UNDP I GEF
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RIVER BASIN MANAGEMENT TOOLS: INTERCALIBRATION

Technical Implementation and Communication of the WFD Intercalibration Exercise in the Danube River Basin

WORKING FOR THE DANUBE AND ITS PEOPLE

UNDP I GEF DANUBE REGIONAL PROJECT

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ABBREVIATIONS

CIS	WFD Common Implementation Strategy
DRB	Danube River Basin
EC GIG	Eastern Continental Geographical Intercalibration Group
ECOSTAT	CIS Working Group on Ecological Status and Intercalibration
EU	European Union
IC	Intercalibration
MA EG	Monitoring and Assessment Expert Group
RBM EG	River Basin Management Expert Group
WFD	Water Framework Directive

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

Outcomes of this assignment include the three main tasks: *Technical implementation of the WFD intercalibration exercise in the Danube River Basin*, *Communication of the WFD intercalibration exercise* and *Overview of river types, reference conditions and water bodies in the Tisza River Basin*.

The technical implementation of the WFD intercalibration exercise in the Danube River Basin comprised the comparison and harmonisation of national assessment methods for benthic macroinvertebrates of six countries participating in the Eastern Continental GIG: Austria, Bulgaria, Czech Republic, Hungary, Romania and Slovak Republic. The intercalibration of national assessment methods was carried out for five common intercalibration stream types. Methods and results of the exercise are presented in the Milestone 6 Report addressed to the European Commission.

Intercalibration of Austrian and Slovak river assessment methods using macrophytes and phytobenthos are currently in progress. Results are expected by mid June 2007.

For the intercalibration to be a transparent exercise both the technical process of boundary setting and the outcome of the exercise (the final "good ecological status" for biological quality elements) should be properly informed. A "communication paper" provides clear information about general objectives, principles and methods of the WFD intercalibration exercise and its implication for the national water quality monitoring.

Within the assignment information about national river typologies, reference conditions and water bodies were collected from the Ukrainian, Romanian, Hungarian, Slovakian and Serbian parts of the Tisza catchment. Data were evaluated concerning type characteristics, design of reference conditions and share of water bodies. Results were compiled in an overview report contributing to the Tisza River Basin Management Plan.

This work assignment was in support of the overall intercalibration process carried out by the EU Member States and the European Commission. Intercalibration is an ongoing process beyond the duration of this contract. Therefore, several upcoming tasks can not be fulfilled within this mission. Among these are intercalibration of national assessment methods currently under development, further biological quality elements and intercalibration types.

1. INTRODUCTION

A main environmental objective of the EU Water Framework Directive (WFD) is to achieve "good ecological status" of all surface waters in the European Union by the year 2015. Status monitoring of water bodies is done by individual Member States using methods for biological quality assessment. Comparability of monitoring results is ensured by means of the intercalibration exercise.

The intercalibration exercise is a legally binding demand of the WFD. European Member States are obliged to compare the results of biological assessment for rivers, lakes, transitional and coastal waters. For rivers, methods using macrophytes and phytobenthos, benthic invertebrates, and fish fauna are currently intercalibrated. Activities are carried out among countries sharing common stream types in similar biogeographical regions. The aim of the process is to ensure consistency in quality classification despite the diverse assessment methods countries are applying.

The work undertaken in this project assisted the ICPDR's River Basin Monitoring and Assessment Expert Group (MA EG) with intercalibration in the Eastern Continental Geographical Intercalibration Group (EC GIG). This assignment supported two activities (River Basin Management Tools and MA EG support) within the UNDP/GEF Danube Regional Project's Objective 1 (Creation of sustainable ecological conditions for land and water management) and Objective 2 (Capacity building and reinforcement of transboundary co-operation for the improvement of water quality and environmental standards in the DRB).

In this report the principal project outcomes are summarised in the three chapters: *Technical implementation of the WFD intercalibration exercise in the Danube River Basin*, *Communication of the WFD intercalibration exercise* and *Overview of river types, reference conditions and water bodies in the Tisza River Basin*. For each part the main deliverables are annexed to this report.

This work assignment was in support of the overall intercalibration process carried out by the EU Member States and the European Commission. Intercalibration is an ongoing process beyond the duration of this contract. Therefore, several upcoming tasks can not be fulfilled within this mission. Among these are intercalibration of national assessment methods currently under development, further biological quality elements and intercalibration types.

2. TECHNICAL IMPLEMENTATION OF THE WFD INTERCALIBRATION EXERCISE IN THE DANUBE RIVER BASIN

The technical implementation of the WFD intercalibration exercise in the Danube River Basin comprised the comparison and harmonisation of national assessment methods for benthic macroinvertebrates of countries participating in the Eastern Continental GIG: Austria, Bulgaria, Czech Republic, Hungary, Romania and Slovak Republic (Table 1). The intercalibration of national assessment methods was carried out for five common intercalibration stream types (Table 2).

Table 1: National assessment methods

country	name	category
Austria	Austrian System for Ecological River Status Assessment	Multimetric Index
Bulgaria	Bulgarian Biotic Index for River Quality Assessment (Q-Scheme)	Biotic Index
Czech Republic	Czech Saprobic Index following Zelinka & Marvan (1961)	Saprobic Index
Hungary	Hungarian Average Score Per Taxon	Biotic Index
Romania	Romanian Saprobic Index following Pantle & Buck (1955)	Saprobic Index
Slovak Republic	Slovak System for Ecological River Status Assessment	Multimetric Index

Table 2: Common intercalibration types of the Eastern Continental GIG

abbreviation	type-name	ecoregion	catchment	altitude	geology	substrate
R-E1	Carpathians: small to medium, mid-altitude	10	10 - 1000	500 - 800	siliceous	gravel and boulder
R-E2	Plains: medium-sized, lowland	11 and 12	100 - 1000	< 200	mixed	sand and silt
R-E3	Plains: large and very large, lowland	11 and 12	> 1000	< 200	mixed	sand, silt and gravel
R-E4	Plains: medium-sized, mid-altitude	11 and 12	100 - 1000	200-500	mixed	sand and gravel
R-E6	Danube River: middle and downstream	11 and 12	> 131000	< 134	mixed	gravel and sand

Within the intercalibration exercise the definition of reference conditions is of major importance for the comparison of national quality assessment methods. In this regard, two problems were obvious in the EC GIG: Either existing reference sites were not available (esp. lowland types) or reference criteria to screen for existing reference sites differed among countries. The EC GIG therefore agreed to follow an alternative approach to resolve these issues by defining IC type specific, harmonised quality criteria. In general, common high-good resp. good-moderate quality class boundaries were set for the national biological assessment methods using existing data assembled within the EC GIG intercalibration exercise. The main idea was to overcome the difficulties of lacking (near-natural) references by defining an alternative reference, i.e. common agreement on a certain level of impairment.

The main tasks carried out within the project assignment were collection of national data, setting up and administration of a central database, elaboration of a conceptual framework, analysis of data and proposal of harmonised quality class boundaries of national assessment methods. Furthermore, the work included presentation and extensive discussion of the intercalibration approach and results with national experts, and communication of the results to coordinating bodies at DRB and EU level (Table 3).

Table 3: Overview of attended meetings and workshops

Nº	occasion	from (date)	to (date)	venue	country
1	EC GIG preparatory meeting	18.04.2005	18.04.2005	Vienna	Austria
2	EC GIG meeting	23.05.2005	24.05.2005	Bratislava	Slovakia
3	EC GIG preparatory meeting	05.09.2005	05.09.2005	Vienna	Austria
4	EC GIG meeting	12.09.2005	13.09.2005	Sofia	Bulgaria
5	EU Enlargement Workshop	09.01.2006	09.01.2006	Bucharest	Romania
6	EC GIG meeting	10.01.2006	11.01.2006	Bucharest	Romania
7	MA EG meeting	02.03.2006	03.03.2006	Prague	Czech Republic
8	EC GIG meeting	19.04.2006	20.04.2006	Budapest	Hungary
9	ECOSTAT meeting	03.07.2006	04.07.2006	Stresa	Italy
10	EC GIG meeting	04.09.2006	04.09.2006	Vienna	Austria
11	RBM EG meeting	10.10.2006	10.10.2006	Chisinau	Moldova
12	ICPDR workshop	11.10.2006	11.10.2006	Chisinau	Moldova
13	ICPDR workshop	09.11.2006	10.11.2006	Kiev	Ukraine
14	Rivers IC workshop	04.12.2006	05.12.2006	Ispra	Italy
15	MA EG meeting	01.02.2007	02.02.2007	Vienna	Austria
16	EC GIG meeting	11.04.2007	12.04.2007	Vienna	Austria

Details on methods and results of the EC GIG intercalibration exercise are explained in the Milestone 6 report that is included as ANNEX 1 to this report. Moreover, ANNEX 2 includes a check list for WFD compliant biological assessment methods as a guideline for DRB countries.

3. COMMUNICATION OF THE WFD INTERCALIBRATION EXERCISE IN THE DANUBE RIVER BASIN

According to ECOSTAT[1] the communication of the intercalibration exercise has been identified as an issue of concern. On one hand, the intercalibration is an unprecedented highly technical and complex task. On the other, its outcome is seen as a crucial step towards enabling the achievement of the environmental objectives of the WFD to be assessed, and therefore it is seen as politically relevant. Several stakeholders have raised their concerns about the on-going work, showing misunderstandings about the process, the role of the intercalibration register and the expected outcome.

For the intercalibration to be a transparent exercise both the technical process of boundary setting and the outcome of the exercise (the final "good ecological status" for biological quality elements) should be properly informed. The publication of the following elements is considered crucial to provide a complete overview of the intercalibration:

- On the general objectives, principles and methods of the WFD intercalibration exercise and its implication for the national water quality monitoring.
- On the technical process, the filled boundary setting protocol explaining how the boundaries have been identified and the dataset or datasets that have been used.
- On the outcome of the exercise, the national methods that have been intercalibrated, the final boundaries, a selection of sites to illustrate those, and biological and pressure data for each site.

Within this project task a "communication paper" on general principles, aims and methods of the WFD intercalibration exercise has been prepared (ANNEX 3).

[1] Heiskanen, A.-S., U. Irmer, J. Rodriguez-Romero, D. Jowett, S. Poikane, P. Pollard & W. van de Bund, 2005. Improving the communication of the intercalibration exercise. 19 October 2005.

4. OVERVIEW OF RIVER TYPES, REFERENCE CONDITIONS AND WATER BODIES IN THE TISZA RIVER BASIN

Within the assignment information about national river typologies, reference conditions and water bodies were collected from the Ukrainian, Romanian, Hungarian, Slovakian and Serbian parts of the Tisza catchment. Data were evaluated concerning type characteristics, design of reference conditions and share of water bodies. Results were compiled in an overview report (ANNEX 4) contributing to the Tisza River Basin Management Plan.

5. DISCUSSION AND OUTLOOK

The intercalibration forms an obligatory step in the implementation of the WFD. Furthermore, it represents a platform for a pan-European dialogue on environmental objectives and the quality assessment of ecological surface water status. The WFD stipulated both the finalisation of the intercalibration exercise and the start of national quality monitoring programmes by end of 2006. Due to this tight schedule national development of assessment methods and international comparison of quality class boundaries currently run in parallel.

The intercalibration of methods using benthic macroinvertebrates in rivers holds a leading role in the overall technical implementation. These methods have a long tradition in European water quality assessment and are thus based on sound principles, validated techniques and a large quantity of existing data. For other Biological Quality Elements (phytoplankton, macrophytes and phytobenthos, fish fauna) or water categories (lakes, transitional and coastal waters) intercalibration enables international cooperation in the early stages of method development, aiming at harmonised definition of good ecological status. Nevertheless, the intercalibration process itself still allows for tailor-made assessment methods satisfying the individual needs of the Member States.

With regard to the EC GIG **intercalibration is only partly finalised**. Many countries are currently lacking WFD compliant biological assessment methods. In addition, data availability on certain Biological Quality Elements (phytoplankton, macrophytes and phytobenthos, fish fauna) is generally scarce. In this project the formal - and legally binding - completion of intercalibration has only been achieved for the invertebrate-based river assessment methods of Austria and Slovak Republic. Intercalibration of macrophytic and phytobenthic methods between these countries is in progress with results expected by mid June 2007. However, the intercalibration approach developed within this assignment allows for future integration of additional Member States as soon as national methods and appropriate data are available.

In European water policy the entire intercalibration process represents a thematic and organisational novelty. Its extension to end of 2007 is decided in order to ensure proper fulfilment. Furthermore, it is considered to start a second round of intercalibration beyond 2007 to overcome current difficulties such as data gaps and lacking assessment methods.

ANNEXES

ANNEX 1	Milestone 6 Report of the Eastern Continental GIG to the European Commission
ANNEX 2	Check list of WFD compliant biological assessment methods
ANNEX 3	Communication paper on general principles, aims and methods of the WFD intercalibration exercise
ANNEX 4	Contribution to the Tisza River Basin Management Plan 2009: "River types, reference conditions and water bodies in the TRB"

ANNEX 1

MILESTONE 6 REPORT OF THE EASTERN CONTINENTAL GIG TO THE EUROPEAN COMMISSION

EUROPEAN COMMISSION
DIRECTORATE GENERAL JRC
JOINT RESEARCH CENTRE
Institute of Environment and Sustainability

Milestone 6 Report – River GIGs

GIG	**Eastern Continental**
Information provided by	Birgit Vogel (ICPDR) and Sebastian Birk

A – General approach

1. Describe the common intercalibration types, specifying the countries participating for each type and the biological quality elements/ pressures that are intercalibrated (update 'types manual' tables)

The Eastern Continental Geographical Intercalibration Group (EC GIG) includes the following countries: Austria (AT), Bulgaria (BG), Czech Republic (CZ), Hungary (HU), Slovak Republic (SK) and Romania (RO). In this GIG five common intercalibration types were defined based on the typological factors ecoregion, catchment area, altitude, geology and channel substrate (see table below).

tbl_common-ic-type							
IC type abbrev.	**IC type name**	**IC type ecoregion**	**IC type catchment**	**IC type altitude**	**IC type geology**	**IC type substrate**	**participating countries**
R-E1	Carpathians: small to medium, mid-altitude	10	10 - 1000	500 - 800	siliceous	gravel and boulder	CZ, SK, HU, RO
R-E2	Plains: medium-sized, lowland	11 and 12	100 - 1000	< 200	mixed	sand and silt	RO, SK, HU
R-E3	Plains: large and very large, lowland	11 and 12	> 1000	< 200	mixed	sand, silt and gravel	BG, HU
R-E4	Plains: medium-sized, mid-altitude	11 and 12	100 - 1000	200-500	mixed	sand and gravel	AT, HU, SK, RO
R-E6	Danube River: middle and downstream	11 and 12	> 131000	< 134	mixed	gravel and sand	AT, SK, HU, RO, BG

Within the EC GIG intercalibration exercise national assessment methods **using benthic invertebrates** are intercalibrated. The exercise includes the pressures: organic pollution, general and hydromorphological degradation.

The following table specifies the number of sites involved in intercalibration exercise per intercalibration type (except R-E6) and country.

The intercalibration of type R-E6 (Danube River) was performed between the countries Austria, Bulgaria, Hungary, Slovak Republic and Romania.

IC type	AT	BG	CZ	HU	RO	SK
R-E1	-	-	12	18	52	39
R-E2	-	-	-	95	24	11
R-E3	-	32	-	189	-	-
R-E4	46	-	-	43	18	18

2. Describe the general intercalibration approach
   - Approach for comparison (e.g. ICMi using common reference criteria), including statistical procedures
   - Approach for harmonisation (if applicable, e.g. use of common benchmark)
   - Specify which data was used to set the boundaries applying the BSP (e.g. common benchmark data [option 2], all MS data [option 3]

R-E1, 2, 3, 4:

Within the intercalibration exercise the definition of reference conditions is of major importance for the comparison of national quality assessment methods. In this regard, two problems became obvious in the EC GIG:

- Either existing reference site are not available (esp. for lowland river types) or
- reference criteria to screen for existing reference sites differ among countries.

Therefore, the EC GIG agreed to follow an alternative approach to resolve these issues by defining IC type specific, harmonised quality criteria. In general, the GIG set common high-good resp. good-moderate quality class boundaries for the national biological assessment methods using existing data assembled within the EC GIG intercalibration exercise. The main idea of using this approach is to overcome the difficulties of lacking (near-natural) references by defining an alternative reference, i.e. common agreement on a certain level of impairment specified by threshold values of selected biotic and abiotic criteria.

This practical approach comprises two steps, which are also described in detail:

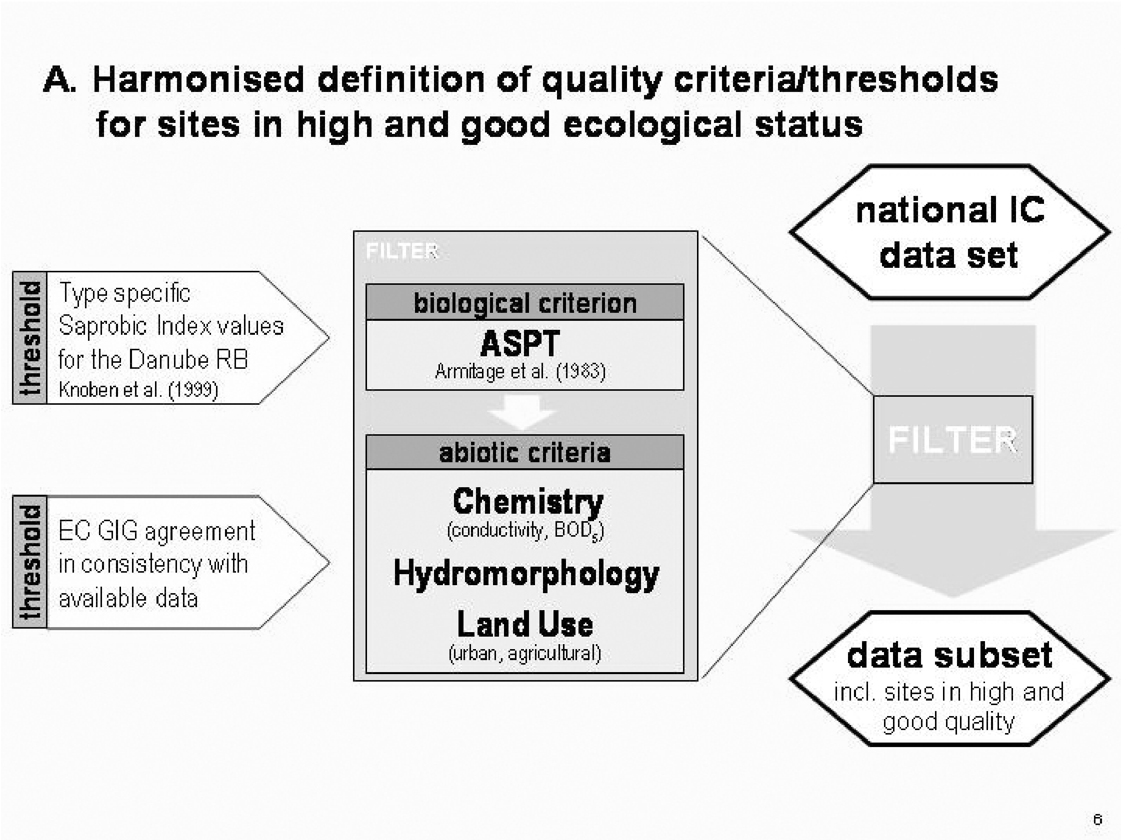
A. Harmonised definition of quality criteria/thresholds for the high and good ecological status

B. Class boundary setting based on 25th percentile value of common metrics using all sampling sites meeting the criteria defined in section A

A. Harmonised definition of quality criteria/thresholds for the high and good ecological status

Based on criteria for saprobiological quality - commonly agreed for monitoring purposes in the

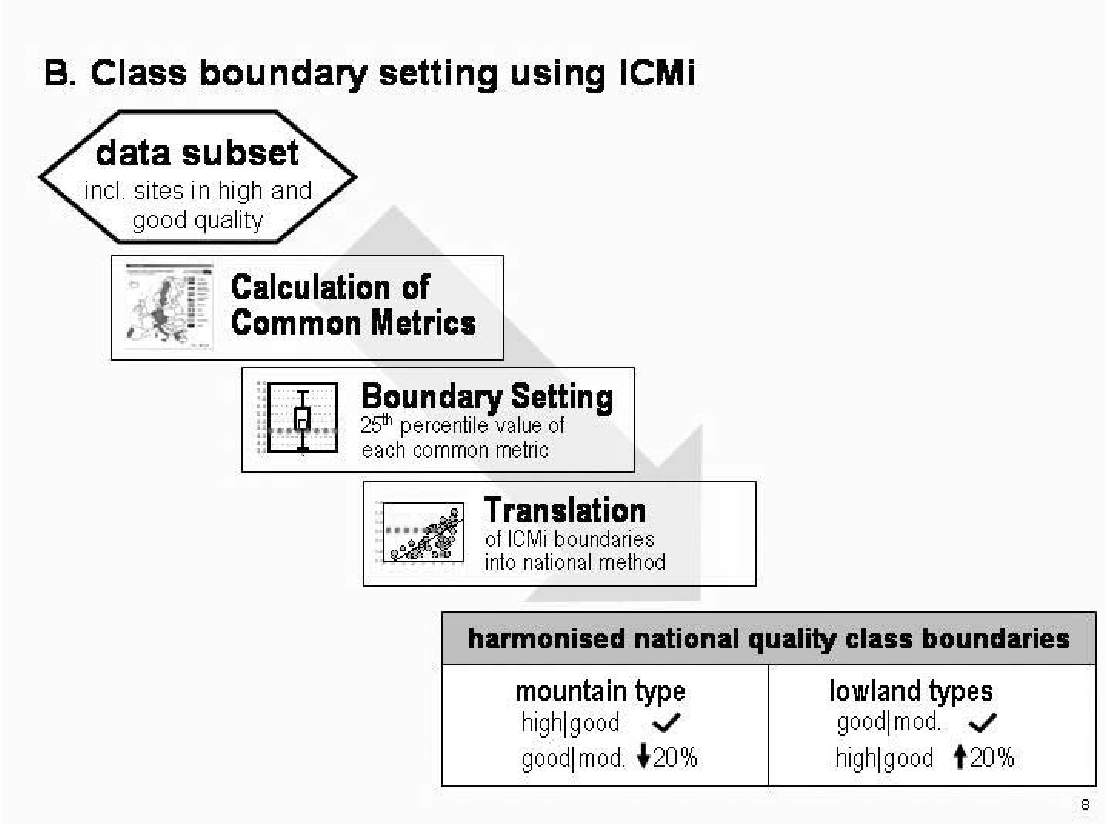
Danube River Basin - biological threshold values are derived using the common metric ASPT (Average Score Per Taxon). Sites with samples showing ASPT values above these thresholds are screened by additional chemical, morphological and land use parameters. The set of sites complying with all criteria/thresholds are regarded as of being in a commonly agreed, ecologically high resp. high and good status.



B. Class boundary setting based on 25th percentile value of common metrics using all sampling sites meeting the criteria defined in section A

The ecological quality class boundaries are expressed in ICMi-EC scale (see MS6 report Part C) to comply with the normative definitions of the WFD. These boundaries are derived by selecting the 25th percentile values of each common metric from the set of sites in high resp. high and good status. By means of regression analysis the boundary values are translated into values of the national assessment method.

See Annex C for a more detailed description of the approach.



Additional specification for R-E1: Common reference criteria have been established and applied to sites of the intercalibration type R-E1 (see MS6 report Part B). The results of the screening procedure were used to validate the intercalibration approach (especially the harmonised class boundary setting procedure) that was chosen by the EC GIG for intercalibration (as specified above). See Annex C for results of the validation procedure.

R-E6 (Danube River):

Biological assessment of the Danube River on the basis of the benthic macroinvertebrate community is limited to the application of Saprobic Systems or Biotic Indices to evaluate the degree of organic water pollution. Currently, no WFD compliant classification method to assess the ecological status of the Danube River using benthic macroinvertebrates is applied by the EC GIG countries. Therefore, the intercalibration exercise performed for the Danube River (R-E6) focused on the comparison of national methods used in regular water quality monitoring of the Danube River. Results of this intercalibration exercise are presented in Annex D.

3. Identify the national methods that were intercalibrated (for all countries, if available); provide detailed description in Annex A

Except for Austria and the Slovak Republic none of the other countries in the EC GIG hold biological assessment methods that are fully compliant with the requirements of the EU-WFD. WFD compliant methods are currently being developed in those countries. Therefore, intercalibration of EQR class boundary values was only fully completed for the methods of Austria and Slovak Republic. The results of the intercalibration exercise for these two assessment methods are listed in MS6 Report Part E. However, the IC exercise was also performed for the non-WFD compliant methods. These results including intercalibrated boundary values are described in Annex C.

The following table presents the methods used in the intercalibration exercise.

country	name	category	WFD compliant
Austria[1]	Slovak System for Ecological River Status Assessment	Multimetric Index	yes
Slovak Republic[1]	Austrian System for Ecological River Status Assessment	Multimetric Index	yes
Czech Republic	Czech Saprobic Index following Zelinka & Marvan (1961)	Saprobic Index	no
Hungary	Hungarian Average Score Per Taxon	Biotic Index	no
Romania	Romanian Saprobic Index following Pantle & Buck (1955)	Saprobic Index	no
Bulgaria	Bulgarian Biotic Index for River Quality Assessment (Q-Scheme)	Biotic Index	no

[1] For the intercalibration of R-E6 the national Saprobic Indices were used instead of the methods listed in this table.

B – Setting of Reference conditions

Summarize the common approach for setting of reference conditions. Give a more detailed description of procedure and criteria, and identify reference sites for each country and type according to those criteria in Annex B

Reference sites were chosen by the GIG countries using the REFCOND guidance. Following the work done in the Central-Baltic GIG, a list of more detailed criteria and type-specific concentrations of key chemical parameters were agreed by the EC GIG. Countries were asked to screen selected reference sites against agreed chemical, hydromorphological and catchment landuse threshold limits. Countries were also asked to complete a check list to indicate which reference criteria - defined in the GIG - were used for the screening exercise.

An overview of the criteria and the number of sites complying with the criteria are given in Annex B.

Note: Reference sites were described for the common stream type R-E1. For all other IC types, reference sites are currently not available.

The table below shows the number of R-E1 reference sites identified for the different countries:

country	number of reference sites	number of samples at reference sites
CZ	3	10
HU	16	41
RO	20	42
SK	22	48

C – Setting of Boundaries

1. Summarize how boundaries were set following the framework of the BSP for the HG and GM boundaries, demonstrating that this was done in accordance to WFD Annex V, normative definitions
   a. For the benchmark (if applicable)
   b. For the national methods (obligatory if no benchmark is used; also recommended if benchmark is used);

   Provide a descritption of the full procedure in Annex C

The EC GIG realizes that methods used by the GIG countries differ in compliance and state of development in relation to WFD normative definitions. The GIG therefore agreed on the construction of a common metric (Intercalibration Common Metric index (ICMi)) which is intrinsically compliant with the normative definitions so that the countries' data can be converted to ICMi.

The ICMi-EC developed for the Eastern Continental GIG consists of four common metrics combined to a common multimetric index by using the average of normalised metric values. The following table specifies the common metrics, WFD indicative parameters addressed and pressures indicated (based on pressure analysis of EC GIG dataset):

Common Metric	WFD indicative parameter	Indicated Pressure
Average Score Per Taxon (ASPT)	Sensitive Taxa	Organic Pollution, General Degradation
Austrian Structure Index (family level)	Sensitive Taxa	Structural and General Degradation
Total Number of Families	Taxonomic composition, diversity	General Degradation
[%] EPT Abundance	Taxonomic composition, abundance, major taxonomic groups	Organic Pollution, Structural and General Degradation

Class boundaries were set in terms of ICMi values derived from data-subsets complying with the criteria for a certain quality status. These criteria cover various aspects of human impacts on rivers including general and structural degradation and organic pollution. More details on the boundary setting procedure are given in Annex C.

2. Point out where the data underlying the analysis is available (e.g. through EEWAI CIRCA or other)

Data will be made available on DANUBIS, the database of the International Commission for the Protection of the Danube River (ICPDR), which is coordinating the work of the EC GIG. The database is accessible via the Internet.

D – Results of comparison and harmonisation of boundaries between countries

1. Present the results of the comparison demonstrating comparability of class boundaries between the countries within the GIG for all types (if applicable)

In the Eastern Continenal GIG harmonised class boundaries were defined within a GIG-wide agreed framework. The GIG decided that national class boundaries will be adjusted according to the results of the intercalibration analysis. Therefore, national class boundaries were not compared between countries but against the boundary values obtained in the intercalibration analysis. These boundaries are presented in MS6 part E.

2. Point out where the data underlying the analysis is available (e.g. through EEWAI CIRCA or other)

Data will be made available on DANUBIS, the database of the ICPDR accessible via the Internet.

E – Boundary EQR values

Provide a table with HG and GM boundary EQR values for the national methods and the common metrics (where applicable) for each type as a table

The table below presents the results of the EC GIG intercalibration exercise for the national assessment methods of Austria and Slovak Republic (WFD compliant) regarding the common intercalibration types R-E1, R-E2 and R-E4. Results of further country/type combinations (based on non-WFD compliant methods) are described in Annex C.

Boundary values of the national methods have been derived using common metric values of data subsets complying with criteria defined for high ecological status sites (R-E1), and high and good ecological status sites (R-E2 and R-E4; see Annex C). Therefore, EQR values for the common metrics (as relative deviation from reference state) do not apply.

Confidence intervals are specified as the 5 percent deviation from the respective boundary value.

common stream type	country	boundary type	boundary value	confidence limit	
				lower	upper
R-E1	Slovak Republic	high-good	0,74	0,69	0,79
		good-moderate	0,54	0,49	0,59
R-E2	Slovak Republic	high-good	0,74	0,69	0,79
		good-moderate	0,54	0,49	0,59
		high-good	0,72	0,67	0,77
		good-moderate	0,52	0,47	0,57
		high-good	0,79	0,74	0,84
		good-moderate	0,59	0,54	0,64

F – Indicative work plan for the continuation of the intercalibration

Indicate plans and appropriate timing for continuation of the intercalibration for types and quality elements not currently included

The intercalibration exercise performed within the Eastern Continental GIG and co-ordinated by the ICPDR PS addresses exclusively the biological quality element (BQE) macroinvertebrates. This results from the fact that data availability for the other BQEs within the Danube River Basin is currently scarce. However, as Austria and Slovakia are already using WFD compliant methods and do have data on macrophytes as well as on phytobenthos available, the intercalibration of these two parameters will be performed and additionally reported by June 2007.

The analysis of the EC GIG are primarily based on data which have not been assessed with WFD compliant methods - only AT and SK are currently using WFD compliant methods whereas the other countries are developing their methods. Due to this fact most of the analysis' results are part of this report's Annex C. As soon as data – based on WFD compliant methods - will be available the analysis will be improved. This improvement will very likely be performed by the end of 2008 and can further be included in the updated version of the Technical IC Report (JRC) by 2011 (see Draft Mandate of Working Group A/ECOSTAT).

Regarding the continuation of the intercalibration exercise within the EC GIG the following issues will be addressed:

- Filling of existing data (see Annex C) by June 2007.
- Intercalibration using the other BQEs: Improvement related to information on other BQEs is expected during the upcoming years. Increasing data sets will be available from assessments of the WFD compliant monitoring networks (by mid 2008) and should be used for the improvement of the intercalibration exercise results.
    - The intecalibration between AT and SK regarding the BQEs macrophytes and phytobenthos will be performed by and reported by June 2007.
- Improvement of the intercalibration analysis for the types RE-2, 3 and 4: Currently an adapted approach had to be chosen due to the lack of reference sites. Further, not all countries are using WFD compliant sampling/assessment methods. The integration of expected results from the WFD compliant monitoring networks will be integrated.
- Intercalibration of type RE-6 (Danube River): The results regarding the intercalibration of the Danube River (Type RE-6) have to be considered preliminary and will have to be revised. The ICPDR is organising Joint Danube Survey2 (JDS2), which will be performed during summer 2007. All BQEs will be addressed, sampled and assessed using WFD compliant methods for the entire Danube River and the main tributaries. The results of this homogenous data set will be used to supplement the current intercalibration of the Danube

River. The improvement of the current IC results should be improved by mid/end 2008. The ICPDR and therefore the countries of the Eastern Continental GIG intend to continue the intercalibration exercise after 2006 and will soon discuss and develop a relevant workprogramme (end of 2006).

The above-mentioned issues should be the objectives of this continued intercalibration exercise. The inclusion of additional countries of the Eastern Continental Region (currently only the EU MS (AT, HU, SK, CZ) and EU Accession Countries (BG, RO) are participating) is intended.

E – Comments and remarks

none

Annexes

Annex A: Description of national classification methods included in the intercalibration; please provide the reference to the method, the status of the method (officially accepted, finalized, under development), describe the metrics and approach.

Annex B: Reference criteria and reference sites

Annex C: Class boundary setting procedure (including results using non-WFD compliant methods)

Annex D: Intercalibration of the Danube River (R-E6)

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ANNEX A

Description of national classification methods included in the IC exercise

ANNEX A1: WFD COMPLIANT National Method - AUSTRIA

Country	AT
Classification System:	Austrian Quality Assessment System
General Description	Selection of reference sites according to REFCOND Guidance, National Strategy paper ("Criteria for the identification of potential reference sites") and criteria used by AQEM/STAR. The Austrian classification scheme consists of three modules (figure 1): 1. Module "Organic Pollution" (Saprobic Index in relation to stream type specific reference value) 2. Module "General Degradation" consisting of two sub-modules (2 multimetric indices) 3. Module "acidification" index (Braukmann & Biss, 2004; applied only in bioregions at risk of acidification) Metrics used for the multimetric indices are standardised in relation to the 95th percentile of metric values under stream type specific reference conditions. These standardized values are termed as "scores". Indices are calculated by averaging these scores. The benchmark value between reference (High) and good status conditions is defined as the 25th percentile of index values under reference conditions and set to a value of 0.8. That means, observed index values are divided by the benchmark value and multiplied by 0.8. Values > 1 are set to 1. Class boundaries for the ecological quality classes are defined as follows: Quality Class 1: ≥ 0.8 Quality Class 2: ≥ 0.6 < 0.8 Quality Class 3: ≥ 0.4 < 0.6 Quality Class 2: ≥ 0.2 < 0.4 Quality Class 2: < 0.2

The Final Ecological Quality Class is determined by the worst case applying all relevant modules.

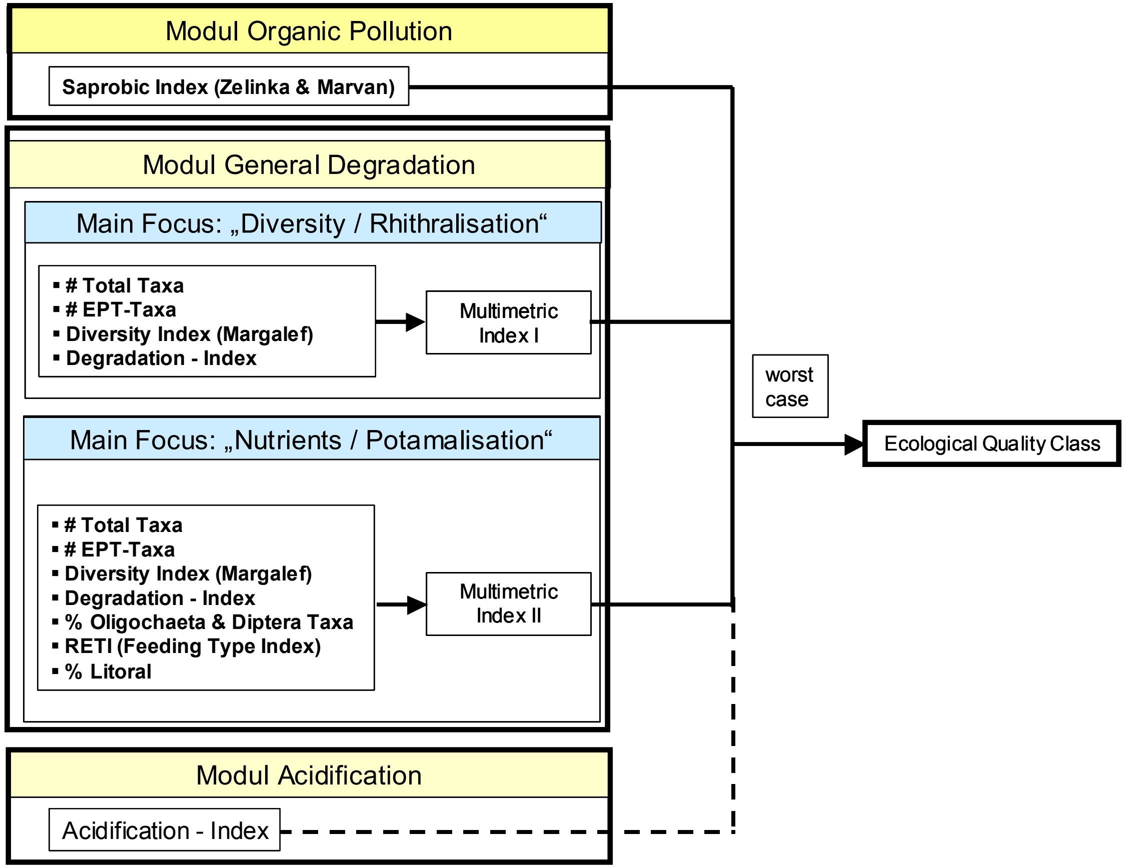

Figure 1: Scheme for the evaluation of ecological quality classes

Criteria for Boundary Setting	**High/Good boundary**	**Good/Moderate boundary**
Taxonomic composition and abundance	25th percentile of reference sites taxonomic composition represented in indices by: # taxa, % Oligochaeta and Diptera taxa, # EPT Abundance included in Saprobic Index (# Individuals/m²) and RETI	25% deviation (of indices) from reference conditions comment: Major taxonomic groups (defined at the level of order - cannot be used for setting good/moderate boundary – see Appendix!): no groups missing
Ratio of disturbance sensitive to insensitive taxa	25th percentile of reference sites sensitive to insensitive represented in MMI by: # EPT, % Oligochaeta and Diptera taxa, RETI, % litoral, degradation index, acidification index	25% deviation (of indices) from reference sites comment: crossover points sensitive/insensitive taxa were not used for setting good/moderate boundary (depending too much on which taxa are selected as sensitive/insensitive)
Level of diversity	25th percentile of reference sites diversity is represented in indices by: Margalef diversity index, # taxa	25% deviation (of indices) from reference sites

ANNEX A2: WFD COMPLIANT National Method - SLOVAKIA

Country	SK
Classification System:	Slovak System for Ecological River Status Assessment
General Description	Selection of reference sites according to REFCOND Guidance, National Strategy paper ("Criteria for the identification of potential reference sites") and criteria used by AQEM/STAR. The Slovak System for Ecological River Status Assessment is composed of a multimetric index composed of a stream type specific combination of single metrics (Table 1). These metrics are normalised using stream type specific reference values and combined by averaging, Table 1: List of single metrics used in the Slovak multimetric index for the ecological assessment of common stream types relevant in the EC GIG intercalibration exercise. The national systems subdivides R-E1 in small (10-100km^2) and medium (100-1000km^2) sized streams.

	common type			
	R-E1 (small-sized)	**R-E1 (medium-sized)**	**R-E2**	**R-E4**
SI (Zelinka & Marvan)	x	x	x	x
oligo [%]	x	x	x	x
BMWP	x	x	x	x
Rhithron Typie Index	x	x	x	x
Index of Biocoenotic Region	x	x	x	x
Rheoindex	x			
[%] Type Aka+Lit+Psa	x	x	x	x
[%] metarhithral		x	x	x
Diversity (Margalef Index)		x	x	x

[%] Shredders		x	x	x
[%] Gatherers/Collectors		x	x	x
EPT taxa	x	x	x	x
Number of families		x	x	x

Class boundaries for the ecological quality classes are defined as follows:

Quality Class 1 (high): ≥ 0.8

Quality Class 2 (good): ≥ 0.6 < 0.8

Quality Class 3 (moderate): ≥ 0.4 < 0.6

Quality Class 4 (poor): ≥ 0.2 < 0.4

Quality Class 5 (bad): < 0.2

ANNEX A2: NON-WFD COMPLIANT National Method – SLOVAKIA (used for Danube River Intercalibration)

Country	Slovakia
Region	entire Slovakia
Altitude range	0 - 800 m
Stream range	applied to all stream types
Elements	Benthic Invertebrates, Macrophytes, Phytobenthos, Phytoplankton, Zooplankton
Name of method	National Surface Water Quality Monitoring System
Stressors detected	Organic Pollution, Eutrophication
Status of method	in current usage
The method covers	field sampling, lab procedure, calculation, presentation
It is combined with the following methods	under development

General Description

Brief description	Biomonitoring of Slovakian watercourses comprises investigations of Benthic Invertebrates, Phytobenthos, and Phyto- and Zooplankton. Qualitative (*diversity*) and (semi-) quantitative (*abundance*) parameters are taken into account. Macrophytes are investigated as part of the 'Macrophyte Inventory Danube - Corridor and Catchment The degree of Organic Pollution is separately assessed by determination of the Saprobic Index (SLOVAK NATIONAL STANDARD 757221 1989) based on taxa lists of Benthic Invertebrates and Phytobenthos, and *Bioseston* (all planktonic organisms). In addition, chlorophyll-a concentration is used to assess water quality.
References	• STN (Slovenská Technická Norma) 83 0532 – 1 *to* 8 (1978/79): Biologický rozbor povrchovej vody. (Biological analysis of surface water quality). Úrad pro Normalizaci a Mereni, Praha.

Sampling

Sampling procedure	Multi habitat sampling is carried out for Benthic Invertebrates, Phytobenthos and Macrophytes: All major habitats are sampled proportionally according to their presence within a sampling reach. Sampling of Benthic Invertebrates is done in accordance with the European Standard EN 27 828. Kick-sampling is performed not exceeding 10 to 15 minutes. Whole sample is preserved in the field and organisms are picked out in the laboratory. Prior to sorting and identification

	samples are sieved through 300 µm meshes. Macrophytes are sampled according to the protocol of the Macrophyte Inventory Danube.
Sampling site	**lenght of sampling site:** 15 to 20 m **width of sampling site:** littoral **rationale of the selection of sampling sites:** depending on point sources of pollution; *Danube specification:* depending on point sources of pollution;
Sampling season	Benthic Invertebrates and Phytobenthos: spring, summer and autumn Phyto- and Zooplankton: monthly
Sampling device	**Benthic Invertebrates:** hand net - mesh-size: 500 µm; net-opening: 25 * 25 cm² **Phytobenthos and Heterotrophic Periphyton:** brushes and knives - scraped area: 10 * 10 cm² **Plankton:** plankton net - mesh-size: 10 µm (Phytoplankton) and 60 µm (Zooplankton); net-opening: 30 cm in diameter
Fixative used	formaldehyde
Sampling reference	• EN 27 828. Water Quality - Methods for biological sampling - Guidance on handnet sampling of aquatic benthic macroinvertebrates. (ISO 7828: 1985) • JANAUER, G.A. (2002): Macrophyte Inventory Danube - Corridor and Catchment. Guidance on the Assessment of Aquatic Macrophytes in the river Danube, in waterbodies of the fluvial corridor, and in its tributaries. - http://www.midcc.at/Methodology/fluvial/methodology_kohler_en_V4.pdf • KNOBEN, R.A.E; BIJLMAKERS, L. & P. VAN MEENEN (1999): Classification/characterisation of water quality, Water Quality Enhancement in the Danube River Basin, Phare Contract No. 98-0399.00. Brussels (IWACO). • KOHLER, A. (1978): Methoden der Kartierung von Flora und Vegetation von Süßwasserbiotopen. Landschaft und Stadt 10: 73-85. • STN (Slovenská Technická Norma) 83 0532 (1978/79)
Record of abundance	number of individuals, abundance classes, percent coverage, number of cells

Abundance specification

abundance class (Phytobenthos)	**description**
1	single
2	**rare**
3	rare to common
4	**common**
5	common to abundant
6	**abundant**
7	very abundant

	Benthic Invertebrates: number of individuals Phytoplankton, Zooplankton: number of cells Macrophytes: plant mass estimates
Level of determination	species, species groups, genus, family
Determination specification	In some cases Benthic Invertebrates are determined to genus or family level (e.g. Oligochaeta, Chironomidae, juvenile organisms).
Expenditures per sample	**fieldwork:** approx. 60 € 5 persons **laboratory:** approx. 100 € 7 persons additional costs for consumables and equipment
Additional environmental data	ecoregion, geology, channel form, bank and bed fixation, riparian vegetation, land use, temperature, discharge, pH, conductivity, dissolved oxygen content, oxygen saturation, COD (Chemical Oxygen Demand), BOD (Biological Oxygen Demand), nitrite, nitrate, ammonium, phosphorus, salinity, odour, mineral substrates, biotic microhabitats, water colour,

Assessment: calculation, classification, presentation

Specifications

- assessment is not related to the reference state concept (with regard to smaller watercourses, reference concept has been implemented in 2003)

Calculation method

single metric(s): SI = *sum of* $(s_i*h_i*I_i)$ / *sum of* (h_i*I_i)

SI: Saprobic Index

S_i: individual saprobic index of species i ($s_i = (0*x_i + 2*b_i + 3*a_i + 4*p_i) / 10$)

h_I: abundance of species i

I_i: individual indicator weight of species i

To which spatial scale do metrics refere?

reach

Number of quality classes

5

Conversion into classes

Class	Saprobic Index of Bioseston	Saprobic Index of Benthic Invertebrates	Saprobic Index of Phytobenthos	Chlorophyll-a (µg/l)
I	< 1.80	< 1.80	< 1.50	< 10
II	1.80 - 2.30	1.80 - 2.30	1.50 - 2.00	10 - 35
III	> 2.30 - 2.70	> 2.30 - 2.70	> 2.00 - 2.50	> 35 - 75
IV	> 2.70 - 3.20	> 2.70 - 3.20	> 2.50 - 3.00	> 75 - 180
V	> 3.20	> 3.20	> 3.00	> 180

Species lists used to calculate index

- STN (Slovenská Technická Norma) 83 0532-6 (1979): Biologický rozbor povrchovej vody. Stanovenie sapróbneho indexu pod'a Pantleho a Bucka. (Determination of Saprobic Index according to PANTLE and BUCK). Úrad pro Normalizaci a Mereni, Praha.

Reference on calculation	calculation: • STN (Slovenská Technická Norma) 83 0532 (1978/79) classification: • STN (Slovenská Technická Norma) (1989): Klasifikace jakosti povrchovych vod. Vyd. Úrad pro Normalizaci a Mereni, Praha.
Presentation	reports (paper)

Monitoring and Database

Status of monitoring program	in current usage
Name of monitoring program	National Surface Water Monitoring System Transboundary Programs: Slovakia-Hungary; Slovakia-Austria; TransNational Monitoring Network (TNMN)
Period of monitoring	since 1963 at the Danube: Benthic Invertebrates since 1996 Macrophytes since 2003 Phytobenthos since 1998 Phyto- and Zooplankton since 1992
Geographical coverage	entire Slovakia
Coverage of monitoring	National Surface Water Monitoring System: 250 sites; Transboundary Programs on the Danube: 11 sites; TNMN: 4 sites
Monitoring interval	monthly; three times per year; once a year
Name of database	OAV
Type of database	multi-user client-server database; desktop-database; non-digital protocols
Program used	MAGIC
Organisation responsible	Slovak Hydrometeorological Institute, Bratislava
Place of database storage	Slovak Hydrometeorological Institute, Bratislava

ANNEX A3: Non-WFD Compliant National Method - BULGARIA

Country	Bulgaria
Region	entire Bulgaria
Altitude range	0 - >800 m
Stream range	applied to all stream types
Elements	Benthic Invertebrates, Macrophytes
Name of method	Biotic Index based on 'Quality Rating System'
Stressors detected	Organic Pollution, General Degradation (stressor not specified)
Status of method	in current usage since 1993
The method covers	field sampling, lab procedure, calculation, presentation

General Description

Brief description

In the national monitoring network of Bulgarian watercourses a Biotic Index is in use which is adapted from the Irish ‘Quality Rating System’. The index relates the relative abundance of five key groups of macroinvertebrates (*sensitive forms* to *most tolerant forms*) to water quality. The scheme uses five basic water quality classes (Q-values).
Saprobity is determined by PANTLE & BUCK (1955) Index for the eight Bulgarian Transnational Monitoring Network (TNMN) sites only. The German DIN norm is used to calculate the Saprobic Index.
Macrophytes are not part of the assessment procedure, only species occurrence and percent coverage are recorded.

References

- MCGARRIGLE, M.L.; LUCEY, J.; CLABBY, K.C. (1992): Biological assessment of river water quality in Ireland. In: NEWMAN, P.J.; PIAVAUX, M.A.; SWEETING, R.A. (eds.): River Water Quality. Ecological Assessment and Control. Brussels (Commission of the European Community): 371-385.
- MINISTRY OF ENVIRONMENT AND WATER (since 1985): Annual report on the state of the environment - The Green Book. Sofia (MOEW). (in Bulgarian and English)
- PANTLE, R. & H. BUCK (1955): Die biologische Überwachung der Gewässer und die Darstellung der Ergebnisse. Gas- und Wasserfach 96: 604.

Sampling

Sampling procedure

Samples are taken from all major habitats proportionally according to their presence within a sampling reach. Where possible, preference is given to riffled sites with turbulent flow conditions. Hand-net sampling is carried out according to ISO Standard 7828 (1985). Substratum is kicked for approx. 2 to 5 minutes.
Organisms are are separated from other materials at sampling site by sieving through meshes of 8 mm, 2 mm, 500 µm and 200 µm in size. Organisms are picked from sieved material and preserved.

Sampling site

lenght of sampling site:
10 to 20 m (up to 50 m)
width of sampling site:
depending on width of watercourse
Danube specification:
10 to 20 m
rationale of the selection of sampling sites:
accessibility; location of pollution sources; presence of riffle sites
Danube specification:
accessibility; location of pollution sources; presence of riffle sites

Sampling season

each season excluding spring (high water level)
Danube specification:
period of lowest water level (usually August to September)

Sampling device

Benthic Invertebrates:
hand-net - mesh-size: 500 µm; net-opening: 30 * 30 cm²

Fixative used

formaldehyde (4 - 10 %)

Sampling reference

- ISO 7828 (1985): Water Quality - Methods for biological sampling - Guidance on handnet sampling of aquatic benthic macroinvertebrates.

Record of abundance

abundance classes, percent coverage

Abundance specification

Benthic Invertebrates

abundance class	number of individuals
I	1-5
II	6-20
III	21-50
IV	51-100
V	>100

Macrophytes

abundance class	percent coverage
1	< 1
2	1 - 5
3	6 - 15

4	16 - 25
5	26 - 50
6	> 50

Level of determination

species, species groups, genus, family

Determination specification

Benthic Invertebrates are identified to different taxonomic levels depending on organism group. For example, Ephemeroptera are identified to species groups and genus level, Diptera to family level.

Expenditures per sample

fieldwork: 30 to 40 minutes 3 € 2 persons , laboratory: 2 hours 4 € 1 person
additional costs: consumables - 1 to 2 € per sample; travel and accommodation - depending on sampling region

Assessment: calculation, classification, presentation

Specifications

- assessment is related to reference conditions based on existing sites and expert judgement

Calculation method

single metric(s): decision tables representing five groups of macroinvertebrates and their relative abundances

To which spatial scale do metrics refere?

catchment, river

Number of quality classes

5

Conversion into classes

<table>
<tr><th colspan="4">Bulgarian Classification</th><th colspan="3">EC Classification</th></tr>
<tr><th>Quality Class</th><th>Q-Value</th><th>Description</th><th>Colour Code</th><th>Quality Class</th><th>Description</th><th>Colour Code</th></tr>
<tr><td>I</td><td>5; 4-5; 4</td><td>unpolluted</td><td>blue</td><td>I</td><td>high</td><td>blue</td></tr>
<tr><td>II</td><td>3-4</td><td>slightly polluted</td><td>green</td><td>II</td><td>good</td><td>green</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">3; 2-3</td><td rowspan="2">moderately polluted</td><td rowspan="2">yellow</td><td>III</td><td>moderate</td><td>yellow</td></tr>
<tr><td>IV</td><td>poor</td><td>orange</td></tr>
<tr><td>IV</td><td>2; 1-2; 1</td><td>heavily polluted</td><td>red</td><td>V</td><td>bad</td><td>red</td></tr>
</table>

Species lists used to calculate index

- MINISTRY OF ENVIRONMENT AND WATER (since 1985) - *comprises about 400 taxa*

Comments on

Bulgarian Classification will soon be adapted to the EC recommendations.

calculation	
Presentation	reports (paper); maps (paper and digital); internet (http://nfp-bg.eionet.eu.int\)

Monitoring and Database

Status of monitoring program	in current usage
Name of monitoring program	National Environmental Monitoring Program of Bulgaria
Period of monitoring	since 1993 (in some river basins)
Geographical coverage	entire Bulgaria
Coverage of monitoring	about 18 to 20 sampling sites per 1000 km² - 1200 sampling points, located along rivers at a distance of 5 to 10 km
Monitoring interval	annual for representative sites and biannual for reference sites
Name of database	National Automated System for Environment Monitoring / NASEM / Subsytem "Water" - functional subsystem "Surface water biological monitoring"
Type of database	desktop-database
Program used	MS Word; MS Access; paper format
Organisation responsible	Ministry of Environment and Water, Executive Environmental Agency
Place of database storage	Ministry of Environment and Water, Executive Environmental Agency

ANNEX A4: Non-WFD Compliant National Method – CZECH REPUBLIC

Country	Czech Republic
Region	entire Czech Republic
Altitude range	0 - > 800 m
Stream range	applied to all stream types
Elements	Benthic Invertebrates
Name of method	Saprobiological Monitoring
Stressors detected	Organic Pollution
Status of method	in current usage
The method covers	field sampling, lab procedure, calculation, presentation
It is combined with the following methods	combination of results (5 quality classes) including PERLA and the Czech version of AQEM is under development (all outputs should be based on standard samples and measurements according to the AQEM/PERLA methodologies)

General Description

Brief description	The method is used for standard assessment of organic pollution in Czech rivers. It is applied in a large monitoring network and evaluates the degree of pollution according to PANTLE and BUCK (1955), modified by MARVAN (1969). Results are expressed in 8 grades, which are converted into 5 different classes.

References

- CSN 757716 (1998): Water quality, biological analysis, determination of saprobic index. - Czech Technical State Standard. Czech Standards Institute, Prague, 174 pp.
- SLADECEK, V. (1973): System of Water Quality from the Biological Point of View. Arch. Hydrobiol. Beih.; Ergeb. Limnol. 7: 1-218.
- MARVAN, P. (1969): Notes to the application of statistical methods in evaluation of saprobiology. Symposium SMEA on Questions of Saprobity: 19-43.
- PANTLE, R.; BUCK, H. (1955): Die biologische Überwachung der Gewässer und die Darstellung der Ergebnisse. Gas- und Wasserfach 96: 604.

Sampling

Sampling procedure

Sampling is done in accordance with the European standard EN 27 828. Samples are taken at a homogenous stretch, preferably in a riffle section. Each sample comprises a fixed distance and a defined sampling time. In flowing shallow water hand-sampling is carried out disturbing the substratum by hand and picking organisms from stones. Deeper but wadable streams are kick-sampled. In slow flowing waters sweep-sampling is applied: Substratum is disturbed with the feet and the dislodged fauna is caught by repeated sweeps of the net through the water above the disturbed area. All different types of sampling are made by utilisation of a hand-net (mesh-size: 500 µm).

Sampling reference

- EN 27 828 (1994): Water Quality - Methods for biological sampling - Guidance on handnet sampling of aquatic benthic macroinvertebrates. (ISO 7828: 1985)
- MRAZEK, K. et al. (1995): Zacleneni saprobiologického monitoringu SVHB do systemu sledovani a hodnoceni jacosti vody. 1. cast: Prirucka saprobiologickeho monitoringu SVHB; 2. cast: Prakticky determinacni klic. ('An integration of saprobiological monitoring into water quality monitoring and assessment. Part 1: Handbook of saprobiological monitoring of water quality balance system; part 2: Practical identification key of benthic invertebrates.') Brno (T.G.M. Water Research Institute Prague). (in Czech)

Record of abundance

number of individuals

Level of determination

species, species groups, genus

Expenditures per sample

80 €

Additional environmental data

physiographic characteristics,

Assessment: calculation, classification, presentation

Specifications

- assessment is not related to a reference condition

Calculation method

single metric(s): SI = *sum of* $(s_i*h_i*I_i)$ / *sum of* (h_i*I_i)

SI: Saprobic Index

S_i: individual saprobic index of species i ($s_i = (0*x_i + 2*b_i + 3*a_i + 4*p_i) / 10$)

h_I: abundance of species i

I_i: individual indicator weight of species i

To which spatial scale do metrics refere?

reach

Number of quality classes

5

Conversion into classes

Saprobic Grades according to Water Quality Balance System	
grade	**Saprobic Index**
1	0 - 1.0
2	1.01 - 1.50
3	1.51 - 2.00
4	2.01 - 2.50
5	2.51 - 3.00
6	3.01 - 3.50
7	3.51 - 4.00
8	> 4.00

Approximative Conversion to Classes according to Czech State Norm 757221		
grade	**class**	**Saprobic Index**
1 - 2	I	< 1.5
3 - (4)	II	1.51 - 2.19
(4) - 5	III	2.20 - 2.99
6	IV	3.00 - 3.49
7 - 8	V	>= 3.5

Reference on calculation

- CSN 757221 (1998): Water quality - Classification of surface water quality. Czech Technical State Standard, Czech Standards Institute, Prague, 10 pp.

Presentation reports (paper); maps (paper)

Monitoring and Database

Status of monitoring program existent

Name of monitoring program (1) Water Quality Balance System; (2) Monitoring Program of the Czech Hydrometeorological Institute

Geographical entire Czech Republic

coverage	
Coverage of monitoring	(1) 1200 sites; (2) 250 important sites
Monitoring interval	(1) repeated every five years; (2) two times per year in spring and autumn
Name of database	BROUCI
Type of database	desktop-database; data older than 10 years: only hard copy
Program used	FoxPro
Organisation responsible	Water Research Institute Prague, branch Brno
Place of database storage	Water Research Institute Prague, branch Brno

ANNEX A5: Non-WFD Compliant National Method – HUNGARY

Country	Hungary
Region	entire Hungary
Altitude range	0 - 800 m
Stream range	applied to all stream types
Elements	Benthic Invertebrates
Name of method	BMWP - HU (adapted to Hungarian conditions)
Stressors detected	Organic Pollution
Status of method	in current usage and under development to be finished in December 2004
The method covers	field sampling, calculation, presentation
It is combined with the following methods	under development

General Description

Brief description

For years Hungarian watercourse biomonitoring has solely been based on biomass and chlorophyll-a examinations of the planktonic river community. Since 2002 a modification of the British BMWP/ASPT score system is applied featuring newly included taxa and modified scores (see score table). Combination of total score and average score per taxon results in a Quality Index (QI) value which is assigned to one of five classes of watercourse quality.

The method is in preliminary phase and practical experience and taxonomic expertise are advancing.

References

- ARMITAGE, P.D.; MOSS, D. et al. (1983): The performance of a new biological water quality score system based on macroinvertebrates over a wide range of unpolluted running-water sites. Water Research 17: 333-347.
- BIOLOGICAL MONITORING WORKING PARTY (1978, unpublished report): Final report of the Biological Monitoring Working Party: assessment and presentation of the biological quality of rivers in Great Britain. London (Department of the Environment Water Data Unit).
- CSÁNYI in NÉMETH, J. (1998): A biológiai vízminosítés módszerei (Methods of biological water quality assessment). Vízi Természet- és Környezetvédelem sorozat 7. Bp.: Környezetgazdálkodási Intézet: 1-304. (in Hungarian)
- JUST, I.; SCHÖLL, F. & T. TITTIZER (1998): Versuch einer Harmonisierung nationaler Methoden zur Bewertung der Gewässergüte im Donauraum am Beispiel der Abwässer der Stadt Budapest. UBA-Texte 53-98. Berlin (UBA).

Sampling

Sampling procedure	Kick-Sampling: Multi habitat sampling is carried out: proportional sampling of all major habitats according to their presence within a sampling reach. In total, a five meter section is sampled for approx. 15 minutes time. In addition, organisms are picked from hard surfaces using pincers. "Turbo-kicking" method (Danube): One driver stands in water of 2 to 2.5 m depth and makes mixing up movements with his fins above the bottom. In the mean time eight sweeping movements are carried out by the hand net close to the bottom. Even large crayfishes can be moved out from heavily stony substrate by this way. Diving: special way of collecting mussels from the bottom because large surface area is under investigation. Using only fins and mask the bottom is touched continuously by hands and mussels are picked up. Dredging method (Danube): Dredging is done from a motorboat moving downstream direction slowly in order to allow the forks of the dredge to take the surface area of the bottom. Several meters are dredged pulling the sampler on rope and keeping it by hands in order to feel the roughness and the carving of the instrument. Two sizes of the dredge are in usage: 25 cm and 40 cm opening on a triangle shaped and forked surface. The dredge has an inside net with the mesh size of 500 µm. It can also be operated without this net. In this case an iron grid with mesh size of 150 mm collects rough sized bed material (e.g. mussel species are collected by this way). Whole sample is preserved in the field and organisms are picked out in the laboratory. Samples are sieved through a net of 950 µm prior to sorting and identification. If the volume of the sample exceeds 2 litres, a smaller part is taken to identify organisms (max. 500 ml).
Sampling site	**rationale of the selection of sampling sites:** identical to former monitoring network; representativeness *Danube specification:* identical to former monitoring network; representativeness
Sampling device	**Benthic Invertebrates:** hand net - mesh-size: 950 µm; net-opening: 25 * 20 cm² *Danube specification:* custom-made dredge - mesh-size: 950 µm or 150 mm; sampled area: 25 or 40 cm * few meters
Fixative used	ethyl alcohol (70 %)
Record of abundance	number of individuals, abundance classes

Abundance specification

abundance class	percentage of individuals in sample (5 m à 15 min)
5	> 50
4	25 - 50

3	12.5 - 25
2	6.25 - 12.5
1	< 6.25

Level of determination species, genus, family, higher taxonomical level

Determination specification Chironomids are identified to family level, Oligochaets to higher taxonomical level.

Expenditures per sample
fieldwork: 1 to 2 hours 40 to 80 € 1 person
laboratory: 1 to 3 hours 40 to 120 € 1 person

Additional environmental data chemical/physical water quality,

Assessment: calculation, classification, presentation

Specifications

- assessment is not related to a reference condition

Calculation method single metric(s): sum of BMWP scores and calculation of the Average Score Per Taxon

To which spatial scale do metrics refere? habitat

Number of quality classes 5

Conversion into classes

Assignment of Quality Index according to BMWP score and ASPT of riffle and					
Scoring System for Riffles			Scoring System for Pools		
BMWP	ASPT	Quality Index	BMWP	ASPT	Quality Index
> 150	> 6.0	7	> 120	> 5.0	7
121 - 150	5.5 -	6	101 - 120	4.5 -	6
91 - 120	5.1 -	5	81 - 100	4.1 -	5
61 - 90	4.6 -	4	51 - 80	3.6 -	4
31 - 60	3.6 -	3	25 - 50	3.1 -	3

	4.5			3.5	
15 - 30	2.6 - 3.5	2	10 - 24	2.1 - 3.0	2
0 - 14	0.0 - 2.5	1	0 - 9	0.0 - 2.0	1

Quality classification of watercourses based on Quality Index

quality class	description	mean Quality Index according to Total Score and ASPT of riffle and pool section
I	high	> 5.0
II	good	> 4.0 - 5.0
III	moderate	> 3.0 - 4.0
IV	poor	> 2.0 - 3.0
V	bad	<= 2.0

Species lists used to calculate index
- score table

Reference on calculation
- CSÁNYI in NÉMETH, J. (1998)

Presentation
reports (paper and digital)

ANNEX A6: Non-WFD Compliant National Method – ROMANIA

Country	Romania
Region	entire Romania
Altitude range	0 - >800 m
Stream range	applied to large watercourses
Elements	Benthic Invertebrates, Phytobenthos, Phytoplankton, Zooplankton
Name of method	Determination of Saprobic Index according to PANTLE & BUCK (1955)
Stressors detected	Organic Pollution
Status of method	in current usage
The method covers	field sampling, lab procedure, calculation, presentation

General Description

Brief description	To assess the biological quality of watercourses in Romania the Saprobic Index according to PANTLE & BUCK (1955) is determined and classified in a five-fold scheme.
References	• MALACEA, I. (1969): Biologia apelor impurificate (biology of polluted waters). Bucharest (Romanian Academy). (in Romanian) • MARCOCI, I. (1984): Analiza biologica a apelor (biological analysis of waters). Bucharest (Romanian Academy). (in Romanian)

Sampling

Sampling procedure	When sampling Benthic Invertebrates by hand-net 'kick and sweep' technique is applied. If possible, all major habitats are sampled proportionally according to their presence within a sampling reach (multi-habitat sampling). Whole sample is preserved in the field and organisms are picked out in the laboratory. Plankton samples are concentrated by means of sedimentation, membran filtration or centrifugation. Benthic Invertebrates are sieved through 475 µm meshes prior to sorting and identification.
Sampling site	**width of sampling site:** 5 to 30 m ***Danube specification:*** 500 to 900 m **rationale of the selection of sampling sites:** representativeness; availability of data on flow dynamics; requirements of international conventions
Sampling season	Phytoplankton, Zooplankton, Benthic Invertebrates: each season; Phytobenthos: summer

Sampling device	*Danube specification:* Phytoplankton: monthly; Zooplankton: each season; Phytobenthos: summer **Benthic Invertebrates:** Surber sampler - mesh-size: 475 µm; sampled area: 35x35 cm² Ponar Grab - sampled area: 22x22 cm² Marinescu Dredge (Romanian version of Ekman type Dredge) - sampled area: 17x17 cm² *Danube specification:* Ponar Grab - sampled area: 22x22 cm² Marinescu Dredge (Romanian version of Ekman type Dredge) - sampled area: 17x17 cm² **Phytobenthos and Heterotrophic Periphyton:** scraping tool: spatula; scraped area: 6 to 20 cm²; petri dish and spatula for collecting soft sediment **Plankton:** plankton net - mesh-size: 126.5 µm; net-opening (diameter): 20 to 25 cm; sampling depth: 10 to 15 cm Phytoplankton: 1 litre plastic bottle and 'Kemmerer Water Sampler' (2 to 3 litres); Zooplankton: 5 buckets (10 litres each)
Fixative used	90 % alcohol
Sampling reference	• SR-ISO - 5667-1: 1998 Water quality – Sampling –Part 1: Guidance on the design of sampling programs. • SR-ISO – 5667-2: 1998 Water quality – Sampling –Part 2: Guidance on sampling techniques. • SR-ISO – 5667-6: 1997 Water quality – Sampling –Part 6: Guidance on sampling of rivers and streams. • SR-ISO – 5667-12: 2001 Water quality– Sampling –Part 12: Guidance on sampling of bottom sediments. • SR-EN – 27828 (ISO 7828: 1985) Water quality - Method of biological sampling: Guidance on handnet sampling of aquatic benthic macro-invertebrate. • MARCOCI (1984)
Record of abundance	number of individuals
Abundance specification	Benthic Invertebrates, Phytobenthos, Phytoplankton, Zooplankton: number of individuals
Level of determination	species, genus
Determination specification	Benthic Invertebrates, Phytobenthos, Phytoplankton, Zooplankton: species level represents the most common level of identification in biological monitoring; some groups are identified to genus level
Expenditures per sample	**fieldwork:** 1 hour 5 US Dollar 1 biologist; 1 lab technician **laboratory:** 16 hours 30 US Dollar 2 persons costs of transport: 10 US Dollar All costs refer to sampling of Benthic Invertebrates.
Additional environmental data	height of source, distance from source, stream order, slope, altitude, catchment area, geology, river continuity (passability), cross section of the river bed and/or floodplain, land use, temperature, current velocity, discharge, pH, conductivity, dissolved oxygen content, oxygen saturation, COD (Chemical Oxygen

Demand), BOD (Biological Oxygen Demand), nitrite, nitrate, ammonium, phosphorus, water colour, type and intensity of human impact,

Assessment: calculation, classification, presentation

Specifications

- Within the classification scheme 'class I' represents the reference condition.
- Stream type-specific assessment is not existing. The establishment of a national stream typology is expected to be finished in June 2004.

Calculation method

single metric(s):

SI = *Sum of* (s_i*h_i) / *Sum of* h_i

SI: saprobic index

s_i: saprobial valence of the i-th taxon

h_i: abundance of the i-th taxon

To which spatial scale do metrics refere?

habitat

Number of quality classes

5 (classification according to EU Water Framework Directive will be applied in 2004)

Conversion into classes

class	Saprobic Index based on Benthic Invertebrates	colour code
I	<= 1.8	blue
II	1.81 - 2.3	green
III	2.31 - 2.7	yellow
IV	2.71 - 3.2	orange
V	> 3.2	red

Species lists used to calculate index

- MARVAN, P.; ROTHSCHEIN, J.; ZELINKA, M. (1980): Der diagnostische Wert saprobiologischer Methoden. Limnologica 12(2): 299-312.
- SLÁDECEK, V. (ed.) (1977): Symposium on Saprobiology. Stuttgart (Schweizerbart).
- SLÁDECEK, V. (1981): Biologický rozbor povrchové vody: komentár k CSN 83 0532, cásti 6 : stanovení saprobního indexu. Praha: Vydavatelství Úradu pro normalizaci a merení: 186 p.

Reference on calculation

- PANTLE & BUCK (1955): Die biologische Überwachung der Gewässer und die Darstellung der Ergebnisse. Gas- und Wasserfach 96: 604.

Presentation

reports (paper and digital), maps (paper)

Monitoring and Database

Status of monitoring

in current usage

program	
Name of monitoring program	National Water Monitoring System
Period of monitoring	since 1978
Geographical coverage	entire Romania
Coverage of monitoring	approx. 1 site per 1000 km²
Monitoring interval	4 times per year
Name of database	Water Quality Component of the National Water Monitoring System
Type of database	desktop-database
Program used	*River Quality*
Organisation responsible	National Administration 'Apele Romane'
Place of database storage	National Administration 'Apele Romane'

ANNEX B

Reference criteria and reference sites

(refer to
http://forum.europa.eu.int/Public/irc/jrc/jrc_eewai/library?l=/milestone_reports/milestone_september_1/rivers&vm=detailed&sb=Title)

ANNEX C

Class Boundary setting procedure and intercalibration results for IC types based on non-WFD compliant methods

Explanation of harmonised quality class boundary setting procedure and intercalibration results for types based on non-WFD compliant methods

Introduction

Within the intercalibration exercise the definition of reference conditions is of major importance for the comparison of national quality assessment methods. In this regard, two problems were obvious in the Eastern Continental GIG: Either existing reference site were not available (esp. lowland types) or reference criteria to screen for existing reference sites differed among countries. In the Eastern Continental GIG we agreed to follow an alternative approach to resolve these issues by defining IC type specific, harmonised quality criteria. In general, we set common high-good resp. good-moderate quality class boundaries for the national biological assessment methods using existing data assembled within the EC GIG intercalibration exercise. The main idea was to overcome the difficulties of lacking (near-natural) references by defining an alternative reference, i.e. common agreement on a certain level of impairment.

Data basis

Basis for the intercalibration analyses were national data derived from sampling sites at rivers belonging to common intercalibration types. The data included information about composition and abundance of macrozoobenthic fauna, selected chemical parameters, classification of hydromorphological quality and land use in the catchment. Table 1 specifies the scope of environmental data collected for each sampling site. Values for the chemical parameters were given as annual averages except for most of the Hungarian and some Czech samples. For these samples the means of at least two single measurements were provided.

Since no common method for the evaluation of the structural status of the sampling sites was available, a classification scheme to assess the hydromorphological quality was developed. According to the degree anthropogenic modification one of three classes was allocated to each site by expert judgement following the descriptions presented in Table 1.

Based on CORINE land cover data the shares of artificial, agricultural and forest land use in the catchment were surveyed. These data were used to calculate the Land Use Index (Böhmer et al., 2004[2]): 4 * artificial land use + 2 * intensive agriculture (e.g. cropland) + non-intensive agriculture (e.g. pasture).

Outline of the harmonisation approach

Harmonised definition of quality criteria/thresholds for the high and good ecological status

[2] Böhmer, J., C. Rawer-Jost, A. Zenker, C. Meier, C. K. Feld, R. Biss & D. Hering, 2004. Assessing streams in Germany with benthic invertebrates: Development of a multimetric invertebrate based assessment system. Limnologica 34: 416-432.

Based on criteria for saprobiological quality commonly agreed for monitoring purposes in the Danube River Basin, biological threshold values were derived using the common metric ASPT (Average Score Per Taxon). Sites with samples showing ASPT values above these thresholds were screened by additional chemical, morphological and land use parameters. The set of sites complying with all criteria/thresholds were regarded as of being in a commonly agreed, ecologically high resp. high and good status.

Class boundary setting based on 25th percentile value of common metrics using all sampling sites meeting the criteria defined in section A (high status sites → high-good boundary, high and good status sites → good-moderate boundary)

The ecological quality class boundaries were expressed in ICMi-EC scale (see MS6 part C) to comply with the normative definitions of the WFD. These boundaries were derived by selecting the 25th percentile values of each common metric from the set of sites in high resp. high and good status (=subset). By means of regression analysis the boundary values were translated into values of the national assessment method.

Setting of boundaries not defined by subset

The good-moderate boundary of R-E1 and the high-good boundary of R-E2, R-E3 and R-E4 were not directly derived by the procedure described above. For the Austrian and Slovak method these boundaries were defined by adopting the 0,2 unit steps of the national classification schemes, i.e. increasing or decreasing the boundary derived from the subset by 0,2 units. This approach was supported by the intercalibration results of Slovak method: Derived from the data subsets the difference between the high-good boundary of R-E1 and the good-moderate boundary of R-E2 amounts to 0,2 units. Boundaries of the non-WFD compliant methods have been set by increasing or decreasing the value obtained by the subset-procedure by 20 percent.

Table 1: Environmental data collected per sampling site

chemical parameters
Conductivity, pH, Alkalinity, Dissolved Oxygen, Oxygen Saturation, Biological Oxygen Demand (5 day), Total Phosphorus, Ortho-Phosphate, Nitrate, Ammonium
hydromorphological quality classification
class 1 – unaltered hydromorphological conditions (= in near-natural state)
- stream type specific variability of channel depth and channel width, shallow profile, close connectivity of the stream and the floodplain
- natural channel substrate conditions (composition and variability), presence of dead wood
- bank profile and bank structure unmodified
- presence of natural riparian vegetation (in most Eastern Continental GIG regions: forest)
- natural hydromorphological dynamic is maintained
- low degree of anthropogenic land use in the floodplain
class 2 – moderately altered hydromorphological conditions
- decreased variability of channel depth and channel width
- minor changes to bank morphologies, or only one bank is fixed with "soft works"
- riparian vegetation altered

- loss of stream length, longitudinal profile is altered by man
class 3 – severely altered hydromorphological conditions
- obvious presence of hard engineering
- severe modifications of instream structures, bed and bank fixation and artificial substrates
- no or only minor variability of channel substrate
- no riparian zone between river and land use
- channelised, straightened and/or deep-cut river
- disconnection of river and floodplain
land use in catchment
% artificial land use
% intensive agriculture
% non-intensive agriculture
% forest

A. Harmonised definition of quality criteria/thresholds for the high and good ecological status

Step 1: Setting biological screening thresholds using TNMN quality criteria for the saprobiological status → Table 2

Table 2: Proposal for classification of Austrian Saprobic Index in two types of natural rivers in the Danube basin according to Knoben et al. (1999)[3]
a= fast flowing/mountainous rivers
b= slow flowing/lowland rivers

Class	**I**	**II**	**III**	**IV**	**V**
ecological status	high	good	moderate	Poor	bad
Saprobic Index (a)	≤ 1.80	1.81-2.30	2.31-2.70	2.71-3.20	> 3.20
Saprobic Index (b)	≤ 2.20	2.21-2.50	2.51-2.90	2.91-3.50	> 3.50

Step 2: Translation of the Austrian Saprobic Index SI (AT) into ASPT values based on regression analyses using Austrian, Czech, Hungarian and Slovak data of R-E1, R-E2, R-E3 and R-E4 → Figure 1 and Table 3

[3] Knoben, R. A. E., L. Bijlmakers & P. van Meenen, 1999. Water Quality Enhancement in the Danube River Basin; subaction 2A: Waterquality classification/characterisation. IWACO, 's-Hertogenbosch.

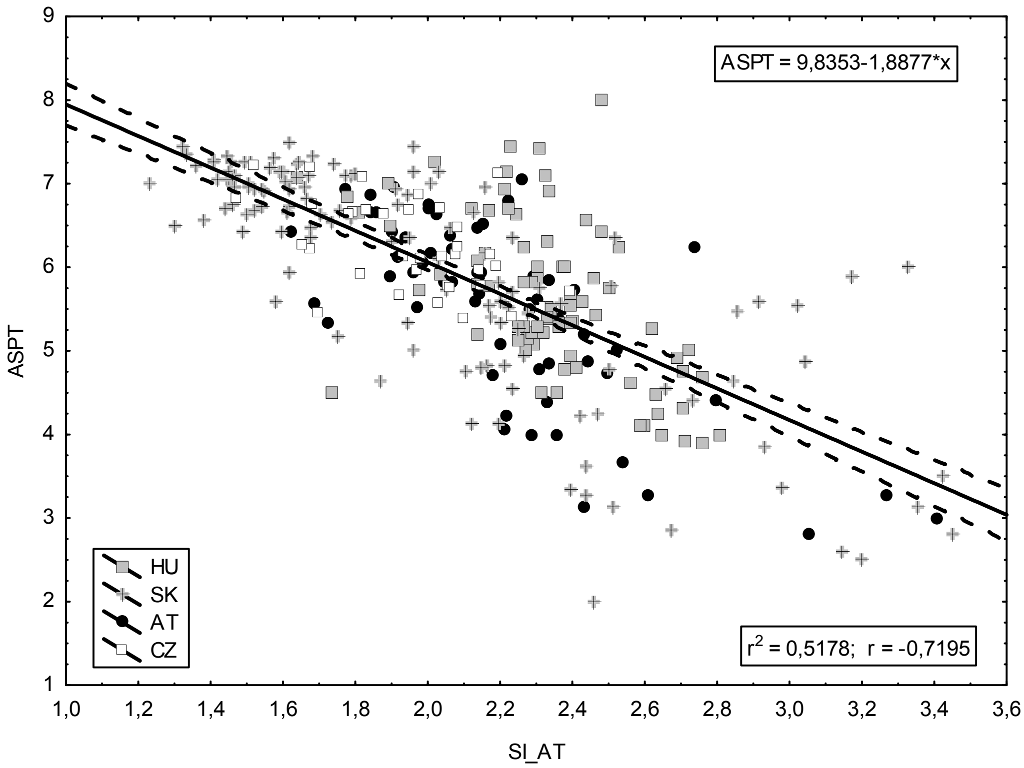

Figure 1: Regression of Austrian Saprobic Index against ASPT using samples derived from multi-habitat sampling technique of Austria, Czech Republic, Hungary (Ecosurv project data) and Slovak Republic (n=302)

Table 3: ASPT values corresponding to SI (AT) quality class boundaries.

	high-good		good-moderate	
	SI (AT)	**ASPT**	**SI (AT)**	**ASPT**
fast flowing/mountainous rivers	1.8	6.4	2.3	5.5
slow flowing, lowland rivers	2.2	5.7	2.5	5.1

Step 3: Site screening using ASPT thresholds and additional criteria according to Table 4 to define subset of sites in high (R-E1) resp. high and good (R-E2, R-E3, R-E4) ecological status.

Table 4: Criteria used for the definition of sampling sites showing high and/or good quality status

	R-E1	**R-E2**	**R-E3**	**R-E4**
defined quality range	high status	high and good status	high and good status	high and good status
quality criteria and thresholds	ASPT ≥ 6.4 additional criteria • class 1: unaltered hydromorphology • mean BOD ≤ 2,5mg/l • Land Use Index ≤ 50	ASPT ≥ 5.1 additional criteria • class 1: unaltered or class 2: moderately altered hydromorphology • mean BOD ≤ 5mg/l • mean conductivity[4] < 1000µS/cm • Land Use Index ≤ 140	ASPT ≥ 5.1 additional criteria • class 1: unaltered or class 2: moderately altered hydromorphology • mean BOD ≤ 5mg/l • mean conductivity[3] <1000µS/cm • Land Use Index ≤ 140	ASPT ≥ 5.1 additional criteria • unaltered or moderately altered hydromorphology • mean BOD ≤ 5mg/l • mean conductivity[3] <1000µS/cm • Land Use Index ≤ 140

B. Class boundary setting based on 25th percentile value of common metrics using all sampling sites meeting common criteria

Step 4: Calculation of 25th percentile values of common metrics for each country/IC type combination to set common high-good (R-E1) or good-moderate boundary (R-E2, R-E3, R-E4) → Table 5

[4] only when available

Table 5: 25th percentile common metric values per IC type and country

IC type	country	quality range	# sites	# sampl	#_fam	ASPT	Struct-Index_fam	%_EPT _fam
R-E1	Czech R.	high	3	6	26	6,63	68,5	19,27
	Hungary	high	6	21	8	6,29	20,0	28,07
	Romania	high	13	22	9	6,80	28,8	61,12
	Slovak R.	high	11	31	23,5	6,85	74,5	25,49
R-E2	Hungary	high+good	13	13	14	6,90	25,0	21,68
	Romania	high+good	6	11	12	5,44	18,5	20,39
	Slovak R.	high+good	3	8	12	5,74	27,5	8,54
R-E3	Bulgaria	high+good	5	8	16	5,43	15,3	32,00
	Hungary	high+good	11	11	13	5,94	7,0	15,51
R-E4	Austria	high+good	7	10	23,5	6,38	51,5	9,33
	Hungary	high+good	6	9	14	6,92	20,0	43,57
	Romania	high+good	3	4	6	5,08	12,0	25,28
	Slovak R.	high+good	4	11	19	6,05	46,0	15,97

Step 4a: Plausibility check of R-E1 high-good boundary values by comparion with median values of common metrics derived from samples at R-E1 reference sites (Table 6)

Based on samples of R-E1 reference sites the median value of common metrics per country was calculated following the procedure to define type specific reference values for intercalibration in the Central-Baltic GIG. Analysis of reference values revealed the following outcomes:

In general, country specific median values are only slightly exceeding the 25th percentile boundary values.
→ Simple set of screening criteria seems more strict compared to extensive catalogue for defining reference sites.

ASPT differences of reference sites between countries are low compared to other common metrics (more robust with regard to sampling differences).
→ Argument for using the common ASPT threshold values as biological screening criterion.

Similar sampling design of Czech and Slovak Republic is reflected by similar values.
→ Argument for direct comparison in the intercalibration of R-E1.

Table 6: Median values of common metrics of samples at R-E1 reference sites

country	# sites	# samples	#_fam	ASPT	Struct-Index_fam	%_EPT_fam
Czech Republic	3	10	28	6,64	67,0	26,00
Hungary	16	41	9	6,75	24,0	33,33
Romania	20	42	11	6,53	33,5	58,09
Slovak Republic	22	48	22,5	6,84	68,0	37,80

Step 5: Normalisation of common metrics using 25th percentile values, composition of ICMi-EC (reflecting boundary value; see Table 5) and translation into national index values via regression analyses → Table 7 and Table 8

Table 7: Coefficients of determination gained in regression analyses of ICMi-EC against national assessment methods

IC type	country	coefficient of determination	comment
R-E1	Slovak Republic	0,67	non-linear regression
	Czech Republic	0,61	direct comparison of Slovak and Czech index
	Hungary	0,78	regression of ASPT against Hungarian ASPT
	Romania	0,53	-
R-E2	Hungary	0,44	-
	Romania	0,49	-
	Slovak Republic	0,51	non-linear regression
R-E3	Bulgaria	0,66	-
	Hungary	0,31	low coefficient of determination in regression of ICMi against national index
R-E4	Hungary	0,59	-
	Romania	0,25	low coefficient of determination in regression of ICMi against national index
	Austria	0,57	non-linear regression
	Slovak Republic	0,60	non-linear regression

Table 8: Harmonised class boundary values of national assessment methods derived by applying common boundary setting criteria
Boundary values are specified within a range of accepted variation of +/- 5% (lower and upper confidence limit). This interval takes into account the systematic error and confidence bands of the regression analysis.

IC type	country	boundary type	boundary value	confidence limit	
				lower	upper
R-E1	Slovak Republic	high-good	0,74	*0,69*	*0,79*
		good-moderate	0,54	*0,49*	*0,59*
	Czech Republic	high-good	1,33	*1,26*	*1,40*
		good-moderate	1,84	*1,77*	*1,91*
	Hungary	high-good	6,39	*6,79*	*5,99*
		good-moderate	5,11	*5,51*	*4,71*
	Romania	high-good	1,78	*1,69*	*1,87*
		good-moderate	2,14	*2,05*	*2,22*
R-E2	Hungary	high-good	6,3	*5,91*	*6,69*
		good-moderate	5,25	*4,86*	*5,64*
	Romania	high-good	1,81	*1,72*	*1,90*
		good-moderate	2,26	*2,17*	*2,35*
	Slovak Republic	high-good	0,74	*0,69*	*0,79*
		good-moderate	0,54	*0,49*	*0,59*
R-E3	Bulgaria	high-good	4-5	*4-5*	*4-5*
		good-moderate	3-4	*3-4*	*3-4*
	Hungary	high-good	6,07	*5,69*	*6,45*
		good-moderate	5,06	*4,68*	*5,44*
R-E4	Hungary	high-good	7,79	*7,30*	*8,28*
		good-moderate	6,49	*6,00*	*6,98*
	Romania	high-good	1,66	*1,58*	*1,74*
		good-moderate	2,08	*2,00*	*2,16*
	Austria	high-good	0,79	*0,74*	*0,84*
		good-moderate	0,59	*0,54*	*0,64*
	Slovak Republic	high-good	0,72	*0,67*	*0,77*
		good-moderate	0,52	*0,47*	*0,57*

Step 5a: Validation of intercalibration results of Austrian and Slovak assessment methods using direct comparison of national indices → Table 9 and Figure 2

Direct comparison of the Austrian and Slovak assessment methods for R-E4 was performed to validate the results of indirect comparison using ICMi-EC. In Table 9 the

Slovak boundaries that correspond to the Austrian boundaries derived from the common boundary setting procedure are presented. The results show high agreement with the outcomes of the indirect comparison.

Table 9: Slovak boundary values derived from regression analysis of direct comparison using Austrian class boundaries derived from common boundary setting

	high-good	**good-moderate**
Slovak Republic	0,67	0,53
95% conf-interval	*0,03*	*0,02*

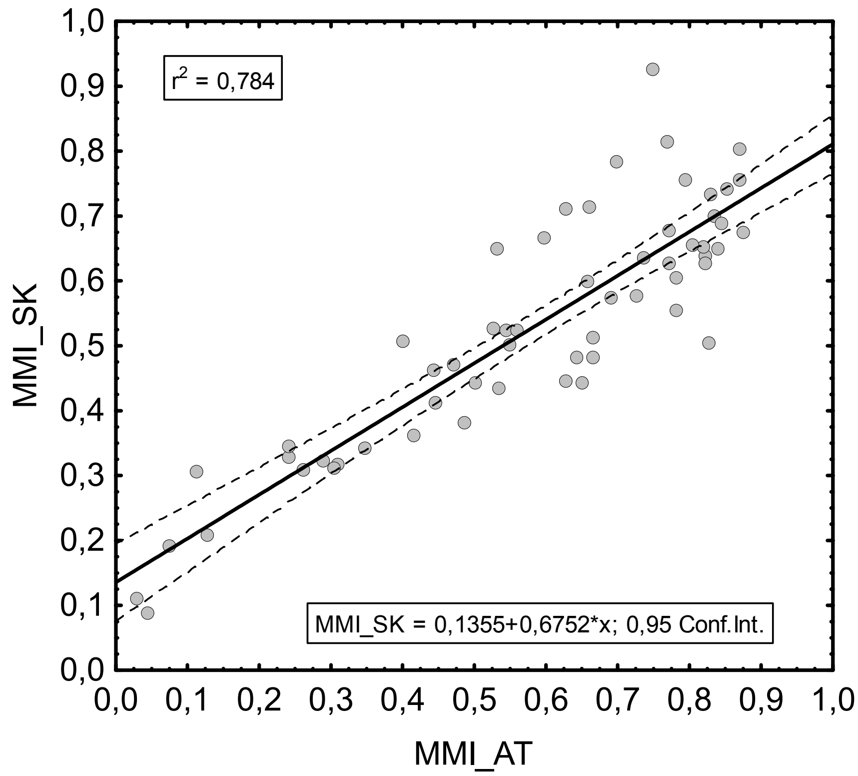

Figure 2: Regression plot showing direct comparison of Austrian and Slovak assessment indices based on Slovak data of stream type R-E4 (n=94)

Data gaps

The intercalibration of national assessment methods is strongly related to the quality of datasets underlying the analysis. In this respect, great efforts were put into the selection process of suitable data by the GIG countries. Nevertheless, some data gaps remained. These gaps and alternative data handling are specified in Table 10.

Table 10: Data gaps and alternative data handling in EC GIG analysis procedure

IC type	country	comment
R-E1	CZ	only 6 samples in subset
	HU	subset includes sites selected without "BOD_5" criterion (missing data)
R-E2	HU	subset was defined based on "land use index" criterion only (threshold <=50)
	RO	subset includes 2 sites in hydromorphological quality class 3
	SK	Only sites in severely altered hydromorphological conditions, therefore good-moderate boundary was derived by using 75th percentile value of common metrics.
R-E3	BG	subset includes 4 sites without "BOD_5" data (missing data)
R-E4	HU	subset includes sites selected without land use criterion (missing data)
	RO	only 4 samples in subset
	SK	subset includes 3 sites selected without "BOD_5" criterion (missing data)

ANNEX D

Intercalibration of the Danube River (R-E6)

Intercalibration of biological assessment methods for the Danube River

Outline of general approach and presentation of preliminary results – June 2006

Introduction

Biological assessment of the Danube River on the basis of the benthic macroinvertebrate community is limited to the application of Saprobic Systems or Biotic Indices to evaluate the degree of organic water pollution. Currently, no WFD compliant classification method to assess the ecological status of the Danube River using benthic macroinvertebrates is applied by the EC GIG countries. In general, two shortcomings impede completed WFD compliant ecological assessment for the Danube River: (1) lack of data derived from techniques to acquire representative samples of the macroinvertebrate community from the different river habitats; (2) lack of near-natural reference conditions.

Therefore, the intercalibration exercise performed for the Danube River (R-E6) focuses on the comparison of national assessment indices used in regular water quality monitoring of the Danube River. For the 5 countries participating in the EC GIG intercalibration exercise these indices are listed in Table 1.

Table 1: National bioassessment methods to evaluate the water quality of the Danube River

country	assessment method	abbreviation
Austria	Austrian Saprobic Index	SI (AT)
Slovakia	Slovak Saprobic Index	SI (SK)
Hungary	Hungarian ASPT	ASPT (HU)
Romania	Romanian Saprobic Index	SI (RO)
Bulgaria	Bulgarian Biotic Index	BI (BG)

Methods

Based on analyses of the JDS 1 dataset, Stubauer and Moog (2003) proposed a basic saprobic condition (=reference value) of SI (AT) = 2,00 for the Danube River below 200 m altitude, arguing against a section type specific differentiation of the basic saprobic condition of the Danube River. Knoben et al. (1999) suggested a harmonised saprobiological classification scheme for the Danube River (see class boundaries of the Austrian Saprobic Index in Table 3). These recommendations formed the basis for the intercalibration exercise of the Danube River.

Intercalibration of quality class boundaries was performed by direct comparison of national assessment indices. Data from samples taken at the Danube River covered a relatively short saprobiological gradient (difference between 25th and 75th percentile values of Austrian SI: 0,11). Thus, direct index comparison was carried out analysing data of all types included in the intercalibration exercise. In particular, the index comparison covered pair-wise analyses of x: SI (AT) against y: SI (SK), x: SI (AT) against y: ASPT (HU), x: ASPT (HU) against y: SI (RO) and x: ASPT (HU) against y: BI (BG). Via modelling using linear regression the reference value and the saprobiological class boundary values were translated from the Austrian Saprobic Index and the Hungarian ASPT into the national index values, respectively.

Results

Table 2 reveals the main descriptors of the correlation and regression analysis. In Table 3 the harmonised class boundary values for the national assessment methods are listed.

Table 2: Main statistics of the correlation and regression analyses

			x-axis	
			SI (AT)	**ASPT (HU)**
y-axis	**SI (SK)**	n	360	
		R square	0,91	
		regression equ.	y=1,22*x-0,56	
	ASPT (HU)	n	360	
		R square	0,43	
		regression equ.	y=-1,81*x+9,55	
	SI (RO)	n		179
		R square		0,53
		regression equ.		y=-0,26*x+3,38
	BI (BG)	n		32
		R square		0,73
		regression equ.		y=1,77*x-2,80

Table 3: Harmonised national class boundary values for biological water quality assessment of the Danube River

		lower quality class boundary values			
national index	**Reference value**	**high-good**	**good-moderate**	**moderate-poor**	**poor-bad**
SI (AT)[5]	2,00	2,20	2,50	2,90	3,50
SI (SK)	1,90	2,10	2,50	3,00	3,70
ASPT (HU)	5,95	5,60	5,00	4,30	3,20
BI (BG)	4 to 5	4	3 to 4	3	2
SI (RO)	1,80	1,90	2,10	2,30	2,65

[5] Reference value acc. to Stubauer and Moog (2003); class boundary values acc. to Knoben et al. (1999)

Literature

Stubauer, I. & O. Moog, 2003. Integration of the Saprobic System into the assessment approach of the WFD - a proposal for the Danube River. In Sommerhäuser, M., S. Robert, S. Birk, D. Hering, O. Moog, I. Stubauer & T. Ofenböck (eds), Final Report of the Activity 1.1.7 "Implementing ecological status assessment in line with requirements of the EU Water Framework Directive using specific bio-indicators". University of Duisburg-Essen, Essen and Vienna: 29-39.

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ANNEX 2

CHECK LIST OF WFD COMPLIANT BIOLOGICAL ASSESSMENT METHODS

Check list of WFD compliant biological assessment methods

The EU Water Framework Directive (WFD) stipulates to monitor the ecological status of surface waters using Biological Quality Elements (BQE). Quality classification is done by biological assessment methods meeting specific requirements. This document outlines the obligatory components of assessment methods complying with the demands of the WFD.

0. Check List

- ☒ *Consideration of certain BQE parameters.*
- ☒ *Ecological status assessment independent of pressures.*
- ☒ *'Ecological Quality Ratio' based on type specific reference values.*
- ☒ *5 classes of ecological quality.*
- ☒ *'Good status' boundaries derived from intercalibration.*
- ☒ *Worst BQE determines ecological status of water body (one out-all out).*
- ☒ *Classification includes measure of uncertainty.*

1. Indicative Parameters

For the different water categories (rivers, lakes, transitional and coastal waters) a certain set of BQEs has to be monitored[6]. Ecological status classification is based on particular **parameters indicative of the BQE**. The biological assessment methods must include all these indicative parameters in the classification of ecological status. In Table 1 indicative parameters are specified per surface water category and BQE.

[6] surveillance monitoring: all BQEs; operational monitoring: BQEs most sensitive to specific pressures

Table 1: Indicative parameters to be included in biological assessment methods for certain surface water categories and BQEs ([a] undesirable disturbance to the balance of organisms or water quality, [b] only lakes, [c] only Macroalgae)

Surface Water Category	Biological Quality Element	Taxonomic composition	Abundance	Ratio sensitive to insensitive taxa	Diversity	Age structure	Frequency and intensity of algal blooms	Secondary effects[a]	Bacterial tufts	Biomass	Absence of major taxonomic groups	Taxa indicative of pollution
Rivers and Lakes	Phytoplankton	x	x				x	x		x[b]		
	Macrophytes and Phytobenthos	x	x					x	x			
	Benthic invertebrate fauna	x	x	x	x						x	
	Fish fauna	x	x	x		x						
Transitional Waters	Phytoplankton	x	x				x	x		x		
	Macroalgae and Angiosperms	x	x					x[c]				
	Benthic invertebrate fauna		x	x	x							x
	Fish fauna	x	x	x								
Coastal Waters	Phytoplankton	x	x				x	x		x		
	Macroalgae und Angiosperms		x	x				x				
	Benthic invertebrate fauna		x	x	x							x

2. Ecological Quality Assessment, Ecological Quality Ratio and Classification

The WFD concept of **ecological status** requires an assessment independent of pressure. “Ecosystem health” has to be in the focus of biological monitoring. In practice, this can be achieved by using multimetric indices combining the results of several pressure specific indices. Multimetric indices provide multi-level outputs: The overall results appraise ecological quality, while single indices inform about causes of degradation. A “cook book” for the development of multimetric indices is provided by Hering et al. (2006)[7].

The biological assessment results need to be expressed using a numerical scale between *zero* and *one*, the ‘**Ecological Quality Ratio**’ (EQR). The EQR value *one* represents (type specific) reference conditions and values close to *zero* bad ecological status (Figure 1).

Ecological quality is classified by one of five classes (high, good, moderate, poor and bad). To ensure comparability of the results of biological assessment methods the

[7] Hering, D., Feld, C.K., Moog, O. and Ofenböck, T., 2006. Cook book for the development of a Multimetric Index for biological condition of aquatic ecosystems: Experiences from the European AQEM and STAR projects and related initiatives. Hydrobiologia 566, 311-324.

boundaries of the good ecological quality status are harmonised by the **intercalibration exercise**.

The WFD requires classification of water bodies at the level of the Quality Element. The worst of the relevant Quality Elements determines the final classification (“**One out, all out**” principle).

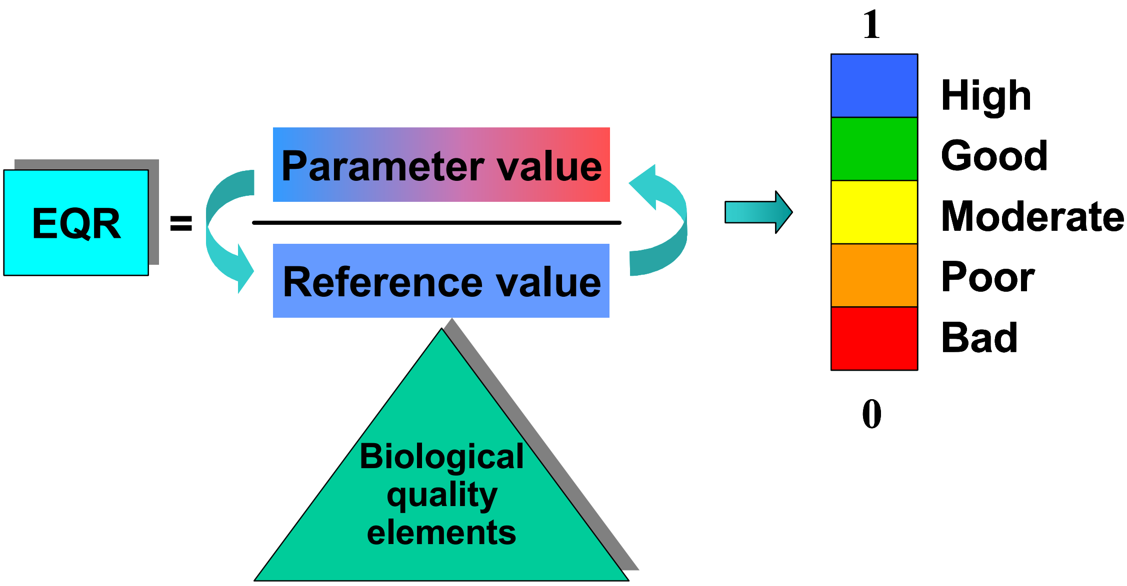

Figure 1: Graphical representation of the concept of the Ecological Quality Ratio (from van de Bund and Solimini, 2006[8])

3. Type specific reference conditions

The natural conditions of a surface water body type define the reference of ecological status assessment. Within types similar biotic communities are expected due to homogeneous environmental conditions. Type specific assessment reduces the natural variability and thus detects the anthropogenic influence on the biology more precisely. Therefore, surface water types shall reflect biotic types, and it may be necessary to establish different biotic typologies for the various BQEs. Channel substrate, for instance, is an important factor for macrozoobenthic communities. Water alkalinity is decisive for macrophytes and phytobenthos.

Type specific reference conditions can be derived by different methods:

1. Investigation of *existing sites* that are not or only minimally influenced by human activity. General criteria for the selection of reference sites are given by

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[8] van de Bund, W. and Solimini, A.G., 2006. Ecological Quality Ratios for ecological quality assessment in inland and marine waters. REBECCA Deliverable 10. JRC IES, Ispra. - http://www.rbm-toolbox.net/docstore/docs/3.0.Deliverable_D10.doc

the REFCOND guidance (CIS WG 2.3, 2003[9]), more specific criteria and threshold values have been elaborated within the intercalibration exercise (e.g. Olsauskyte and van de Bund, 2007[10]).

2. *Modelling* of reference conditions by prediction and historical data. Long-lasting, ubiquitous anthropogenic activity especially in European lowland areas limits the presence of existing reference sites. Knowledge about how indicative parameters react to human pressure enables prediction of parameter values at the absence of human influence. Historical records (e.g. old scientific literature, lake sediments, historical maps) dating from times of low industrial and agricultural intensity (usually end of 19th century and earlier) give information about natural conditions.
3. Definition of reference conditions by *expert judgment*. In this option information from a range of sources (e.g. monitoring data, relevant information on background levels) shall be used to confidently derive reference values for different Biological Quality Elements. This approach is only feasible if references cannot be established using existing sites or modelling.

4. Confidence and Precision

The use of ecological data in environmental monitoring and assessment bears various sources of **uncertainty** due to natural and/or methodological variability. The WFD demands an “adequate confidence and precision” of biological assessment methods to avoid misclassification of ecological status. Tools for the estimation of uncertainty are, for instance, given by Clark (2004)[11] and Brown and Heuvelink (2005)[12].

[9] CIS WG 2.3, 2003. Guidance on establishing reference conditions and ecological status class boundaries for inland surface water. - http://www.minenv.gr/pinios/00/odhgia/7th_draft_refcond_final.pdf

[10] Olsauskyte, V. and van de Bund, W., 2007. WFD intercalibration technical report. Joint Research Centre, Ispra. - http://forum.europa.eu.int/Public/irc/jrc/jrc_eewai/library?l=/intercalibration_2&vm=detailed&sb=Title

[11] Clark, R.T., 2004. Error/uncertainty module software STARBUGS. User manual. CEH, Dorchester. - http://www.ceh.ac.uk/products/software/software_starbugs.html

[12] Brown, J.D. and Heuvelink, G.B.M., 2005. Data Uncertainty Engine (DUE) - User's Manual. University of Amsterdam and Wageningen University and Research Centre, Amsterdam and Wageningen. - http://161.67.10.126/harmonirib/download/WP2/DUE_MANUAL_V3.0.pdf

ANNEX 3

COMMUNICATION PAPER ON GENERAL PRINCIPLES, AIMS AND METHODS OF THE WFD INTERCALIBRATION EXERCISE

Communicating the intercalibration exercise in the Danube River Basin – general principles and methods of intercalibration

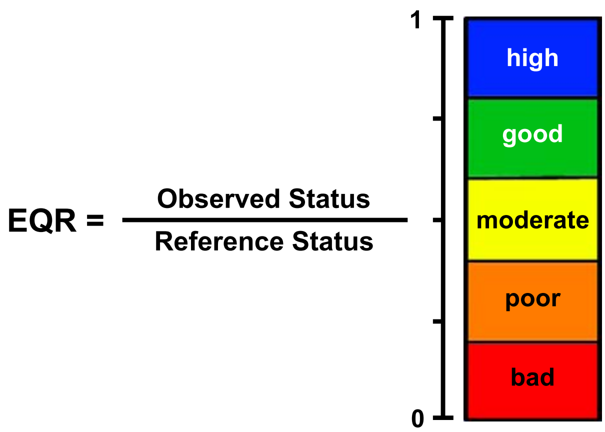
A. Background

A main environmental objective of the EU Water Framework Directive (WFD) is to achieve "good ecological status" of all surface waters by 2015[13]. Status monitoring of water bodies is done by individual Member States using biological quality assessment methods. Comparability of monitoring results is ensured by means of the intercalibration exercise. Aim of intercalibration is the Europe-wide harmonised definition of "good ecological status" according to Annex V of the WFD for all surface water categories (rivers, lakes, transitional and coastal waters) and Biological Quality Elements.

B. Characteristics of national methods to monitor ecological water body status

The Water Framework Directive provides the basis for water body monitoring: Distinct groups of aquatic plants and animals (Biological Quality Elements) have to be monitored. These groups are able to indicate various pressures on water bodies like man-made modification, pollution or acidification.

The classification of the ecological water body status is based on biological assessment methods using certain indicative parameters of the Biological Quality Elements (e.g. taxa composition and abundance, taxa diversity, ratio sensitive to insensitive taxa etc.; Table 1). The water body status not influenced by anthropogenic activity (=reference state) is the benchmark for assessment. For each water body type individual reference states are defined. Quality assessment results in Ecological Quality Ratios - numerical values representing relative agreement with the reference state. Depending on the degree of agreement ecological status is classified as "high", "good", "moderate", "poor" or "bad" (Figure 1).



[13] European Commission, 2000. Directive 2000/60/EC. Establishing a framework for community action in the field of water policy. European Commission PE-CONS 3639/1/100 Rev 1, Luxembourg.

Figure 1: Ecological Quality Ratio (EQR) and quality status classification

National methods to monitor the ecological status of the Biological Quality Elements differ between Member States. These differences are due to the specific environmental conditions of a country, the diverse types of pressure acting at water bodies, as well as the non-uniform techniques of sampling and data analysis. While for the medium term harmonisation of sampling and data analysis is planned by the European Standardisation Committee (CEN)[14], a general standardisation of biological assessment methods is not foreseen. Therefore, the intercalibration exercise is required.

Table 1: Indicative parameters to be included in biological assessment methods for certain surface water categories and BQEs ([a] undesirable disturbance to the balance of organisms or water quality, [b] only lakes, [c] only Macroalgae)

Surface Water Category	Biological Quality Element	Taxonomic composition	Abundance	Ratio sensitive to insensitive taxa	Diversity	Age structure	Frequency and intensity of algal blooms	Secondary effects[a]	Bacterial tufts	Biomass	Absence of major taxonomic groups	Taxa indicative of pollution
Rivers and Lakes	Phytoplankton	x	x				x	x		x[b]		
	Macrophytes and Phytobenthos	x	x					x	x			
	Benthic invertebrate fauna	x	x	x	x						x	
	Fish fauna	x	x	x		x						
Transitional Waters	Phytoplankton	x	x				x	x		x		
	Macroalgae and Angiosperms	x	x					x[c]				
	Benthic invertebrate fauna		x	x	x							x
	Fish fauna	x	x	x								
Coastal Waters	Phytoplankton	x	x				x	x		x		
	Macroalgae und Angiosperms		x	x				x				
	Benthic invertebrate fauna		x	x	x							x

C. Organisation of the intercalibration exercise

The intercalibration exercise is carried out by the EU Member States and facilitated by the European Commission. As part of the Common Implementation Strategy (CIS) endorsed by the Water Directors the intercalibration is part of the international working group ECOSTAT (Ecological Status). To coordinate the scientific implementation of the intercalibration exercise, the "European Centre for Ecological Water Quality and Intercalibration (EEWAI)" of the Joint Research Centre in Ispra (Italy) has been established.

[14] Cardoso, A. C., A. G. Solimini, G. Premazzi, S. Birk, P. Hale, T. Rafael & M. L. Serrano, 2005. Report on Harmonisation of freshwater biological methods. EUR 21769 EN. European Communities, Ispra.

Currently, intercalibration is conducted for rivers, lakes, coastal and transitional waters, but only for selected water body types (intercalibration types), types of pressure and Biological Quality Elements. Intercalibration is carried out in so called Geographical Intercalibration Groups (GIGs) – larger geographical units including Member States with similar water body types.

D. Intercalibration types

Water bodies of comparable size, elevation, morphology and physico-chemistry in the same region show similar biological communities. This enables grouping of individual water bodies to water body types. The reference state - as benchmark of biological assessment - is specified by the biological, chemical and hydromorphological characteristics of the water body type.

Intercalibration types encompass water bodies of similar characteristics that can be found in different Member States (e.g. small sandy rivers of the Hungarian Lowlands, shallow mesohaline coastal waters of the Black Sea). The delineation of intercalibration types is based on parameters like ecoregion, size, altitude, geology or salinity (Table 2).

In general, the intercalibration typology does not cover the complete national water body typology. Several national types can possibly belong to a single intercalibration type, or one intercalibration type is related to only a part of a national type.

Intercalibration of biological assessment methods is taking place among Member States belonging to the same Geographical Intercalibration Group that share a common intercalibration type.

Table 2: Common intercalibration types of the Eastern Continental GIG

abbreviation	type-name	ecoregion	catchment	altitude	geology	substrate
R-E1	Carpathians: small to medium, mid-altitude	10	10 - 1000	500 - 800	siliceous	gravel and boulder
R-E2	Plains: medium-sized, lowland	11 and 12	100 - 1000	< 200	mixed	sand and silt
R-E3	Plains: large and very large, lowland	11 and 12	> 1000	< 200	mixed	sand, silt and gravel
R-E4	Plains: medium-sized, mid-altitude	11 and 12	100 - 1000	200-500	mixed	sand and gravel
R-E6	Danube River: middle and downstream	11 and 12	> 131000	< 134	mixed	gravel and sand

E. Intercalibration network

The Water Framework Directive stipulates to establish an intercalibration network. For each intercalibration type Member States were asked to nominate two sites representing the upper ("high-good") and lower ("good-moderate") boundary of good ecological status according to the national assessment method. These intercalibration sites are compiled in the intercalibration register that has been published as a Commission Decision[15].

Although prescribed by the WFD the intercalibration sites are of limited benefit for the actual intercalibration exercise. On the one hand intercalibration makes use of statistical approaches that require extensive environmental data from sites in different ecological status. On the other hand the intercalibration register has been designed in the year 2003 when most Member States held neither WFD compliant assessment methods nor sufficient data to precisely evaluate the ecological status of the denominated intercalibration sites.

F. Intercalibration approaches

Purpose of intercalibration is to ensure Europe-wide harmonised classification of good ecological status by the national assessment methods. Put simply, intercalibration shall assure that, for instance, a Romanian water body in good status according to the Romanian assessment method would be classified as “good” by the Slovak or Bulgarian method, if the same water body would be located at a Slovak or Bulgarian river.

By setting normative definitions for ecological status classification the WFD establishes a basis for harmonised assessment. In the intercalibration exercise these definitions are specified for the individual Biological Quality Elements and their indicative parameters.

In general, intercalibration is carried out in a two-step approach:

1. Comparison of good quality status boundaries of national assessment methods

The ecological status is delimited by an upper (“high-good”) and lower (“good-moderate”) boundary. Within the intercalibration exercise these boundaries are compared among national assessment methods. Three different options are applied:

Option 1: Use of identical assessment methods. If countries are using the same assessment method in quality monitoring, the quality boundaries can be compared directly between countries.

Option 2: Use of common metrics. The purpose of common metrics is to translate the results of national assessment methods into a general, thus comparable format. By means of statistical methods national boundary values are transformed into common metric values (Figure 2)[16]. Unlike nationally adapted methods common metrics are not designed for quality monitoring due to their unspecific character.

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[15] European Commission, 2005: Commission Decision of 17 August 2005 on the establishment of a register of sites to form the intercalibration network in accordance with Directive 2000/60/EC of the European Parliament and of the Council.

[16] Buffagni, A., S. Erba, S. Birk, M. Cazzola, C. Feld, T. Ofenböck, J. Murray-Bligh, M. T. Furse, R. T. Clark, D. Hering, H. Soszka & W. v. d. Bund, 2005. Towards European Inter-calibration for the Water Framework Directive: Procedures and examples for different river types from the E.C. project STAR. 11th STAR deliverable. STAR Contract No: EVK1-CT 2001-00089. Quad. Ist. Ric. Acque 123: 1-468.

Option 3: Direct comparison of national class boundaries at intercalibration sites. Under certain conditions the application of different national assessment methods to the same sampling site enables direct boundary comparison. For statistical reasons this option encompasses more data than those included in the official intercalibration register[17].

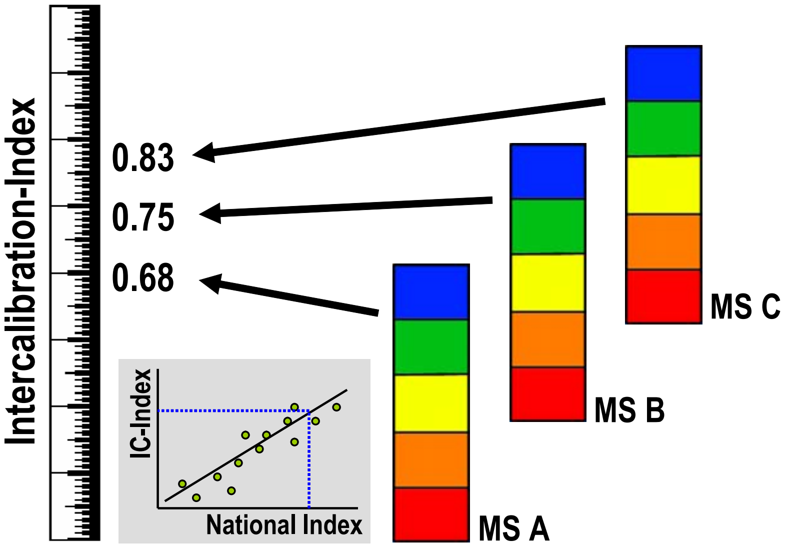

Figure 2: Translation of Member States' (MS) class boundary values into Intercalibration Index (common metric) using linear regression analysis.

2. Adaptation of national class boundaries to international requirements

In the intercalibration process threshold values for individual parameters of the Biological Quality Elements are defined, mostly backed by up-to-date knowledge on structural and functional aspects of aquatic ecosystems influenced by human activity. For example: Nutrient enrichment caused by farming leads to accelerated growth of phytoplankton in a lake. Water transparency becomes reduced and results in a loss of macrophytes growing on the lake bottom. The maximum phytoplankton concentration that has no effect on the lake's macrophyte composition can be defined as an ecologically derived threshold value.

Within the Geographical Intercalibration Groups the agreement on threshold values for the biological parameters establishes international benchmarks used in intercalibration. With reference to these harmonised values the national class boundary settings are compared. If significant deviations of national boundaries from the benchmark are identified, Member States are asked to adjust to the international specifications.

[17] Birk, S. & D. Hering, 2006. Direct comparison of assessment methods using benthic macroinvertebrates: a contribution to the EU Water Framework Directive intercalibration exercise. Hydrobiologia 566: 401-415.

Methods and results of intercalibration for the individual Biological Quality Elements are documented in the Intercalibration Technical Reports[18]. In general, Intercalibration Option 2: Use of common metrics is most frequently used.

G. Conclusions and Outlook

The intercalibration forms an obligatory step in the implementation of the WFD. Moremore, it represents a platform for a pan-European dialogue on environmental objectives and the quality assessment of ecological surface water status. The WFD required both the finalisation of the intercalibration exercise and the start of quality monitoring programmes by end of 2006. Due to this tight schedule national development of assessment methods and international comparison of quality class boundaries currently run in parallel.

The intercalibration of methods using benthic macroinvertebrates in rivers holds a leading role in the overall technical implementation. These methods have a long tradition in European water quality assessment and are thus based on sound principles, validated techniques and a large quantity of existing data. For other Biological Quality Elements (phytoplankton, macrophytes and phytobenthos, fish fauna) or water categories (lakes, transitional and coastal waters) intercalibration enables international cooperation in the early stages of method development aiming at harmonised definition of good ecological status. Nevertheless, the intercalibration process itself still allows for tailor-made assessment methods following the individual requirements of the Member States.

In European water policy the entire intercalibration process represents a thematic and organisational novelty. Its extension to end of 2007 is decided in order to ensure proper fulfilment. Furthermore, it is considered to start a second round of intercalibration beyond 2007 to overcome current difficulties such as data gaps and lacking national assessment methods.

[18] Olsauskyte, V. & W. van de Bund, 2007. WFD intercalibration technical report. Joint Research Centre, Ispra. - http://forum.europa.eu.int/Public/irc/jrc/jrc_eewai/library

ANNEX 4

CONTRIBUTION TO THE TISZA RIVER BASIN MANAGEMENT PLAN 2009: “RIVER TYPES, REFERENCE CONDITIONS AND WATER BODIES IN THE TRB”

THE TISZA RIVER AND ITS MAIN TRIBUTARIES

With 966 km the Tisza River is the longest tributary of the Danube, and the second largest by flow, after the Sava River. The Tisza River Basin drains an area of 157,186 km² in five countries: Ukraine, Romania, Hungary, Slovak Republic, Serbia. The drainage basin encompasses 24 main tributaries, 17 2nd order tributaries and 10 3rd order tributaries.

The Tisza can be divided into three main sections:

- the mountainous **Upper Tisza** in Ukraine, upstream of the Ukrainian-Hungarian border (Vilok – Tiszabecs),
- the **Middle Tisza** in Hungary and partly in Ukraine, which is joined by large tributaries including the Bodrog and the Slaná/Sajó (both fed by water from the Carpathian Mountains in Slovakia and Ukraine), as well as the Somes/Szamos, the Crisul/Körös River System and the Mures/Maros from Transylvania,
- the **Lower Tisza** downstream of the Hungarian-Serbian border, fed directly by the Bega/Begej, and indirectly by other tributaries via the Danube – Tisza – Danube Canal System.

CHARACTERISATION OF SURFACE WATERS

1 Ecoregions in the Tisza River Basin

The Tisza River Basin (TRB) covers two ecoregions or parts thereof (see **Table 1).** Ukraine, Romania and Slovak Republic have territories in both ecoregions. Hungarian and Serbian parts of the TRB belong to ecoregion 11 (Hungarian Lowland).

Table 1 Ecoregions in the TRB

Ecoregion	Countries with territories in the TRB
10 – The Carpathians	Ukraine, Romania, Slovak Republic
11 – Hungarian Lowlands	Ukraine, Romania, Hungary, Slovak Republic, Serbia

In three countries (Hungary, Ukraine and Romania) the ecoregions were divided into smaller geographical regions to address differences in river types based on different landscape features or differences in the natural vegetation or aquatic communities.

Hungary subdivided ecoregion 11 (Hungarian Lowland) into five sub-ecoregions based on the topography and the (hydro-)geochemical character of the region. The definition of Ukrainian sub-ecoregions based on geographic and natural vegetation is under development. For the eastern part of the ecoregion 10 (The Carpathians) the sub-ecoregion "Eastern-Carpathian biogeographical sub-province, Zakarpattya district" was described. For the ecoregion 11 (Hungarian Lowland) the sub-ecoregion "Forest-step province, Zakarpattya lowlands" was delineated. Romania introduced a new sub-ecoregion within ecoregion 10, the Carpathians. This sub-ecoregion is the Transylvania Plateau, an inner mountain area that shows differences in altitude, geomorphology and in the macroinvertebrate communities. For this reason three sub-ecoregions or bio-ecoregions were delineated for the ecoregion 10 and six for the ecoregion 11 (see **Table 2**).

Table 2 Sub-ecoregions or bio-ecoregions in the TRB

Ecoregion	Country	Sub-ecoregions or bio-ecoregions
10	Ukraine	Eastern-Carpathian biogeographical sub-province, Zakarpattya district
	Romania	Carpathian Intramountain area
11	Ukraine	Zakarpattya lowlands / Forest-steppe province
	Hungary	Mountainous regions with calcareous character
		Mountainous regions with siliceous character
		Hilly regions with calcareous covering layers
		Plains with calcareous covering layers
		Peaty areas

2 Typology of the Rivers in the Tisza River Basin

2.1 Typology Systems used in the TRB

Most countries in the Tisza River Basin (Ukraine, Romania, Hungary and Serbia) applied System B according to Annex II of the WFD. Only the Slovak Republic used System A.

The common factors used in all TRB typologies are the obligatory factors of System A: ecoregion, altitude, catchment area and geology (see **Table 3**). But most of the countries amended the classification according to their national requirements. Their use in the TRB is described below.

Table 3 Obligatory factors used in river typologies

Descriptor	Country	Class boundaries			
altitude	WFD	0-200 m	200-800 m		>800 m
	Ukraine	0-200 m	200-800 m		>800 m
	Romania	0-200 m	200-500 m	500-800 m	>800 m
	Hungary	0-100 m	100-200 m	200-500 m	>500 m
	Slovak Republic	0-200 m	200-500 m	500-800 m	>800 m
	Serbia	0-200 m	200-500 m	500-800 m	>800 m
catchment area	WFD	10-100 km2	100-1,000 km2	1,000-10,000 km^2	>10,000 km^2
	Ukraine	10-100 km2	100-1,000 km2	1,000-10,000 km^2	>10,000 km^2

	Romania	10-100 km2	100-1,000 km2	1,000-10,000 km²	>10,000 km²	
	Hungary	10-200 km2	100-2,000 km2	1000 -12,000 km2	>10,000 km2	
	Slovak Republic	10-100 km2	100-1,000 km2	>1,000 km²		
	Serbia	10-100 km2	100-1,000 km2	1,000-4,000 km²	4,000-10,000 km²	>10,000 km2
geology	WFD	siliceous	calcareous	organic		
	Ukraine	siliceous	calcareous	organic		
	Romania	siliceous	calcareous	organic		
	Hungary	siliceous	calcareous	organic		
	Slovak Republic	mixed				
	Serbia	siliceous	calcareous	organic		

Altitude

Ukraine applied the size-classes according to Annex II of the WFD. The other countries set an additional class boundary at 500 m. Since most of the Hungarian territory is located in the lowlands, class boundaries were adapted in this regard.

Catchment area

In general, the size classes of System A were applied. Hungary, Slovak Republic and Serbia introduced other class boundaries than those suggested in the WFD. Hungary established overlapping class boundaries accounting for the continuous changes observed in natural systems. Large rivers were not differentiated into several size classes in the Slovak Republic. All rivers > 1.000 km² were pooled in one size-class. Serbia defined an additional catchment area boundary at 4000 km².

Geology

The Directive delineates three main categories for geology: siliceous, calcareous and organic. These categories were refined by most of the countries. The Slovak Republic only used the category "mixed" in their typology system.

Optional factors

Countries using **System B** used different optional factors to further describe the river types. With six descriptors Romania employed the highest number of optional factors (mean water slope, river discharge category, mean substratum composition, mean air temperature, precipitation and yearly minimum specific monthly flow with 95% probability). All other countries used mean substrate composition as the only optional factor within their System B typology (see **Table 4**).

Channel substrate is differently defined by the countries. Both Ukraine and Romania specified the substrate diameter (d) to differentiate size classes, but boundaries were different: Romania defined blocks with d >200 mm, boulders with d = 70 to 200 mm, gravel with d = 2 to 70 mm, sand with d = 0.05 to 2 mm, silt with d = 0.05 to 0.005 mm and clay with d <0.005 mm. Ukraine delineated gravel and pebble with d < 70 mm, pebble and boulder with d = 70 to 150 mm and boulder with d > 150 mm. Hungary and Serbia differentiated the substrate size classes "fine", "medium" and "coarse". For the Hungarian system fine substrates are "mud", medium substrates are "sand" and coarse substrates are "cobbles and pebbles". In Serbia a mixture of clay, silt, sand and gravel is fine substrate, a mixture of sand, gravel and cobbles is medium substrate and gravel, cobbles and boulders constitute coarse substrates.

Table 4 Optional factors used in the river typologies by countries using System B

<table>
<tr><th>Descriptor</th><th>Country</th><th colspan="6">Class boundaries</th></tr>
<tr><td>mean water slope</td><td>Romania</td><td colspan="2"><10 p.m.</td><td colspan="2">10-40 p.m.</td><td colspan="2">>40 p.m.</td></tr>
<tr><td>river discharge</td><td>Romania</td><td colspan="2">high:
>30 l/s km^2</td><td colspan="2">average:
3-30 l/s km^2</td><td colspan="2">minimum:
<3 l/s km^2</td></tr>
<tr><td rowspan="4">mean substratum composition</td><td>Ukraine</td><td colspan="2">gravel-pebble</td><td colspan="2">pebble-boulder</td><td colspan="2">boulder</td></tr>
<tr><td>Romania</td><td>blocks</td><td>boulders</td><td>gravel</td><td>sand</td><td>silt</td><td>clay</td></tr>
<tr><td>Hungary</td><td colspan="2">fine</td><td colspan="2">medium</td><td colspan="2">coarse</td></tr>
<tr><td>Serbia</td><td colspan="2">fine</td><td colspan="2">medium</td><td colspan="2">coarse</td></tr>
<tr><td>mean air temperature</td><td>Romania</td><td colspan="2">high: >8 °C</td><td colspan="2">average: 0-8 °C</td><td colspan="2">low: <0 °C</td></tr>
<tr><td>precipitation</td><td>Romania</td><td colspan="2">abundant:
>800 mm</td><td colspan="2">average:
500-800 mm</td><td colspan="2">reduced:
<500 mm</td></tr>
<tr><td>yearly minimum specific monthly flow with 95% probability</td><td>Romania</td><td colspan="2">high:
>2 l/s km^2</td><td colspan="2">average:
0.3-2 l/s km^2</td><td colspan="2">minimum:
<1 l/s km^2</td></tr>
</table>

2.2 Typology of the Tisza River

The Tisza flows through or borders on territories of five countries (Ukraine, Romania, Hungary, Slovak Republic and Serbia). These countries divided the Tisza River into eight types altogether (see **Table 5**). The typologies of the Tisza River were individually developed by the countries. Adjustment or harmonisation on international level has not yet been completed. Therefore, 5 types were identified for the Upper Tisza: the Ukraine delineated three types and both Romania and Slovak Republic one type. For the Middle Tisza two types of the Hungarian typology were delineated, and for the Lower Tisza one type by Serbia.

Table 5 Stream types defined for the Tisza River

Country	No	Name of the types
Ukraine	3	UA_2C: Large rivers, low mountains, calcareous
		UA_1C: Large rivers, lowland
		UA_1D: Very large river, lowland
Romania	1	RO_06: Stream sector with wetlands in hilly or plateau area
Hungary	2	HU_14: Very large calcareous lowland stream
		HU_20: Very large calcareous lowland river
Slovak Republic	1	P1V_B1Large streams in Hungarian lowland
Serbia	1	CS_Typ1.1: Very large rivers, lowland, siliceous, fine sediments

2.3 Typology of the relevant tributaries in the TRB

In total, 40 stream types have been defined at relevant rivers of the Tisza River Basin with catchment size >1,000 km² (see **Table 6**). In **Annex xy** all stream types at relevant rivers are listed. This includes the eight types for the Tisza River itself.

Table 6 Number of stream types defined in the TRB

Country	Number of stream types defined for the relevant rivers in the TRB
Ukraine	7
Romania	12
Hungary	11
Slovak Republic	7
Serbia	3
Total number of types	40

The types of the TRB are evenly distributed on both ecoregions (see **Table 7**). Only three types were delineated for the altitude class >800 m. The other types were described for the low and medium altitude range. For each small, medium and large rivers approximately the same number of types was defined, considering that small and medium-sized rivers are merged in the Romanian typology. For the very large rivers only 4 types were differentiated. The ratio siliceous to calcareous stream types is approximately 1:1, only a few types were described as being of mixed geology.

Table 7 Number of types per ecoregion, altitude, catchment size and geology class

<table>
<tr><th rowspan="2"></th><th colspan="5">Countries</th><th rowspan="2">Total number</th></tr>
<tr><th>Ukraine</th><th>Romania</th><th>Hungary</th><th>Slovak Republic</th><th>Serbia</th></tr>
<tr><td colspan="7">Ecoregion</td></tr>
<tr><td>Ecoregion 10</td><td>5</td><td>7</td><td>-</td><td>6</td><td>-</td><td>18</td></tr>
<tr><td>Ecoregion 11</td><td>2</td><td>5</td><td>11</td><td>1</td><td>3</td><td>22</td></tr>
<tr><td colspan="7">Altitude</td></tr>
<tr><td><200 m</td><td>2</td><td>5</td><td>8</td><td>1</td><td>3</td><td>19</td></tr>
<tr><td>200-800 m</td><td>3</td><td>6</td><td>3</td><td>6</td><td>-</td><td>18</td></tr>
<tr><td>>800 m</td><td>2</td><td>1</td><td>-</td><td>-</td><td>-</td><td>3</td></tr>
<tr><td colspan="7">Catchment size</td></tr>
<tr><td>small rivers</td><td>2</td><td rowspan="2">5</td><td>3</td><td>2</td><td>-</td><td rowspan="2">20</td></tr>
<tr><td>medium-sized rivers</td><td>2</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>large rivers</td><td>2</td><td>7</td><td>3</td><td>3</td><td>1</td><td>16</td></tr>
<tr><td>very large rivers</td><td>1</td><td>-</td><td>2</td><td>-</td><td>1</td><td>4</td></tr>
<tr><td colspan="7">Geology</td></tr>
<tr><td>siliceous</td><td>-</td><td>12</td><td>-</td><td>-</td><td>3</td><td>15</td></tr>
<tr><td>calcareous</td><td>7</td><td>-</td><td>11</td><td>-</td><td>-</td><td>18</td></tr>
<tr><td>organic</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0</td></tr>
<tr><td>mixed</td><td>-</td><td>-</td><td>-</td><td>7</td><td>-</td><td>7</td></tr>
</table>

3 Reference conditions

Annex II 1.3 (i) WFD prescribes, that for each surface water type, type-specific hydromorphological and physico-chemical conditions shall be established representing the values of the hydromorphological and physico-chemical quality elements specified for that surface water type at high ecological status. Type-specific biological reference conditions shall be established, representing the values of the biological quality elements for that surface water type at high ecological status.

On the level of the Danube River Basin countries have agreed on general criteria as a common base for the definition of reference conditions (see **Table 8**). These have then been further developed by the countries of the TRB on the national level into type-specific reference conditions.

The definition of reference conditions was based on the following approaches:

- spatially based approach using data from monitoring sites, or
- approach based on predictive modelling, or
- definition of temporally based reference conditions using either historical data or palaeo-reconstruction, or
- use of expert judgement (where none of the above methods was possible).

Spatially based reference conditions and expert judgement were the two methods predominantly used in the TRB. Methods were also combined to derive reference conditions.

Use of spatially based data from monitoring sites

The method is based on the use of existing sites of high ecological status. In the TRB (as in other European river basins) only few reference sites are available, which fulfil all criteria mentioned in **Table 8**. Especially in the lowlands, and for large rivers, undisturbed reference sites do not exist anymore. Therefore, the description of reference conditions was based on best available sites for these types. This method was used by all countries to describe the reference conditions for benthic invertebrates, phytoplankton and the fish fauna.

Use of expert judgement

In addition to spatially based reference sites, most countries applied expert judgement for deriving reference conditions for respective biological quality elements and the physico-chemical and hydromorphological elements.

Historical reconstruction

Historical data were frequently applied to define reference conditions for benthic invertebrate communities, the fish fauna and hydromorphology.

Predictive modelling

Predictive modelling was used to define macrozoobenthos and phytobenthos reference conditions in the Slovak Republic. Ukraine and Serbia applied this approach for defining the physico-chemical aspect of the references.

Table 8 Basic criteria for defining reference conditions (harmonised basin-wide)

Basic statements	
	Reference conditions must be reasonable and politically acceptable.
	Reference sites have to include important aspects of "natural" conditions.
	Reference conditions should reflect no or minimum stress.
Land use in catchment area	
	Influence of urbanisation, land use and forest management should be as low as possible.
Stream and habitats	
	Reference sites should be covered by natural climax vegetation or unmanaged forests.
	No removal of coarse woody debris.
	No bed or bank fixation.
	No obstructions that hinder the migration of organisms or the transport of bed material.
	Only minor influence due to flood protection measures.
Bank and floodplain vegetation	
	Bank and floodplain vegetation should be present to allow lateral migration.
Hydrology and water management	
	No alteration of natural discharge regime.
	No or only minor alteration of hydrology by dams, reservoirs, weirs, or sediment retaining structures affecting the site.
	No or only minor alteration of hydrology by dams, reservoirs, weirs, or sediment retaining structures affecting the site.
	No alteration of regime due to water diversion, abstraction, and no pulse releases.
Physico-chemistry	
	No point source of organic pollution.
	No point source of nutrient pollution.
	No sign of diffuse pollution inputs.
	No acidification.
	No liming.
	No alteration of natural thermal regime.
	No salinisation.
Biology	
	No significant impairment of the indigenous biota by introduction of animals and plants (e.g. in the frame of fish farming).
Stream morphology	
	Morphological alterations do not influence biodiversity and ecological functioning.
Biomanipulation	
	No biomanipulation (e.g. in lakes).
Recreation uses	
	No intensive recreational use.

Biological quality elements

The TRB countries defined reference conditions for all relevant biological quality elements except 'macrophytes and phytobenthos' that was not described by Ukraine (**Table 9**).

The TRB countries used different indicative parameters to describe the reference conditions for **phytoplankton**: Taxonomic composition was applied by all countries. Abundance is considered by all countries except Ukraine. The Slovak Republic additionally used phytoplankton biomass. The Saprobic Index applied to phytoplankton taxa is used by Romania for reference definition.

For the biological element '**macrophytes and phytobenthos**' all countries (except Ukraine) defined the reference conditions for taxonomic composition and abundance. Romania defined reference conditions for phytobenthos; the description of macrophytic references is under development. Hungary used abundance only for macrophytes, while Serbia defined this parameter only for phytobenthos. Furthermore, Serbia added the parameter diversity to the description of reference state.

The variables taxonomic composition, abundance, diversity and the ratio sensitive to insensitive taxa were used by all countries to define reference conditions for **benthic invertebrates**. Romania defined type-specific reference values for the Saprobic Index and for various other metrics (e.g. total number of taxa, percent of Plecoptera taxa, Mayfly Average Score).

Reference values for the **fish fauna** were used by all countries, but different indicative parameters were applied: Taxonomic composition was defined by all countries. Age structure was considered by Romania, Hungary and Serbia. In addition Serbia described fish diversity in reference state. The ratio 'sensitive to insensitive fish taxa' was applied by Ukraine and Romania. In the Slovak Republic the definition of fish fauna references is in preparation.

The **hydromorphological** and **physico-chemical** reference conditions for rivers were defined by Ukraine, Hungary and Serbia. For both Slovak Republic and Romania the definition is still under development.

Table 9 Definition of reference conditions for different indicative parameters of biological quality elements (x – parameter applies to quality element)

		taxonomic composition	abundance	diversity	sensitive to insensitive taxa	age structure	biomass
Ukraine	Phytoplankton	x			x		
	Macrophytes and Phytobenthos						
	Benthic Invertebrates	x	x	x	x		
	Fish Fauna	x			x		
Romania	Phytoplankton	x	x				
	Macrophytes and Phytobenthos	x	x				
	Benthic Invertebrates	x	x	x	x		
	Fish Fauna	x	x		x	x	
Hungary	Phytoplankton	x	x				
	Macrophytes and Phytobenthos	x	x1				
	Benthic Invertebrates	x	x	x			
	Fish Fauna	x	x			x	
Slovak Republic	Phytoplankton	x	x	x	x		x
	Macrophytes and Phytobenthos	x	x	x	x		
	Benthic Invertebrates	x	x	x	x		
	Fish Fauna	x	x				
Serbia	Phytoplankton	x	x	x			
	Macrophytes and Phytobenthos	x	x1	x			
	Benthic Invertebrates	x	x	x			
	Fish Fauna	x	x	x		x	

[1] **only Macrophytes**

4 IDENTIFICATION OF SURFACE WATER BODIES

According to Annex II 1.1 WFD *"Member States shall identify the location and boundaries of bodies of surface water …"*. *"A body of surface water means a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water"* (Art. 2. 10. WFD).

Water bodies need to be clearly identified. Certain rules apply for their delineation. For this initial characterisation water bodies may also be aggregated to form groups of water bodies of similar character. The surface water categories have been identified in **Chapter xy**. The water bodies described here refer to the Tisza River Basin overview map (see **Map xy**), i.e. to those relevant on the basin-wide level. All other water bodies are dealt with in detail in the National Reports (Part B). Ukraine has not finalised the identification of water bodies.

16 water bodies were identified on the Tisza River. The number of water bodies on the Tisza varied per country, e.g. on the Hungarian part of the Tisza 7 water body were delineated, on the Romanian and Slovakian part only one. This means that the size of the water bodies also varies significantly. The smallest water body on the Tisza is only 5 km long (Slovak Republic), the longest is 159 km (Hungary). **Table 10** and **11** give an overview of the number of water bodies identified on rivers. So far, 203 water bodies have been identified on the tributaries on the overview scale. Romania has the largest number of water bodies but also the largest part of the basin. The mean length of water bodies is 37 km on the tributaries, on the Tisza it is 62 km.

Table 10 Number and lengths of water bodies at the Tisza River

country	number	mean length [km]	min [km]	max [km]
Ukraine	5	35,5	13	75
Romania	1	61	-	-
Hungary	7	83,5	21	159
Slovak Republic	1	5	-	-
Serbia	2	80,5	63	98
	Σ 16			

Table 11 Number and lengths of water bodies at tributaries of the TRB

country	number	mean length [km]	min [km]	max [km]
Ukraine	17	34	6	65
Romania	100	38,5	1	142
Hungary	43	39,5	7	94
Slovak Republic	30	34	5	91
Serbia	13	39,5	13	81
	Σ 203			

Table 12 and **13** give an overview of the main pressures at water bodies of the Tisza and tributaries. For the Tisza water bodies various pressures were determined. Morphological degradation is the most frequently specified for water bodies at tributaries.

In summary, Ukraine, Romania, Slovak Republic and Serbia identified morphological degradation and pollution at most of the tributary water bodies (both 30 %), followed by alteration of hydrological regime (24 %) and fishing/angling (16 %).

Table 12 Main pressures at water bodies of the Tisza River

country	total number of WBs	main pressure (named most frequently)
Ukraine	5	pollution, flood protection, fishing/angling
Romania	1	mining (UA), flood protection, fishing/angling
Hungary	7	no information
Slovak Republic	1	pollution, structural degradation
Serbia	2	agricultural, urban and industrial land use, damming, navigation

Table 13 Main pressures at water bodies of tributaries in the TRB

country	total number of WBs	main pressure (named most frequently)
Ukraine	17	fishing/angling
Romania	100	morphological degradation
Hungary	43	no information
Slovak Republic	30	morphological degradation
Serbia	13	alteration of hydrological regime

An overview of the number of Heavily Modified and Artificial Water Bodies in the TRB is given in **Table 14** and **15**. Nearly half of the water bodies at the Tisza River were provisionally identified as Heavily Modified Water Bodies (HMWB). At the tributaries 53 % of water bodies are provisionally designated HMWB. One-third of these water bodies are possible candidates for HMWB. At the Tisza no Artificial Water Bodies (AWB) are reported. 17 AWB were delineated at tributaries: 6 for Romania and 11 for Serbia.

Table 14 Number of Heavily Modified Water Body candidates (cand. HMWB) and Artificial Water Bodies (AWB) at the Tisza River

country	total number of WBs	cand. HMWB	AWB
Ukraine	5	0	0
Romania	1	1	0
Hungary	7	3	0
Slovak Republic	1	0	0
Serbia	2	2	0

Table 15 Number of Heavily Modified Water Body candidates (cand. HMWB) and Artificial Water Bodies (AWB) at tributaries in the TRB

country	total number of WBs	cand. HMWB	AWB
Ukraine	17	1	0
Romania	100	33 (plus 29 "possibly")	6
Hungary	43	7 (plus 10 "possibly")	0
Slovak Republic	30	4 (plus 21 "possibly")	0
Serbia	13	2	11

ANNEX

Overview of all types for relevant rivers with catchment size >1,000 km² in the Tisza River Basin

Country	Code	Name of river type
Ukraine	UA_ 2A	Small rivers, calcareous, low-mountain
	UA_ 3A	Small rivers, calcareous, mid-mountain
	UA_ 2B	Medium rivers, calcareous, low-mountain
	UA_ 3B	Medium rivers, calcareous, mid-mountain
	UA_ 1C	Large rivers, lowland
	UA_ 2C	Large rivers, low-mountain
	UA_ 1D	Very large river, lowland
Romania	RO_01	Mountain stream - Ecoregion 10
	RO_02	High plateau or piedmonts stream - Ecoregion 10
	RO_03	Stream sector in piedmont or high plateau area - Ecoregion 10
	RO_04	Stream sector in hilly or plateau area - Ecoregion 10
	RO_05	Stream sectors in intramountain depression - Ecoregion 10
	RO_06	Stream sector with wetlands in hilly or plateau area - Ecoregion 10
	RO_08	Stream sector in hilly or plateau area - Ecoregion 10
	RO_10	Stream in plain area - Ecoregion 11
	RO_11	Stream sector in plain area (1,000-3,000 km²) - Ecoregion 11
	RO_12	Stream sector in plain area (>3,000 km²) - Ecoregion 11
	RO_13	Stream sector with wetlands in plain area - Ecoregion 11
	RO_32	Temporary stream in plain area - Ecoregion 11
Hungary	HU-Type 2	Small calcareous mountainous stream
	HU-Type 5	Medium calcareous hilly stream
	HU-Type 6	Large calcareous hilly stream
	HU-Type 13	Large calcareous lowland stream
	HU-Type 14	Very large calcareous lowland stream
	HU-Type 15	Small calcareous lowland brook
	HU- Type 16	Small with low slope calcareous lowland stream
	HU- Type 17	Medium with low slope calcareous lowland stream
	HU-Type 18	Middle calcareous lowland stream
	HU-Type 19	Large calcareous lowland streams

	HU-Type 20	Very large calcareous lowland river
Slovak Republic	P1V - B1	Large streams, < 200 m, in Hungarian lowland
	K2V - H1	Large streams, 200-500 m, Carpathians
	K2V - H2	Large streams, 200-500 m, Carpathians
	K2M	Small streams, 200-500 m, Carpathians
	K3M	Small streams, 500-800 m, Carpathians
	K2S	Middle size streams, 200-500 m, Carpathians
	K3S	Middle size streams, 500-800 m, Carpathians
Serbia	CS_Typ1.1	Very large rivers, lowland, siliceous, fine sediments
	CS_V1_P4_SIL	Large rivers, lowland, siliceous
	CS_V1_P3_SIL	Medium rivers, lowland, siliceous

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