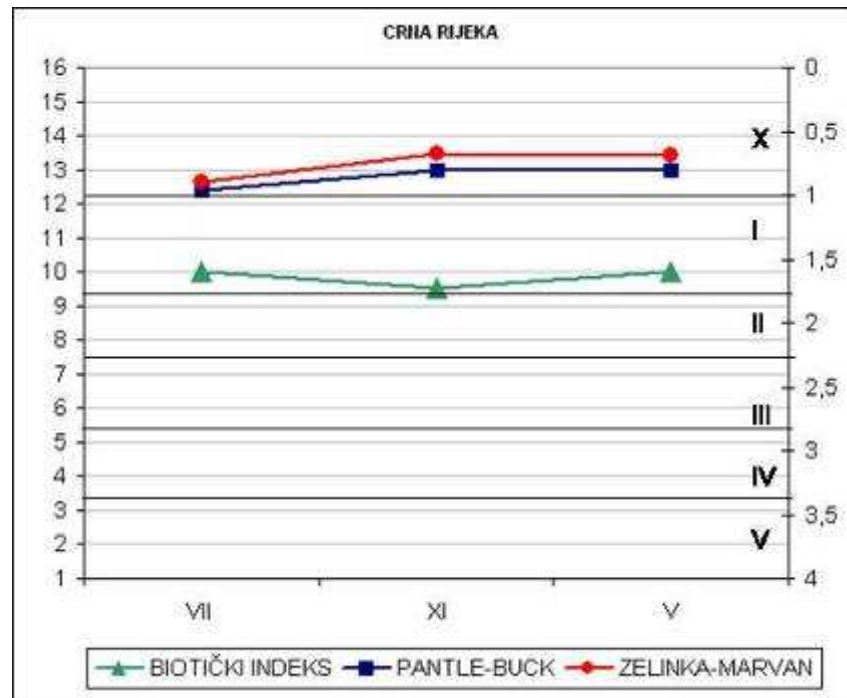
Mountain stream



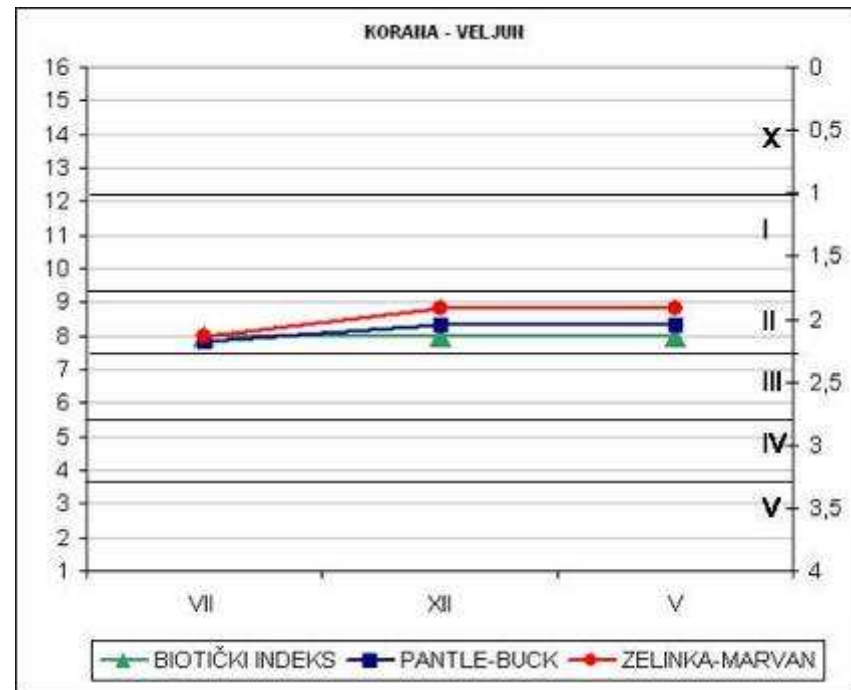
Large lowland river - middle reach



Comparison of water quality indices



Crenal section



Mountain river - middle reach



Need for revision of the water monitoring system

- According to WFD water bodies as primary water management units must be nominated;
- Prevent deterioration, reduce pollution and achieve good status of aquatic ecosystems;
- Information on ecological quality status must be obtained;
- BQE – Aquatic flora: Phytoplankton, Macrophytes,
Phytobenthos
 - Benhic macroinvertebrates
 - Fishes
- Information on water bodies` ecological quality are prerequisite for establishment of management plans.
- For WFD implementation a multimetric method for assessing the ecological status of rivers is in preparation.

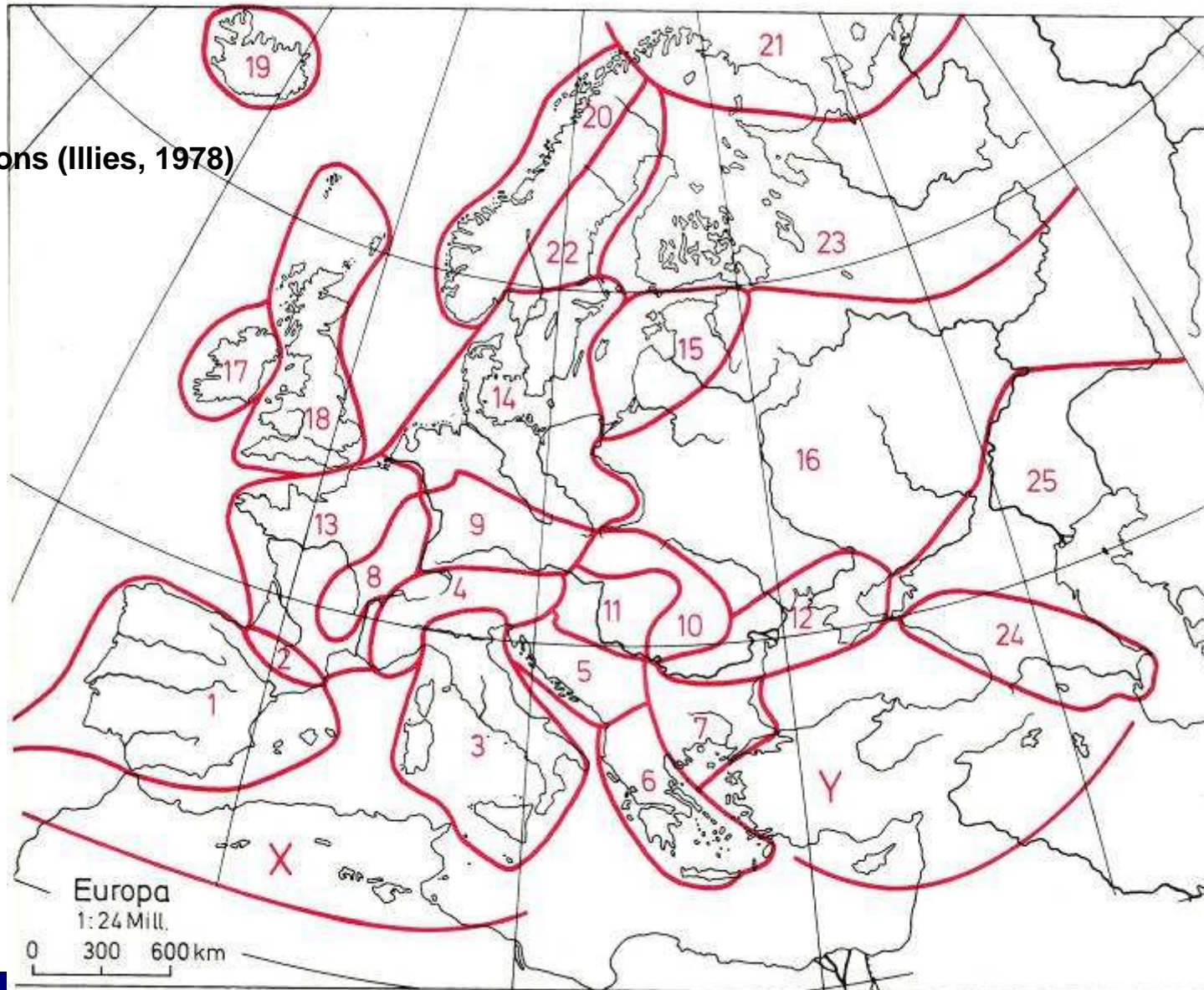


Application of AQEM sampling protocols

- Implementation of AQEM methodology in Croatia
 - ✓ Project: **“Ecological Research of freshwater in Croatia regarding criteria of the Water Framework Directive of EU”**
- Its application is under development
- Definition of type specific reference conditions
- Required modification;
 - ✓ Integration of HRIS
 - ✓ Characteristic type-specific species (Dinaric area)



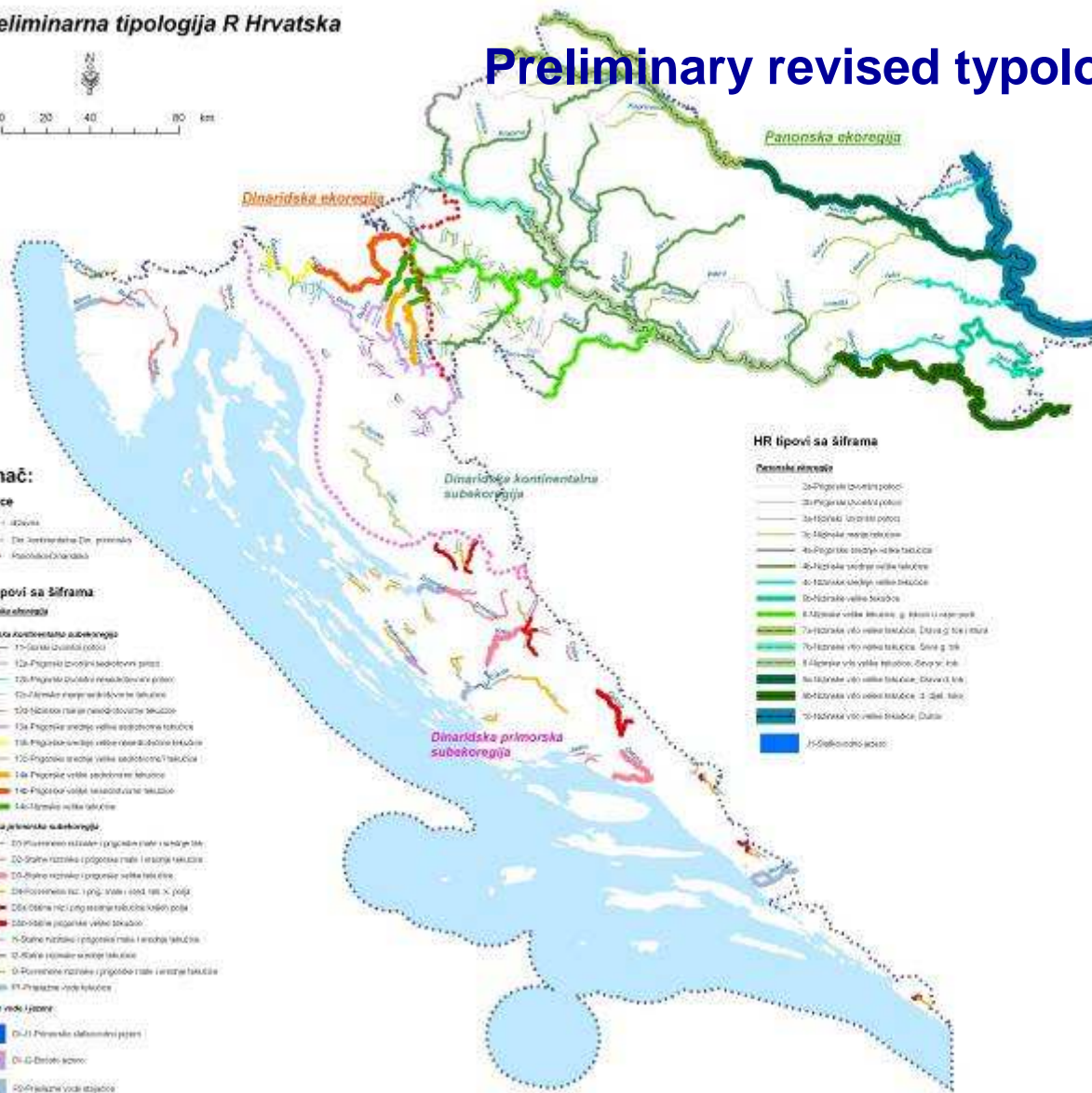
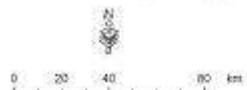
Ecoregions (Illies, 1978)





Preliminary revised typology for Croatia

Preliminarna tipologija R Hrvatska



Ecoregions (2):

- Pannonian
- Dinaric
 - subcoregions; Continental
 - Mediterranean



Preliminary revised typology for Croatia

- ❑ 3 type specific watercourses for each eco/subecoregion;
 - ✓ Mountain streams
 - ✓ Mountain rivers
 - ✓ Lowland rivers

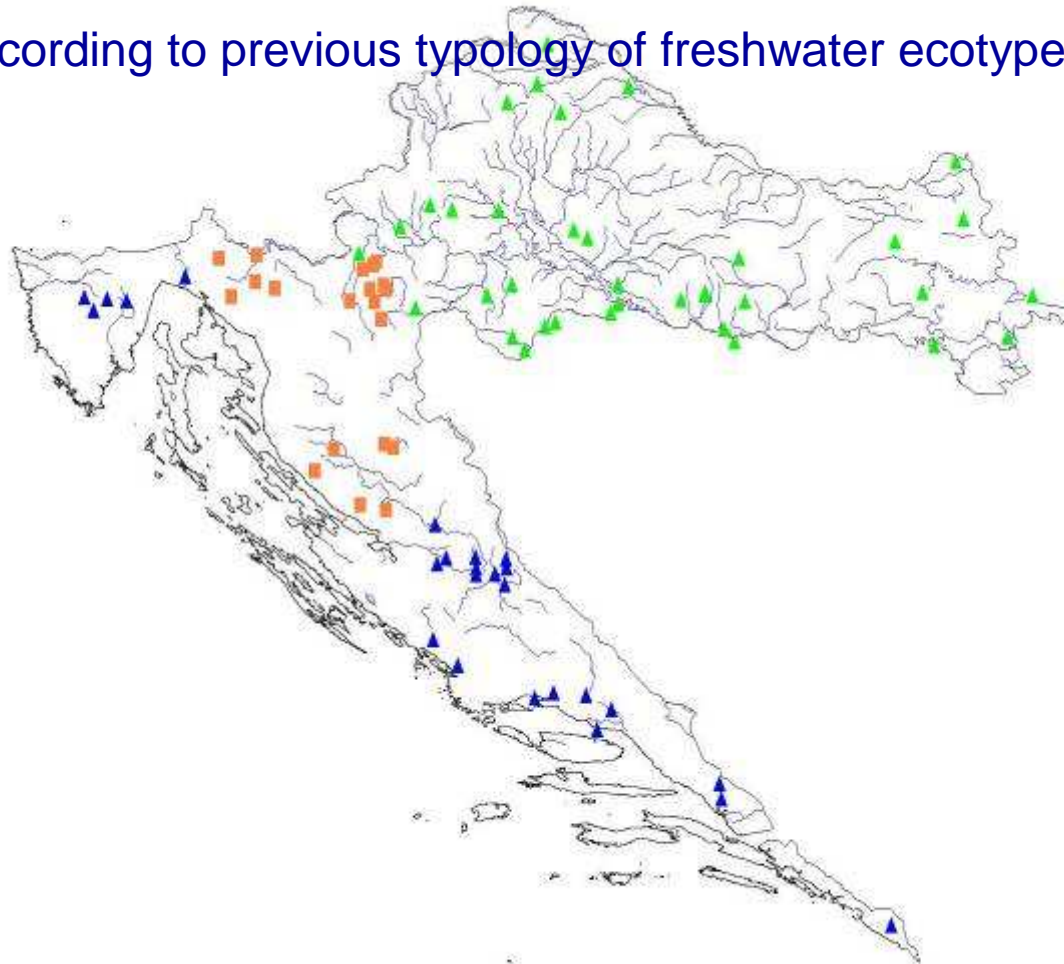
- ❑ Problems: selection of referent sites (conditions) for the lowland rivers in the Pannonian region
 - ✓ all rivers highly influenced (general degradation)
 - ✓ historical data insufficient



Application of AQEM methodology

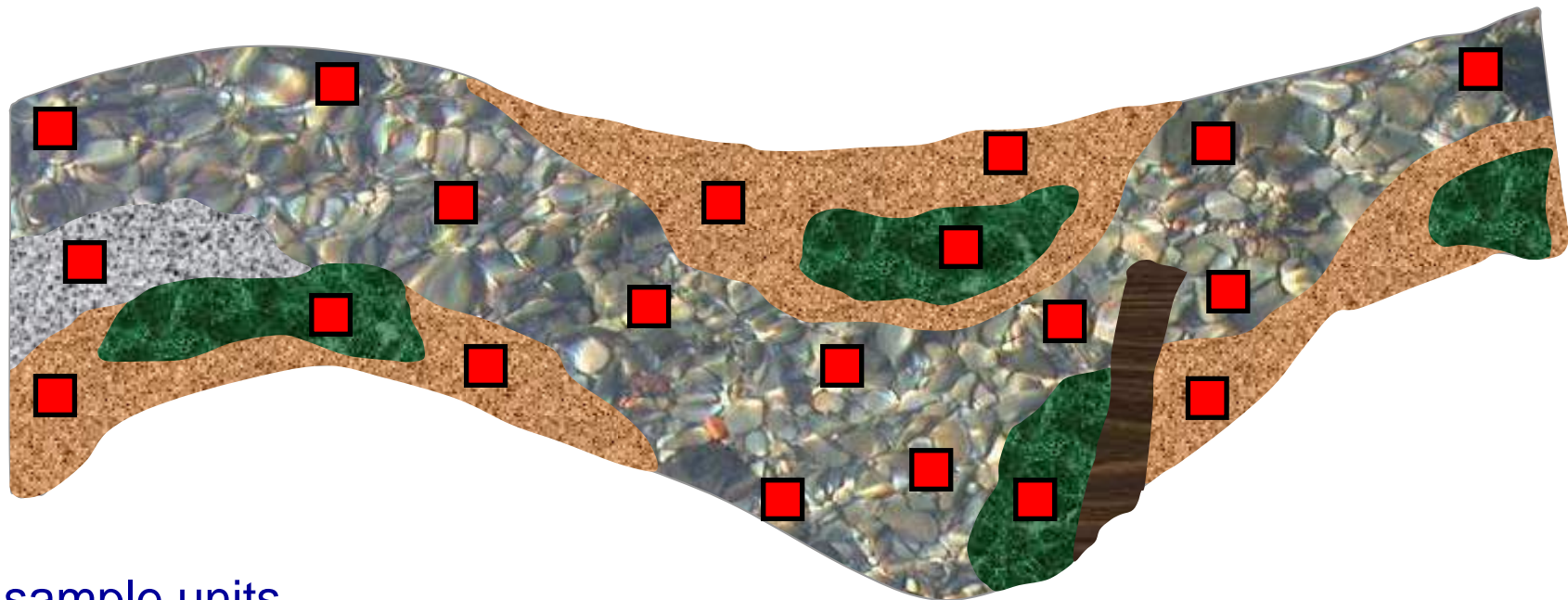
Mutihabitat sampling – 80 sampling sites

All habitat types according to previous typology of freshwater ecotypes were sampled





Multi-habitat Sampling (MHS)



- 20 sample units
- each sample unit represents 5 % of stream bottom
- $20 \times 5 \% = 100 \%$



Application of AQEM methodology

- Mineral microhabitats



Megalithal (> 40 cm), Blocks, bedrock



Macrolithal (20 - 40 cm), Blocks



Mesolithal (6 - 20 cm), Cobbles



Microlithal (2 - 6 cm), Pebbles



Akal (0,2 - 2 cm), Gravel

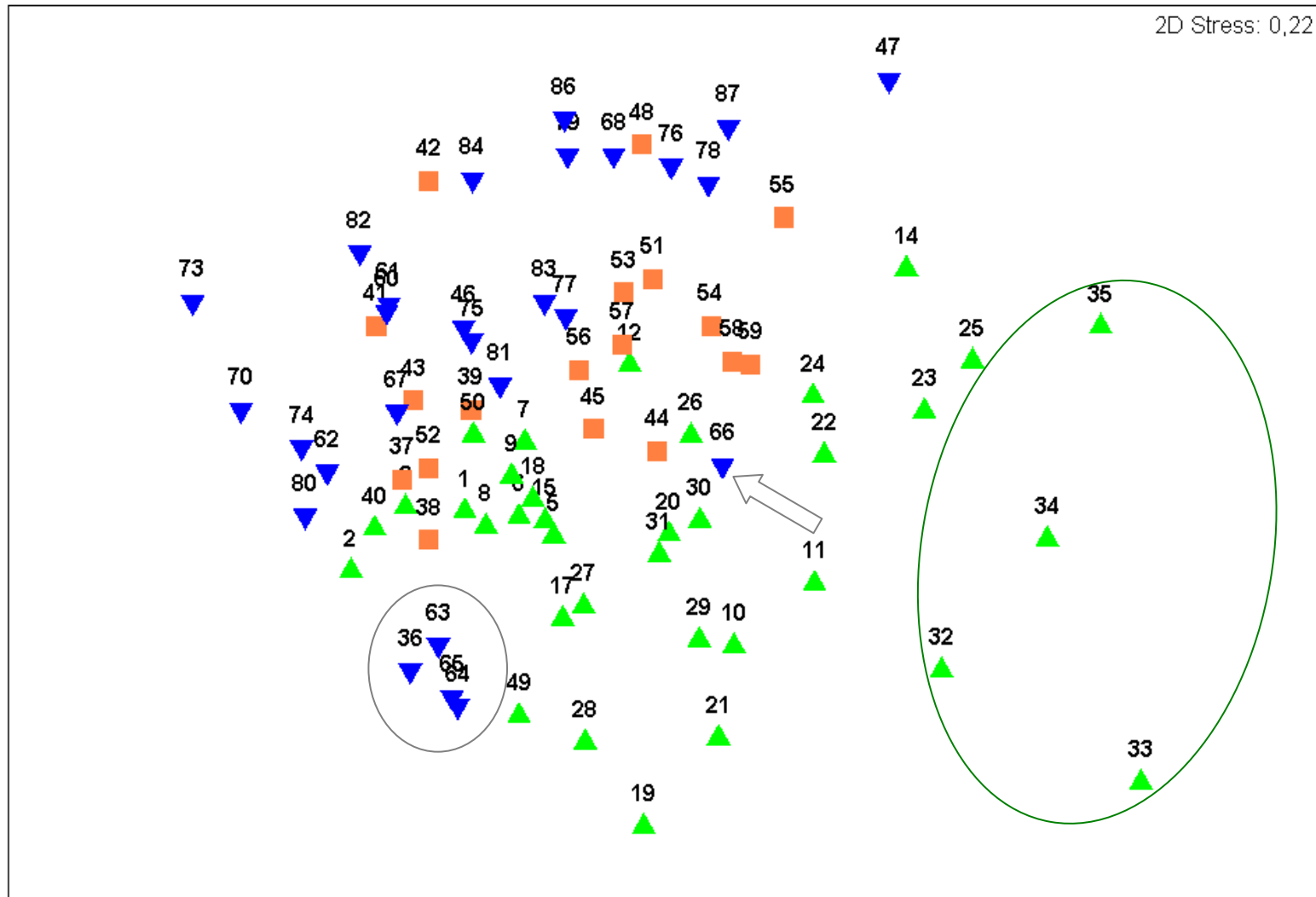


Psammal (6 μ m - 2 mm), Sand



Community composition of pooled data

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity





Type-specific Saprobic Index

Preliminary quality criteria

	High	Good	Moderate	Poor	Bad
Lowland rivers (Pannonian ecoregion; < 200 m a.s.l.)	< 1.9	– 2.4	– 3.0	– 3.6	– 4.0
Lowland rivers (Dinaric ecoregion; < 200 m a.s.l.)	< 1.7	– 2.2	– 2.8	– 3.4	– 4.0
Mountain streams (200 – 800 m a.s.l.)	< 1.3	– 1.9	– 2.5	– 3.2	– 4.0
Mountain rivers (200 – 800 m a.s.l.)	< 1.4	– 2.0	– 2.6	– 3.3	– 4.0
(...)					



Main stressors



Metrics:

- Saprobic Index (Pantle-Buck)
- Shannon-Wiener
- EBI

Metrics:

- number of EPT taxa
- abundance of Trichoptera
- number of taxa
- total abundance
- Index of Biocenotic Region
- [%] EPT-Taxa
- [%] Oligochaeta & Diptera
- [%] Gatherers/Collectors
- [%] littoral preferences



Suggested type specific sites

Dinaric ecoregion

→ Continental subcoregion;

→ mountain streams:

→ Crna rijeka



Pollution

Saprobic Index (Pantle-Buck)	1,00
IBE	11
Shannon-Wiener	2,32

Degradation in stream morphology

number of EPT taxa	16
abundance of Trichoptera	140
number of taxa	40
total abundance	12789
Index of Biocenotic Region	3,444
[%] EPT-Taxa	18
[%] Oligochaeta & Diptera	27,54
[%] Gatherers/Collectors	16,00
[%] littoral preferences	5,971



Suggested type specific sites

Dinaric ecoregion

→ Continental subecoregion;

→ mountain streams:

→ Mrežnica upper reach (Zvečaj)



Pollution

Saprobic Index (Pantle-Buck)	2,24
IBE	12
Shannon-Wiener	2,72

Degradation in stream morphology

number of EPT taxa	18
abundance of Trichoptera	637
number of taxa	74
total abundance	13315
Index of Biocenotic Region	6,404
[%] EPT-Taxa	18,919
[%] Oligochaeta & Diptera	59,73
[%] Gatherers/Collectors	30,69
[%] littoral preferences	13,808



Suggested type specific sites

Dinaric ecoregion

→ Mediterranean subecoregion;

→ mountain streams: Ljuta



Pollution

Saprobic Index (Pantle-Buck)	1,74
IBE	10
Shannon-Wiener	1,87

Degradation in stream morphology

number of EPT taxa	13
abundance of Trichoptera	20
number of taxa	27
total abundance	2754
Index of Biocenotic Region	4,658
[%] EPT-Taxa	56,935
[%] Oligochaeta & Diptera	36,71
[%] Gatherers/Collectors	38,68
[%] littoral preferences	23,922



Suggested type specific sites

Dinaric ecoregion

→ Mediterranean subecoregion;

→ mountain river: Zrmanja
upper reach



Pollution

Saprobic Index (Pantle-Buck)	1,16
IBE	10,4
Shannon-Wiener	2,04

Degradation in stream morphology

number of EPT taxa	18
abundance of Trichoptera	243
number of taxa	34
total abundance	10341
Index of Biocenotic Region	4,416
[%] EPT-Taxa	19,853
[%] Oligochaeta & Diptera	24,10
[%] Gatherers/Collectors	14,62
[%] littoral preferences	6,108



Suggested type specific sites

Dinaric ecoregion

→ Mediterranean subecoregion;

→ Lowland rivers:

Zrmanja lower reach



Pollution

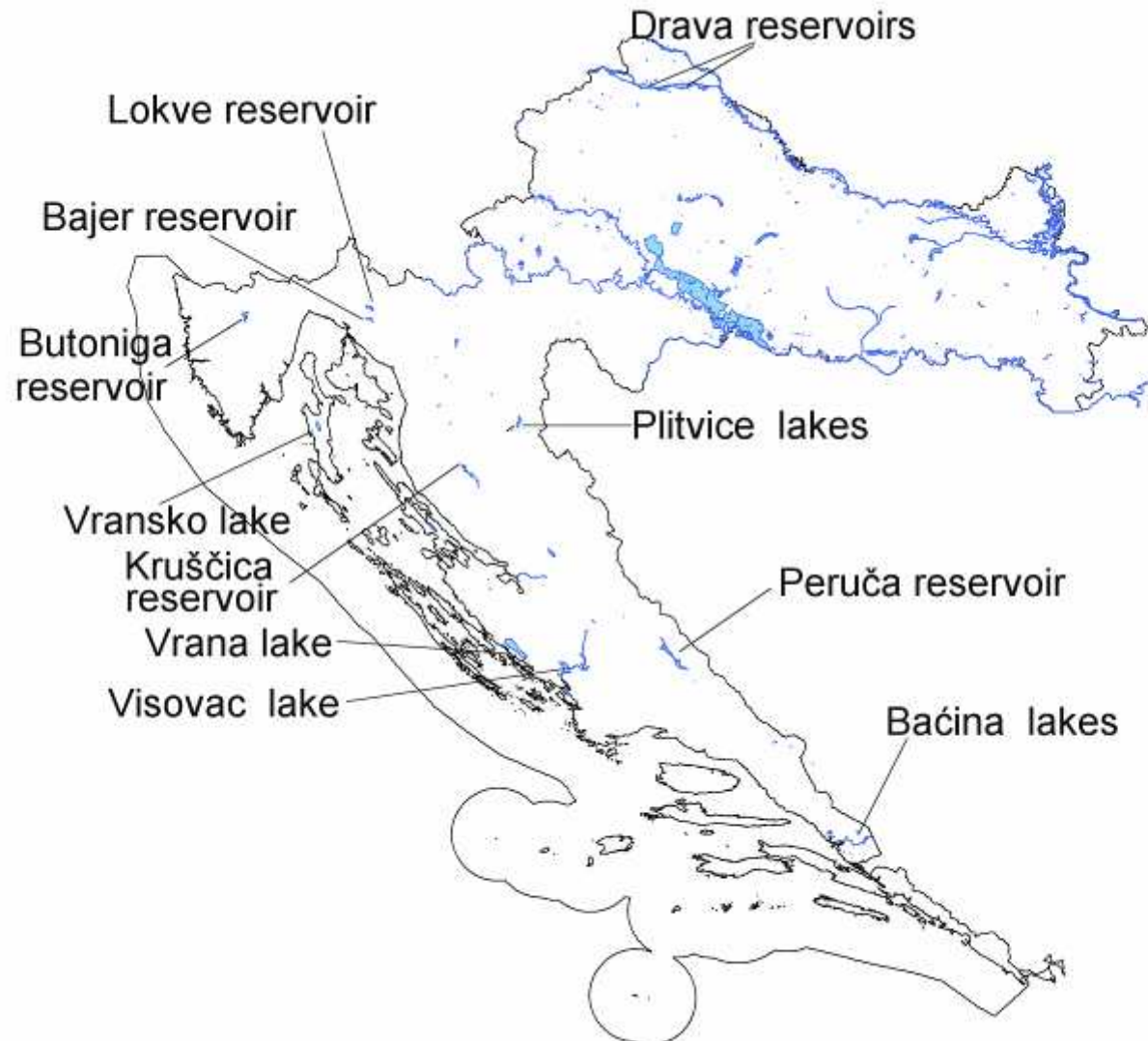
Saprobic Index (Pantle-Buck)	1,53
IBE	11
Shannon-Wiener	2,90

Degradation in stream morphology

number of EPT taxa	18
abundance of Trichoptera	85
number of taxa	59
total abundance	4420
Index of Biocenotic Region	5,408
[%] EPT-Taxa	31,946
[%] Oligochaeta & Diptera	23,80
[%] Gatherers/Collectors	32,22
[%] littoral preferences	5,848



Croatian lakes and reservoirs





Definition of ecological status of lakes according to benthic macroinvertebrates

The most relevant pressure in Croatian lakes and reservoirs are eutrophication (nutrient loading).

Metrics:

- 1) the taxonomical composition and abundance
- 2) the ratio of disturbance, sensitive to insensitive taxa
- 3) the level of diversity
- 4) Saprobic index

Problems:

- 1) Dominance of chironomids and oligochaetes in benthic communities
- 2) Identification to species and genus level (costly and time-consuming)
- 3) Lack of experts



Specific water bodies; travertine barrage lakes



Roški slap



Skradinski buk



Brljan Lake



Visovac Lake



	Brijan	Visovac 1	Visovac 2	Visovac 3
no. of taxa	33	35	11	14
ind. m ⁻²	44487	5948	2627	2439
% oligochaeta	75	51,4	50,2	39,5
Shannon-Wiener	1,86	2,53	1,75	1,86

<i>L. hoffmeisteri</i>	<i>P. hammoniensis/</i>	<i>Chironomus</i>	<i>P. hammoniensis/</i>
<i>P. heuscheri</i>	<i>heuscheri</i>	<i>P. barbatus</i>	<i>heuscheri</i>
<i>Sphaerium</i>	<i>P. barbatus</i>	<i>Tanytarsus</i>	<i>Chironomus</i>
	<i>Chironomus</i>		<i>P. barbatus</i>
	<i>Procladius</i>		<i>Tanytarsus</i>



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