



Twinning Project

Implementation of the Water
Framework Directive in Croatia

European Union Twinning Project Implementation of the WFD in Croatia

**Croatian concept for the development of biological assessment
systems for rivers and lakes – freshwater fish**

P. Mustafić, M. Mrakovčić
Faculty of Science, Univ. of Zagreb

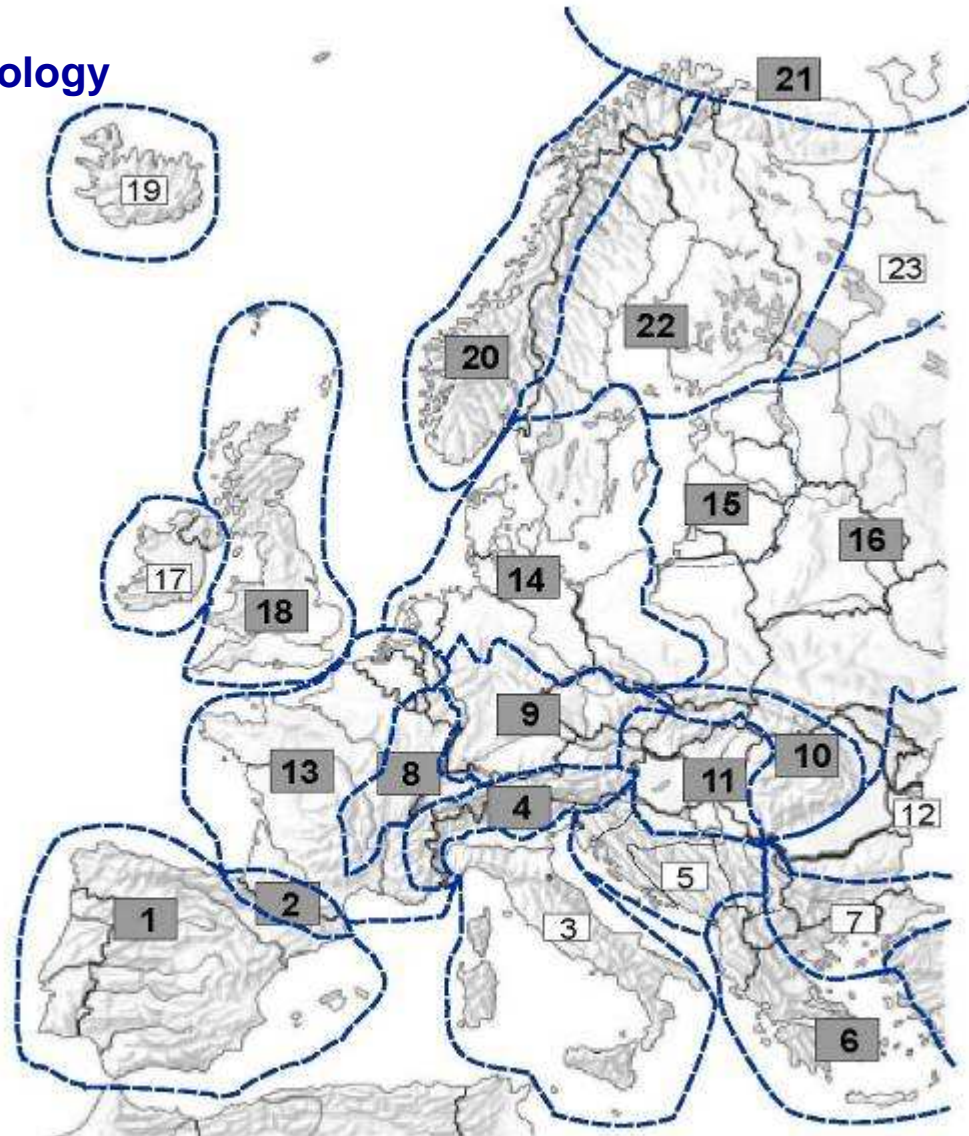


Basic principle

- ❑ The development of a fish-based ecological status assessment method was founded on the principle of the **I**ndex of **B**iotic **I**ntegrity (IBI) established in the USA in the early 1980s (Karr, 1981). In the last 2 decades the IBI was adapted to different regional conditions, although the basic principles are the same for all methods. The fundamental assumption is that the composition and structure of fish assemblages change under human pressures in a traceable manner.
- ❑ Fish species have different and in many cases well-known ecological requirements. Thus, they also have a specific sensitivity to human alterations. To account for these particularities, “metrics” are introduced as a measurable part or process of the biological system responding to human influence. Within each metric group considered, species with similar ecological requirements are compiled into functional guilds (e.g. for reproduction, habitat, tolerance, migration, feeding).
- ❑ The original IBI as well as many of the modified fish-based assessment methods were developed based on expert knowledge. In contrast, FAME aimed at establishing a method based on the analysis of a large number of existing sampling data. (FIDES – 12 EU countries. Altogether about 15,000 samples (“fishing occasions”) from some 8000 sites on 2700 rivers are integrated in FIDES.)

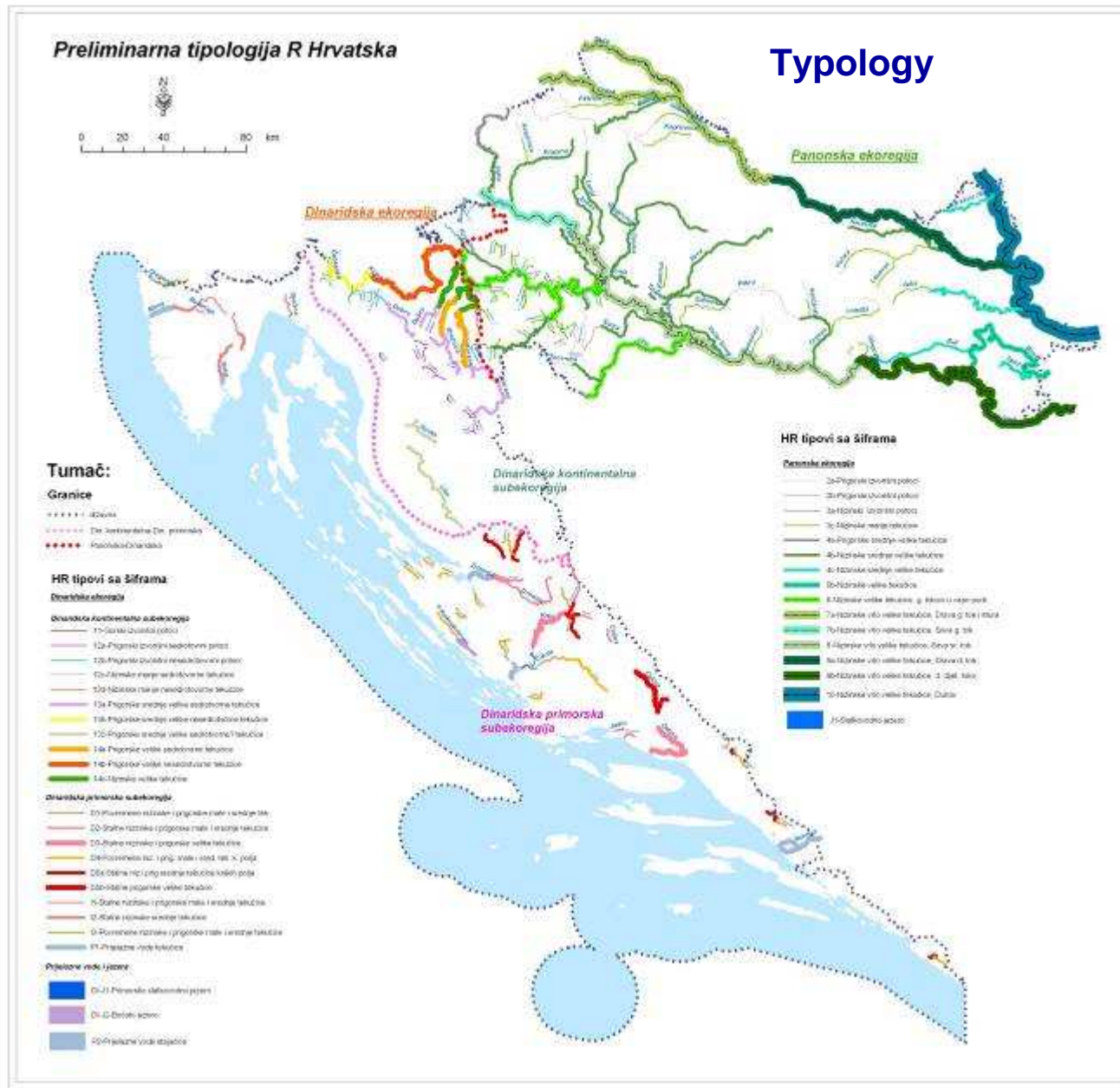


Typology



Fish-based Assessment Method for the Ecological Status of European Rivers - FAME

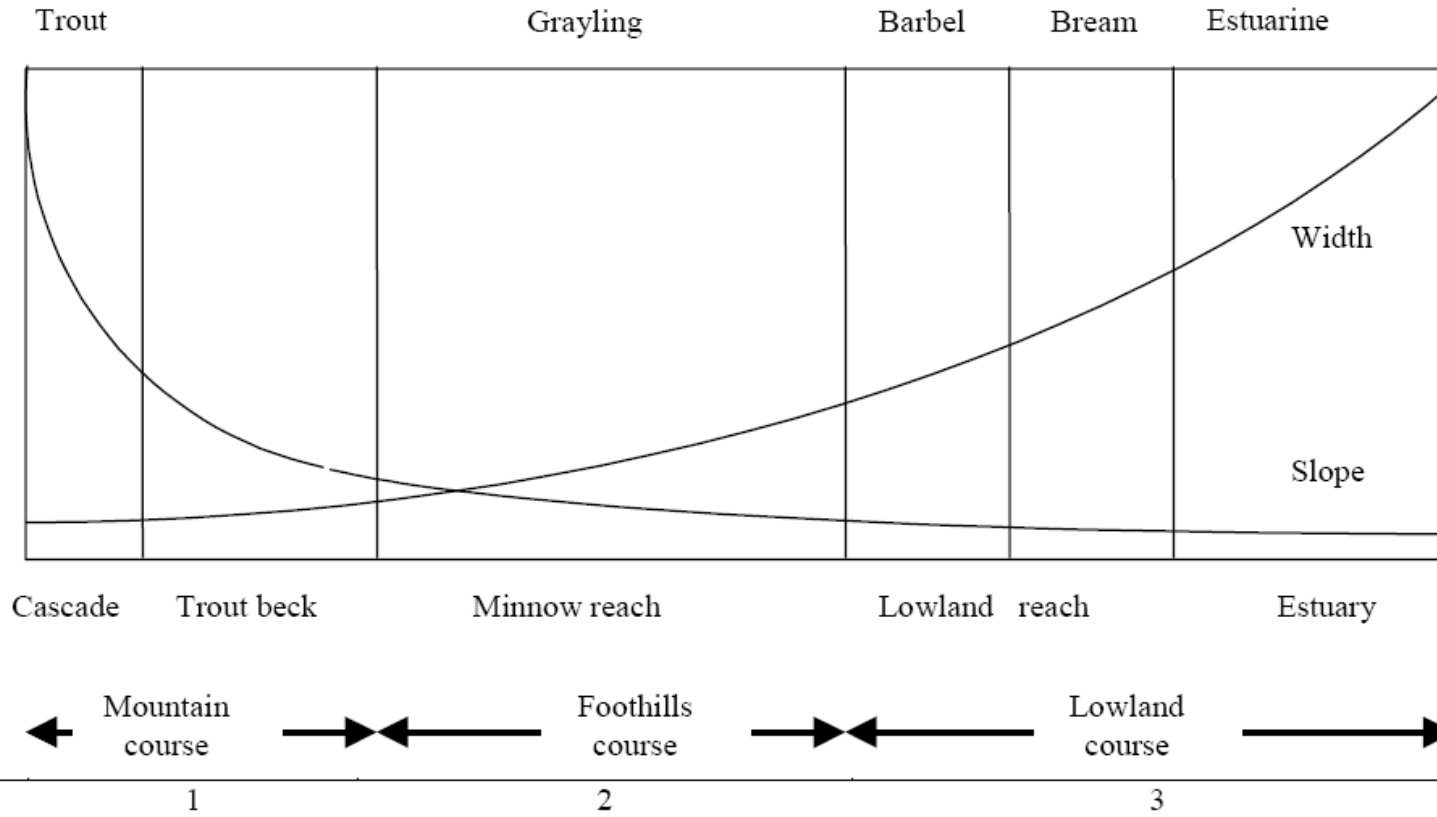
- ❑ WFD requires that a water body is placed into one of the regional "types" described by Illies (1978).
- ❑ This classification assumes that the 25 biogeographical regions or ecoregions proposed are relatively homogeneous ecological systems, and the biological communities, e.g. fishes, are correlated with these ecoregions. For fishes this is implicitly untrue.



- Ecoregions (2):
- Pannonian
- Dinaric
- 2 subcoregions:
 - ✓ Continental
 - ✓ Mediterranean



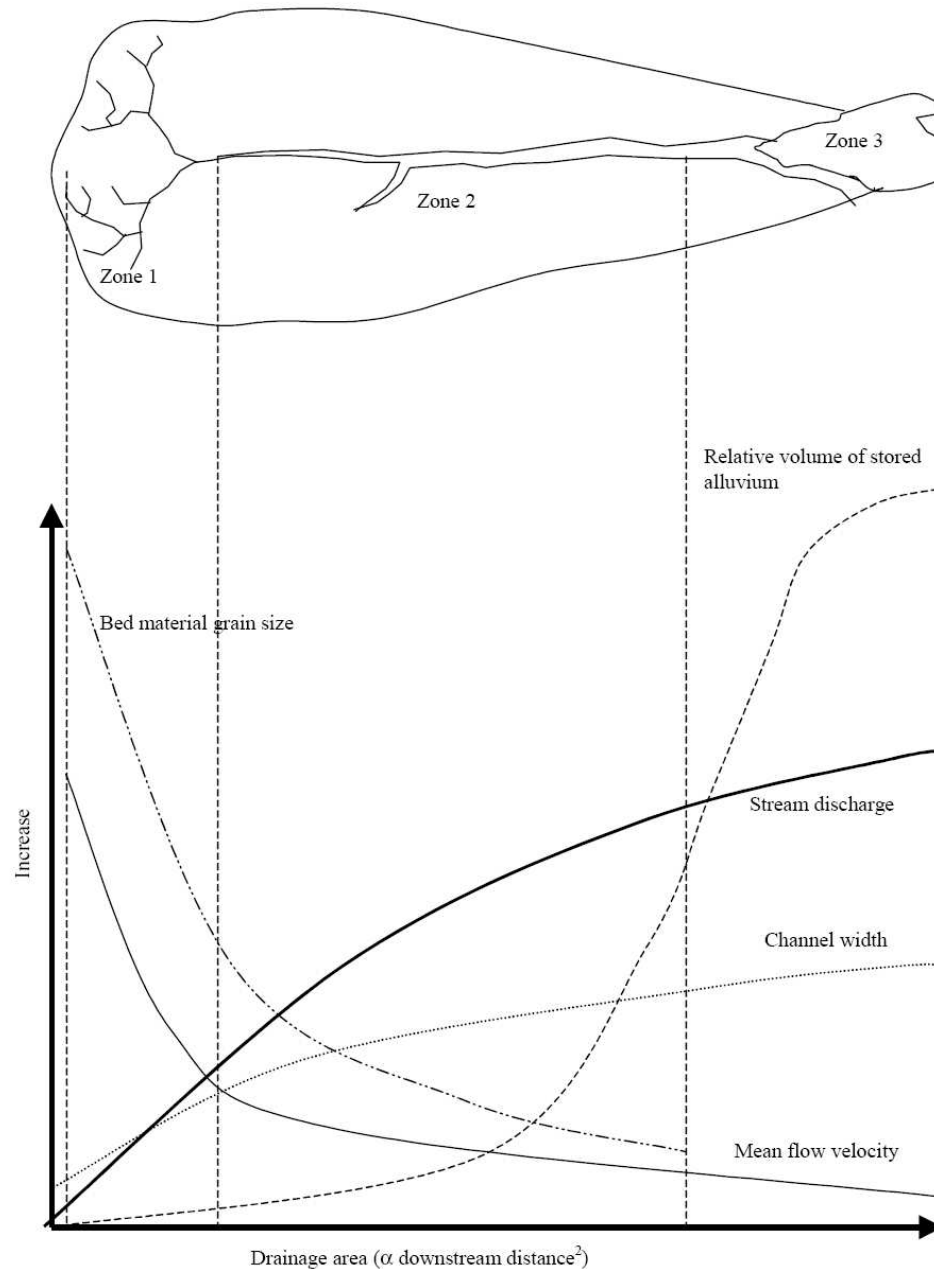
Typology



River zones, biotopes and biocoenoses (Huet 1949, 1954).

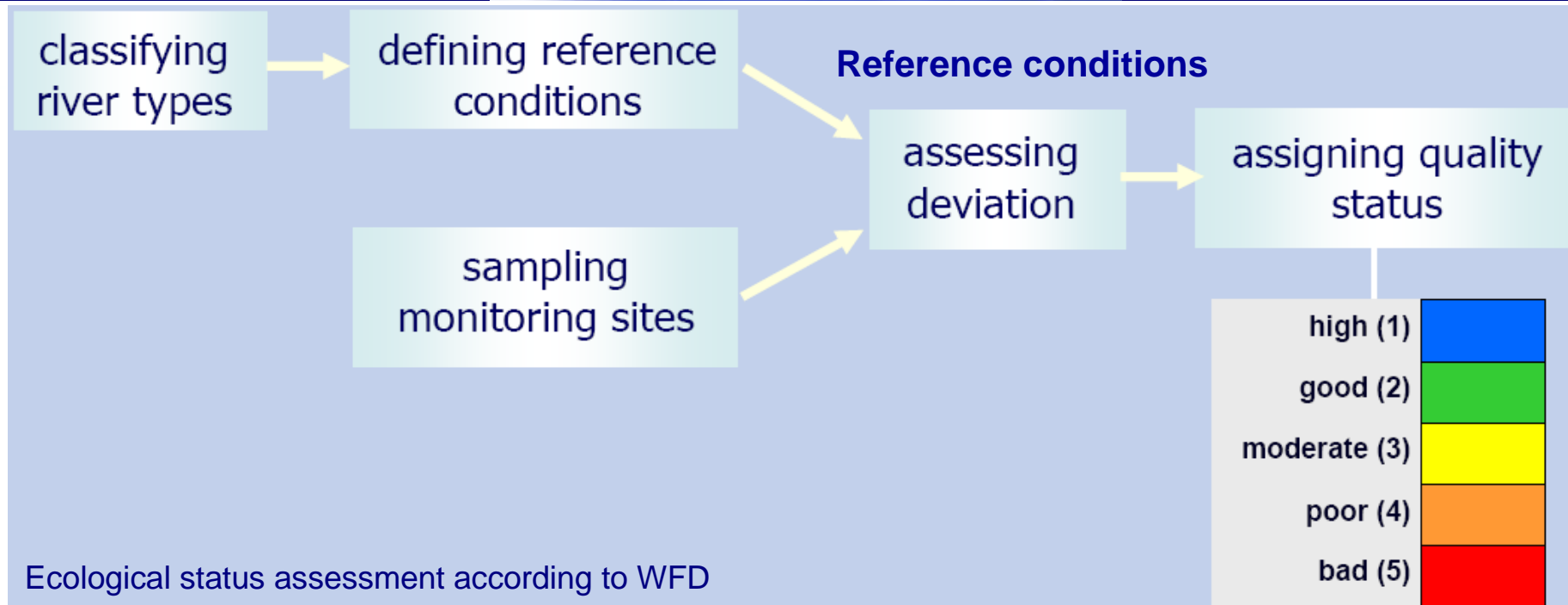
Altitude typology:

1. high > 800 m
2. mid-altitude 200 to 800 m
3. lowland < 200 m



Typology

The concept of Schumm (1977) offers a scheme where channel size is assumed to increase systematically through a river system as the increasing drainage area contributes larger flows to the trunk channel. The morphological scale of the channel changes accordingly.



- ❑ The glossary of the US Environmental Protection Agency (EPA) provides the following definitions:
- ❑ *“Reference Site is a specific locality on a waterbody which is minimally impaired and is representative of the expected ecological integrity of other localities on the same waterbody or nearby waterbodies”.*
- ❑ *“Reference Condition is a set of selected measurements or conditions of minimally impaired waterbodies characteristic of a waterbody type in a region”.*



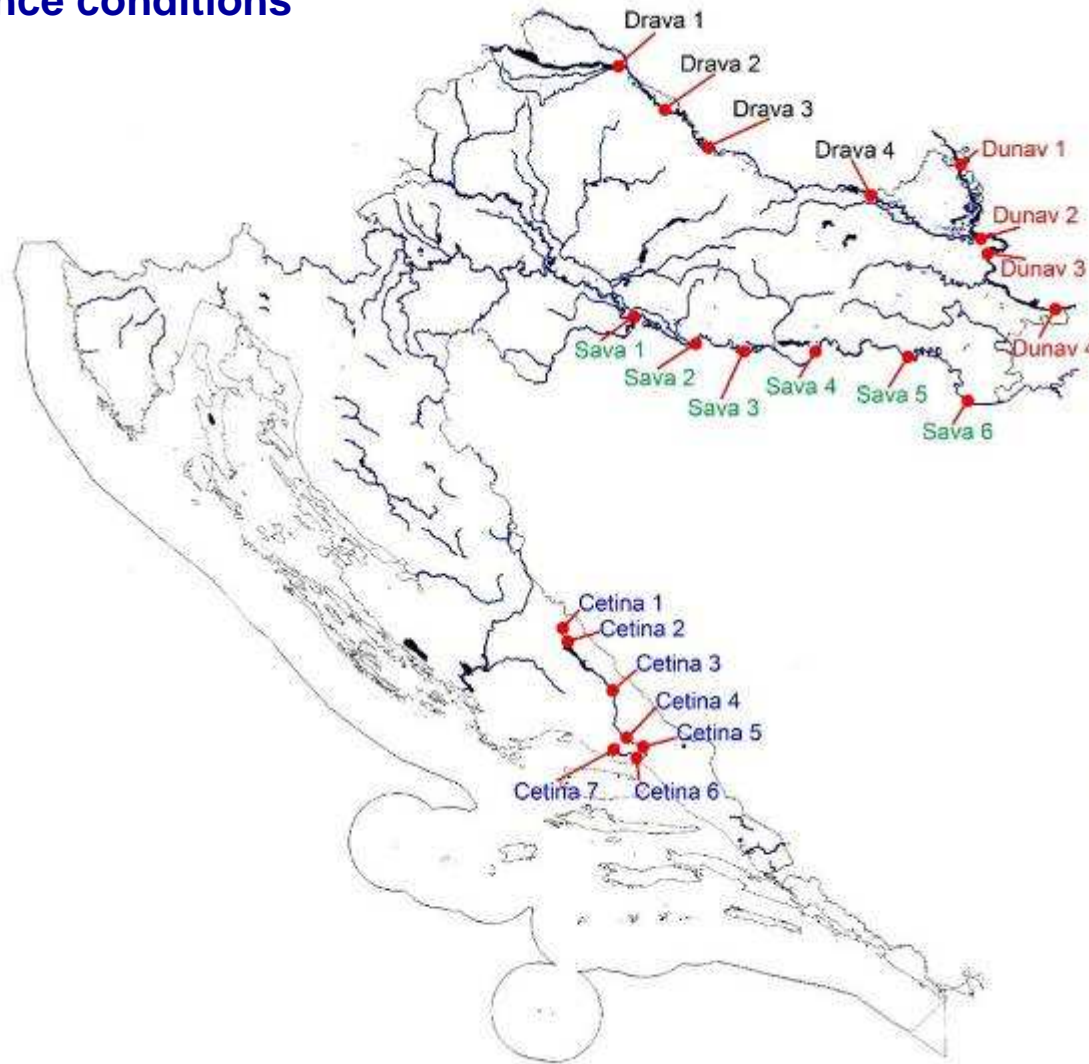
Reference conditions

Table 2.1 Strengths and weaknesses of methods used to determine reference condition.
(from Johnson 2001a)

Approach	Strengths	Weaknesses
Expert opinion or best judgement	May incorporate both historical data/opinion and present day concepts	Bias may be present
Historical data	Often inexpensive to obtain	Variable data, few metrics and data quality may be poor or unknown, static measure
Paleoreconstruction Direct Indirect	Incorporate both physico-chemical and biological data Site-specific Calibration models currently available for modelling a number of stressor variables; pH, TP and temperature reconstruction.	Basically limited to lentic systems, high initial costs. Not many metrics
Modelling Survey	Site-specific Region specific	Requires data, calibration and validation Expensive to initiate



Reference conditions



Example:

Reference conditions on lower parts of Sava, Drava and Danube: SURVEY during one year while we made 73 samples of ichthyofauna on 14 different localities. We recorded 52 fish species with 23 847 individuals. From this sample we excluded small shoaling species and introduced ones to get the reference sample with 48 species and 11 051 individuals.



Reference conditions

Metric of IBI	Sample		Value
	Reference	Sava 4	
Total number of fish species	48	27	3
Benthic species	31	14	3
Water column species	14	11	3
Large long-lived species	10	7	3
Intolerant species richness	6	2	3
% of Tolerant individuals (<i>Rutilus rutilus</i>)	24,63	16,10	5
% Omnivorous individuals	56,80	35,60	5
% Invertivorous individuals	1,95	1,55	3
% Top carnivorous individuals	15,41	12,07	3
Catch per Unit Effort	3	3	3
% Litophilous individuals	26,61	6,40	1
% Individuals with anomalies	3	3	3
IBI Score			38



Reference conditions

Locality	IBI	Water quality	EFI	Water quality
Sava 1	32	IV	0,42	III
Sava 2	28	IV	0,28	IV
Sava 3	26	IV	0,29	III
Sava 4	38	III	0,26	IV
Sava 5	38	III	0,37	III
Sava 6	26	IV	0,20	IV
Drava 1	40	III	0,36	III
Drava 2	26	IV	0,26	IV
Drava 3	36	IV	0,45	II
Drava 4	38	III	0,43	III
Dunav 1	38	III	0,24	IV
Dunav 2	32	IV	0,25	IV
Dunav 3	46	III	0,25	IV
Dunav 4	38	III	0,28	IV
Cetina 1	50	II	0,59	II
Cetina 2	48	II	0,57	II
Cetina 3	42	III	0,43	III
Cetina 4	30	IV	0,35	III
Cetina 5	34	IV	0,44	III
Cetina 6	38	III	0,46	II
Cetina 7	34	IV	0,52	II



Reference conditions

Locality	Water quality				
	IBI	EFI	Oxygen regime	Nutrients	Mikrobiology
Sava 1	IV	III	III	III	IV
Sava 2	IV	IV	III	III	V
Sava 3	IV	III	III	IV	IV
Sava 4	III	IV	II	III	IV
Sava 5	III	III	II	IV	IV
Sava 6	IV	IV	II	III	IV
Drava 1	III	III	III	III	IV
Drava 2	IV	IV	III	III	IV
Drava 3	IV	II	III	III	III
Drava 4	III	III	III	III	III
Dunav 1	III	IV	III	III	III
Dunav 2	IV	IV	III	III	III
Dunav 3	III	IV	III	III	III
Dunav 4	III	IV	III	III	III
Cetina 1	II	II	III	II	IV
Cetina 2	II	II	III	II	IV
Cetina 3	III	III	II	II	IV
Cetina 4	IV	III	II	II	IV
Cetina 5	IV	III	III	II	IV
Cetina 6	III	II	III	II	IV
Cetina 7	IV	II	II	II	IV



Reference conditions

Ichthyofauna of Cetina river:

15 fish species from 8 families, with 2 504 individuals:

Anguillidae: *Anguilla anguilla*

Salmonidae: *Salmo trutta*, *Oncorhynchus mikiss*

Thymallidae: *Thymallus thymallus*

Cobitidae: *Cobitis dalmatina*

Cyprinidae: *Aulopyge huegelii*, *Carassius gibelio*, *Cyprinus carpio*, *Leuciscus illyricus*, *L. ukliva*, *Pseudorasbora parva*

Gobiidae: *Knipowitschia panizzae*, *Pomatoschistus canestrinii*

Mugilidae: *Liza aurata*

Bleniidae: *Salaria fluviatilis*



Assessment method

- ❑ Several fish sampling methods are currently used in Croatia. The principal methods are electric fishing in wadable streams or rivers, and electric fishing from a boat and gillnetting in large rivers and lakes.
- ❑ In wadable streams, the removal method is usually applied, with 1-3 passages over a river length of 100-150m, depending on site characteristics and sampling objectives. One hand-net per anode and 1-3 persons for other activities (transporting fish, electric generator control (Direct Current DC – 1.5 + 2.5 KW, etc.).
- ❑ In non-wadable or large rivers, electric fishing is performed from a boat with a Pulsating Direct Current (PDC – 5 + 10 KW) electric generator, principally in autumn, but also in summer.



Assessment method





EFI+ vs. EFI

On January 1st, 2007 the EC-funded research project “Improvement and Spatial Extension of the European Fish Index (EFI+)” was started. EFI+ is a research project designed to gain new knowledge, and to further develop and improve biological assessment methods that meet needs of the Water Framework Directive (WFD). The output of the project will be a standard methodological approach to assess the ecological status of rivers in accordance with the WFD. Therefore, the *EFI+* project represents a direct and obligatory contribution to the Water Framework Directive in the further development and implementation of harmonised fish-based assessment tools and standard methods that can be used in EU Member States, as well as in Candidate countries.



EFI+ vs. EFI

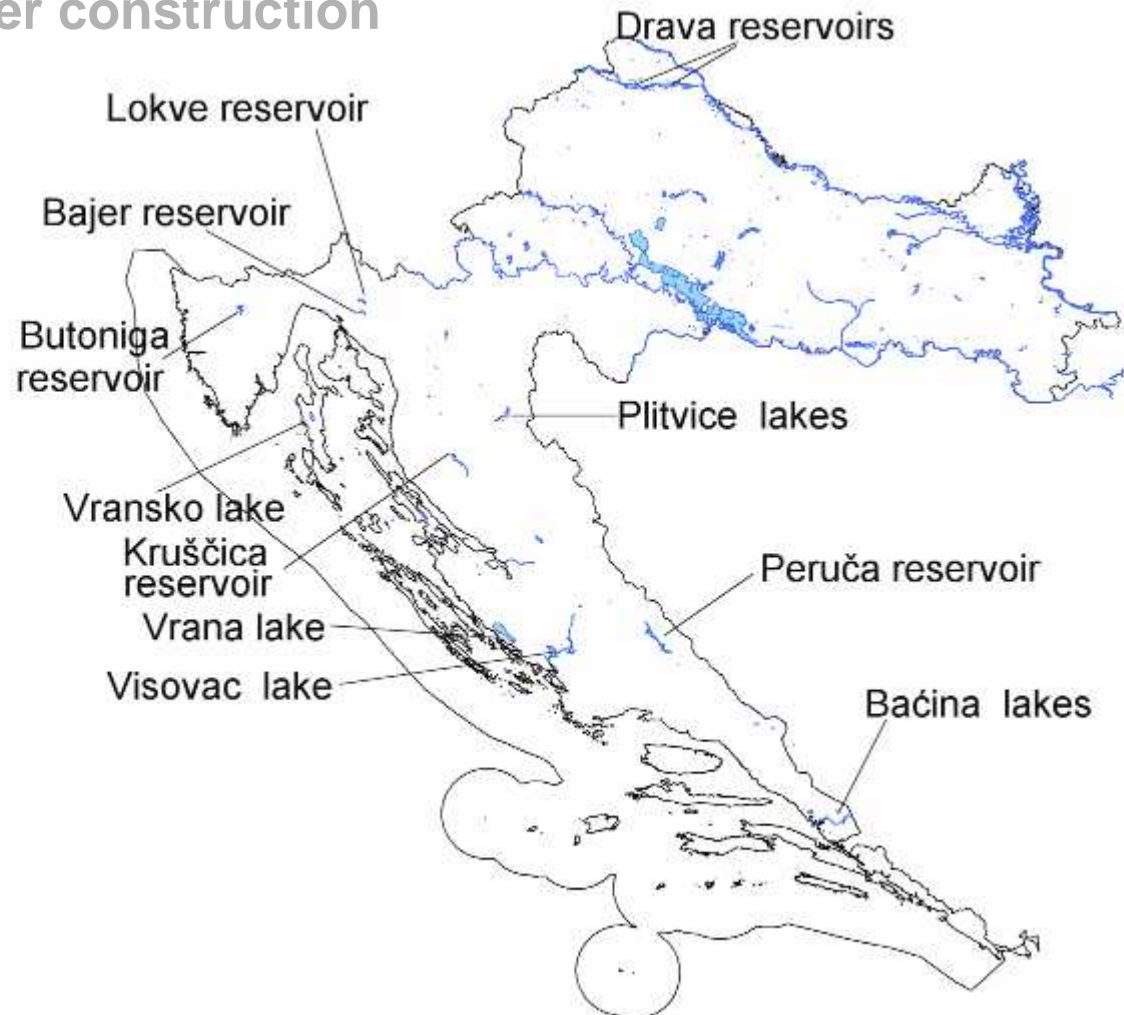
The overall objective of **EFI+** is to overcome existing limitations of the EFI by developing a new, **more accurate and pan-European fish index**. The scientific and technological objectives are to (1) evaluate the applicability of the existing EFI and make necessary improvements to the existing index in Central-Eastern Europe and Mediterranean ecoregions, (2) extend the scope of the existing EFI to cover very large rivers, (3) analyse relationships between hydromorphological pressures (incl. continuity disruptions) and fish assemblages to increase the accuracy of the EFI, (4) adapt existing software to the requirements of the new EFI to allow calculation of the ecological status for running waters, (5) implement and disseminate the EFI and supporting software by integration of the project results into the CIS activities (Common Implementation Strategy) and ongoing national and international monitoring programmes such as the **Joint Danube Survey**. These results will be presented in end-user workshops and at an international conference.



Lakes and Reservoirs



Still Under construction



Thank you!

