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Report on the

Central Baltic River GIG
Macrophyte Intercalibration Exercise

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Abbreviations

AIM Rivers	Austrian Index for Macrophytes in Rivers
AT	Austria
BE (FL)	Belgium (Flanders)
BE (WL)	Belgium (Wallonia)
BQE	Biological Quality Element
CBrivGIG	Central Baltic rivers Geographical Intercalibration Group
CZ	Czech Republic
DE	Germany
DK	Denmark
EQR	Ecological Quality Ratio
ES	Spain
FR	France
GM	Good-Moderate Quality Class Boundary
HG	High-Good Quality Class Boundary
IBMR	Indice Biologique Macrophytique en Rivière
IC	Intercalibration
ICM	Intercalibration Common Metric
IT	Italy
ITEM	Index of Trophy for European Macrophytes
ITEMcov	ITEM based on international abundance scale translated into cover percentages
LT	Lithuania
LU	Luxemburg
LV	Latvia
MIR	Polish Macrophyte Index for Rivers
MTR	Mean Trophic Ranking
NL	Netherlands
PL	Poland
R-C	Abbreviation of Common Intercalibration Types of the CBrivGIG
REF	Reference Value
RI	German Reference Index
RMNI	British River Macrophyte Nutrient Index
SE	Sweden
UK	United Kingdom

0 Executive Summary

National macrophyte assessment methods

- 7 countries and 8 regions (Austria, Belgium (FL), Belgium (WL), France, Germany, Great Britain, Netherlands, Poland) participate in the macrophyte intercalibration exercise for rivers.
- National assessment methods are designed to deliver diverse information on stream ecosystems. The majority of schemes focuses on the assessment of **nutrient enrichment** (France, Great Britain, Poland, Wallonia, partly Austria). A list of indicator taxa graded by their sensitivity to nutrient enrichment forms the principal component of this approach.
- The Dutch, Flemish and German macrophyte assessment methods are oriented towards the indication of **non-specific anthropogenic disturbance**. Besides compositional measures these schemes consider additional metrics such as richness and abundance of growth forms, or taxa richness and dominance.

Intercalibration typology for river macrophytes

- To adapt the intercalibration typology to the specific requirements of river macrophyte assessment, lowland types were further **sub-divided** based on the descriptors altitude, alkalinity and geology.

Common intercalibration database

- The common international database established for macrophyte intercalibration currently comprises approx. 1400 macrophyte survey data from about 1200 river sites in 16 countries. Data originate from national monitoring programmes or scientific projects.

International abundance scale

- To allow for common analysis of data national abundance values were assigned to one of five international abundance classes using expert judgement. This harmonisation was enabled by agreeing on common verbal descriptions of taxon abundances that surveyors come across in the field.

Common list of macrophyte taxa

- A common macrophyte list covering the operational taxa lists of all countries involved in intercalibration was built. Principal objective was to have a common basis for the selection of indicator taxa available as a reference for the comparison of national survey data and assessment methods.

Analysis using IC Option 2

- Main focus of the intercalibration analyses was the development and application of Intercalibration Common Metrics following the approaches of the invertebrate and phytobenthos intercalibration exercises.
- Intercalibration basics were established by setting up international macrophyte indicator scores related to nutrient pressure, compiling a list of type-specific international species response groups, and developing a common intercalibration metric to compare class boundaries of national methods assessing eutrophication.
- **Preliminary** analyses of boundary comparison between national methods for IC types R-C2, R-C3 and R-C4.x.2 are presented in this report. Instruments for the validation of

harmonised boundary setting are outlined (biological community aspects, pressure-impact relations).

Application of IC Option 3

- In an attempt to circumvent difficulties in applying Option 2 due to weak correlations between some national classifications and the common metric IC Option 3 was applied to three common river types.
- Most of the observed deviation between national classifications seemed to be caused by misinterpretation of data because of incompleteness for the national assessment method of other countries. Future adjustments of the analysis will most probably improve intercalibration according to Option 3.
- Option 3 will not produce intercalibration if national methods are measuring different aspects of the Biological Quality Element (BQE) or reflecting different pressures to which the BQE responds.
- In comparison to Option 2, it appears that countries falling outside the bands of acceptability in Option 3 must make quite substantial changes to their classifications in order to harmonise (based on the thresholds currently set).

Conclusions and outlook

- At the moment intercalibration tools are available to compare schemes focussing on nutrient pressure, or to intercalibrate at common types in which eutrophication gradients play the major role (mountain rivers).
- Joint evaluation of lowland datasets within the CBrivGIG intercalibration exercise revealed general agreement about type-specific biological communities at high status. This common view was not always reproduced by the classification results of national schemes.
- This suggests that a harmonisation of assessment concepts will facilitate the completion of intercalibration: Countries employing schemes focussing on the effects of nutrient pressure are recommended to additionally consider aspects of community richness and function.
- In this regard the development of an integrative common multi-metric index for lowland rivers has to be tackled, enabling an intercalibration according to IC Option 2.

Anticipated work plan

- It is planned to continue the work of the CBrivGIG macrophyte group covering
    - Compilation of additional data (2007 monitoring cycle),
    - Definition of a common reference basis,
    - Development of integrative common multi-metric index,
    - Analysis of amended national assessment methods,
    - Parallel continuation/advancement of IC Option 3 approach.

1 Introduction

A main environmental objective of the EU Water Framework Directive (WFD, European Commission 2000) is to achieve “good ecological status” of all surface waters by 2015. 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 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.

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.

This report presents the outcomes of the activities done within the Central-Baltic GIG on intercalibration of methods using river macrophytes. The contents result from 2-years work among national experts. During that time five whole-GIG meetings took place arranged by various national hosts. These gatherings always represented major steps forward in the implementation of macrophyte intercalibration, and the working group of national experts can be seen as the driving force of this exercise. In this regard this report contains the recent quintessence of extensive analytical and discursive efforts.

However, intercalibration of national macrophyte classifications has not yet been completed. Therefore, the report also describes the current obstacles that were identified by the group, and outlines the major steps towards successful implementation.

Acknowledgements

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2 National Assessment Methods

7 countries participate in the macrophyte intercalibration exercise of the CBrivGIG with 8 national or regional macrophyte assessment methods: Austria, Belgium (Flanders and Wallonia), France, Germany, Great Britain, the Netherlands and Poland. Table 1 provides an overview of their main characteristics. Almost all methods have recently been developed and are subject to amendments in the near future.

2.1 Survey

All field procedures applied to acquire data on macrophyte composition and abundance are in line with the requirements of EN 14184:2003. Representative river stretches are visually surveyed by wading, diving or boating, using rake, grapnel, aqua-scope where necessary. Representative sites span about 100 metres of river length, but may be more extensive in case of large river surveys. Single survey sites of the Dutch assessment method (as one of several samples for the appraisal of whole water bodies) comprise about 50 metres.

In-channel vegetation is recorded by all national methods. The Flemish scheme optionally considers plants growing at the river banks. In general, only those plants in the channel are considered that occur with most of their leaf tissue under water (i.e. submerged or floating). In the Austrian, Dutch and German protocols fully emerged vegetation is also recorded. Furthermore, growth form information of individual taxon records (submerged, emerged, floating) is collected by the Flemish and German schemes.

The scope of recorded taxonomic groups is different (see also Chapter 4.3). While recording of spermatophytes (“higher plants”) and charophytes (stoneworts) is generally required by all survey protocols, Flanders and Netherlands survey only selected aquatic mosses. The British, Flemish, Polish, French and Walloon protocols also include certain algae groups, that are considered within phytobenthos assessment by other countries. France and Wallonia additionally survey lichens and sewage fungi. The latter are also recorded by the Flemish scheme.

Taxonomic records are broadly made at species level except for algae (genus level). Within some national protocols certain taxa are identified to sub-species or variant level (e.g. *Eleocharis palustris palustris* or *Ranunculus penicillatus penicillatus*). Depending on vegetative state some plants are determined to genus level (e.g. non-fruiting state of *Callitriche*).

2.2 Abundance

Different scales to estimate the abundance of macrophyte taxa at the survey site are applied by the various assessment methods (Table 2). Taxa abundance is mainly specified as relative coverage of the surveyed area. Percent values are graded into three, five, seven or nine classes. The Austrian system combines the number of single plant records per surveyed section and the plant quantity per habitat following Kohler (1978) in a 5-class scheme. Germany estimates the plant quantity (Melzer et al. 1986) in one of five different classes.

Table 2: Abundance scales of national assessment methods

country	AT	BE (FL)	BE (WL), FR	DE	NL	PL, UK
type of abundance		*%cover*	*%cover*	*plant quantity*	*various scales*[1]	*%cover*
1st class	very rare	less than 3 specimens	<0.1%	1	rare, scattered	<0.1%
2nd class	rare	more specimens (not covering)	0.1-1%	8	(locally) common, frequent	0.1-1%
3rd class	widely spread	higher number of specimens; <5% cover	1-10%	27	very common, abundant	1-2.5%
4th class	common, frequent	5-25%	10-50%	64		2.5-5%
5th class	very common, plentiful, abundant	25-50%	>50%	125		5-10%
6th class		50-75%				10-25%
7th class		>75%				25-50%
8th class						50-75%
9th class						>75%

2.3 Assessment and Classification

All methods except the British *LEAFPACS* assess the actual macrophyte community against stream type-specific reference conditions. *LEAFPACS* models reference communities using abiotic parameters, enabling a site-specific quality appraisal.

Macrophytic reference states were derived differently by the countries: abiotic procedures can be distinguished from biological approaches. In the French, Polish and Walloon methods references are spatially based using existing river sites in near-natural state. These sites resulted from screening applying type-specific physico-chemical, hydromorphological and land use criteria and threshold values amongst others. In Flanders and the Netherlands reference sites are generally unavailable. These countries used historical records and expert judgement to establish reference communities for macrophytes. Combined outcomes of pristine site investigations and expert judgement are basis for the German reference community definitions, that describe species response groups (reference and disturbance indicating taxa). Using a similar concept (taxa sensitive and tolerant to nutrient enrichment) the Austrian and British method models reference conditions by establishing defined ratios of species response groups.

The setting of the good ecological status class boundaries is related to the reference concept followed by the national method. Countries using a spatial reference network specified a certain amount of deviation from the reference value to establish high-good boundaries. While France and Belgium (Wallonia) divided the remaining index gradient in equal parts (good, moderate, poor, bad) to set the good-moderate boundary, Poland established linear relationships between abiotic criteria and its macrophyte index to apply threshold values (physico-chemical and land use) in boundary setting. All other methods referred to their definitions of species response groups and set boundaries by defining certain states in the macrophyte community (e.g. good-moderate boundary: switch between sensitive and tolerant species).

The 8 assessment methods participating in the intercalibration exercise are designed to deliver diverse information on stream ecosystems. The majority of schemes focuses on the assessment

[1] Conversion table of the most used scales to 3-class abundance

Standard	verbal description	Tansley	STOWA	Braun-Blanquet
Class 1	rare, scattered	R, O, LF	1,2,3	r,+
Class 2	(locally) common, frequent	F, LA (, LD)	4,5,7	1, 2a,2b,2m,3
Class 3	very common, abundant	A, CD, D	6,8,9	4-5

of nutrient enrichment (France, Great Britain, Poland, Wallonia, partly Austria). A list of indicator taxa graded by their sensitivity to nutrient enrichment forms the principal component of this approach. Numerical assessment results are obtained by computing a compositional metric, i.e. the average score of indicative species weighted by their abundance (in case of AIM Rivers and IBMR also including a factor considering the taxon's ecological amplitude).

The Dutch, Flemish and German macrophyte assessment methods are oriented towards the indication of non-specific anthropogenic disturbance. Besides compositional measures all schemes consider additional metrics such as richness and abundance of growth forms, or taxa richness and dominance.

Basic element of the German *Reference Index* (RI) is the type-specific definition of reference and non-specific disturbance indicating taxa. RI is a numerical expression of the relation of both response groups at a river site. Supplementing assessment criteria directly contribute to the score of RI. In the Dutch method, that is designed for the assessment of whole water bodies, abundance-related taxa scores are summed up. The overall score is derived by averaging this value and the results of growth form types evaluation. Both the Dutch and German systems are macrophyte components of a more comprehensive scheme to assess the aquatic flora (including phytobenthos), i.e. the ecological status is determined based on macrophytes and phytobenthos.

The Flemish method integrates four (optionally six) metrics in the appraisal of ecological status by the "one out – all out" principle. Two optional metrics allow for the numerical evaluation of bank vegetation. In addition to compositional metrics the Flemish scheme regards richness of various growth forms and abundance of submerged vegetation.

Table 1: Overview of national macrophyte assessment methods participating in the CBrivGIG intercalibration exercise

country	**Austria**	**Belgium (Flanders)**	**Belgium (Wallonia)**	**France**	**Germany**	**Great Britain**	**Netherlands**	**Poland**
name of method	Austrian Index for Macrophytes in Rivers (AIM Rivers)	MAFWAT (Macrofyten Waterlopen)	Indice Biologique Macrophytique en Rivière (IBMR)	Indice Biologique Macrophytique en Rivière (IBMR)	Reference Index (RI)	LEAFPACS	Maatlatten	Macrophyte Index for Rivers (MIR)
literature reference	BMLFUW (2006); Pall & Moser (2006)	Leyssen et al. (2005)	NF T90-395:2003; Galoux (2007)	NF T90-395:2003	Meilinger et al. (2005); Schaumburg et al. (2006)	Willby et al. (2006)	Molen & Pot (2007)	Szoszkiewicz et al. (2006)
survey								
international standard	EN 14184:2003							
survey procedure	visual survey of representative river stretch (record of macrophyte taxa and estimation of abundance) by wading, diving or boating, using rake, grapnel, aqua-scope where necessary							
length of survey site	100 m (large rivers: up to 500 m)	100 m	100 m	100 m	100 m	100 m	50 m (water body assessment: data aggregation of at least 3 survey sites)	100 m (large rivers: up to 500 m)
survey month(s)	May – September	June – September	May – October	May – October	mid-June – end-August	June – September	June – August	mid-June – mid-September
surveyed river compartment	channel	channel and banks	channel	channel	channel	channel	channel	channel
recorded channel vegetation	all plants submerged or floating in the channel at time of survey; additional record of emerged plants	all plants submerged or floating in the channel at time of survey; additional record of emerged plants	all plants submerged or floating in the channel at time of survey	all plants submerged or floating in the channel at time of survey	all plants submerged or floating in the channel at time of survey; additional record of emerged plants	all plants submerged or floating in the channel at time of survey	all plants submerged or floating in the channel at time of survey	all plants submerged or floating in the channel at time of survey
recorded taxonomic groups	bryophytes, pteridophytes, spermatophytes, charophytes	*selected* bryophytes, spermatophytes, charophytes, *selected* algae genera, filamentous algae, sewage fungi	bryophytes, pteridophytes, spermatophytes, filamentous algae including charophytes, cyanobacteria clumps, lichen, sewage fungi	bryophytes, pteridophytes, spermatophytes, filamentous algae including charophytes, cyanobacteria clumps, lichen, sewage fungi	bryophytes, spermatophytes, charophytes	bryophytes, pteridophytes, spermatophytes, filamentous algae including charophytes, cyanobacteria clumps, lichen	*selected* bryophytes and pteridophytes, spermatophytes, charophytes	bryophytes, pteridophytes, spermatophytes, algae groups composed of a single species (e.g. charophytes)
level of identification	species	species; genus; group	species; genus (only algae except Characeae and Cyanobacteria)	species; genus (only algae except Characeae and Cyanobacteria)	species	species	species	species; genus

Table 1 (continued): Overview of national macrophyte assessment methods participating in the CBrivGIG intercalibration exercise

country	Austria	Belgium (FL)	Belgium (Wallonia)	France	Germany	Great Britain	Netherlands	Poland
assessment and classification								
key source to derive reference conditions	reference sites, modelling, expert judgement (composition and abundance of species response groups)	expert judgement (reference communities)	reference sites	reference sites	reference sites, expert judgement (composition and abundance of species response groups)	modelling (composition and abundance of species response groups)	expert judgement, historical records (reference communities)	reference sites
scope of reference definition	river type	river type	river type	river type	river type	site	river type	river type
rationale/technique of quality class boundary setting	***HG:*** reference species are dominating ***GM:*** switch between sensitive and tolerant species	***HG:*** less than 1/5th of relevant vegetation made up by non-type specific taxa; idem for disturbance indicators; all expected growth forms present; no reduction or increase of biomass. ***GM:*** less than 2/5th of relevant vegetation made up by non-type specific taxa; idem for disturbance indicators; small reduction of expected number of growth forms; small reduction or increase of biomass.	***HG:*** 5% deviation from reference (absolute IBMR value) ***GM:*** upper one-third of subdivided IBMR gradient ranging from good to poor status	***HG:*** 25th percentile of IBMR reference value. Adjusted by expert judgement. ***GM:*** upper one-third of subdivided IBMR gradient ranging from good to bad status. Adjusted by expert judgement	***HG:*** RI values are slightly below range of reference sites ***GM:*** switch between sensitive and tolerant species or sensitive species dominate but additional criteria are fulfilled	***HG:*** highly tolerant species become subordinate to highly sensitive species ***GM:*** derived from HG boundary and switch between sensitive and tolerant species (mid-point of moderate class)	***HG:*** 70% of reference weighed taxa richness of selected characteristic species ***GM:*** 40% of reference weighed taxa richness of selected characteristic species	***HG:*** 5% deviation from reference (MIR EQR value) ***GM:*** defined by regression of MIR against physico-chemical and land use data
assessment metrics	one metric combining occurrence (indicator value per taxon), ecological amplitude and abundance	(1) type specific index for water vegetation (2) type specific index for bank vegetation: *optional* (3) perturbation index (organic pollution, eutrophication) for water vegetation (4) perturbation index for bank vegetation: *optional* (5) index: growth form richness (6) index: abundance of submerged vegetation	one metric combining occurrence (indicator value per taxon), ecological amplitude and abundance	one metric combining occurrence (indicator value per taxon), ecological amplitude and abundance	Reference Index (RI) plus additionally criteria (depending on stream type): % of mosses indicating acidification, number of species growing submerged, dominance of species growing emerged, Evenness, total quantity of Myriophyllum spicatum and Ranunculus spp.	one metric combining occurrence (indicator value per taxon) and abundance	(1) abundance of growth forms (2) composition of macrophytes	one metric combining occurrence (indicator value per taxon) and abundance

Table 1 (continued): Overview of national macrophyte assessment methods participating in the CBrivGIG intercalibration exercise

country	Austria	Belgium (FL)	Belgium (Wallonia)	France	Germany	Great Britain	Netherlands	Poland
assessment and classification (continued)								
computation details	weighted average of scoring taxa	weighted average of scoring taxa	weighted average of scoring taxa	weighted average of scoring taxa	difference of species response group percentages	weighted average of scoring taxa	sum of abundance-related taxa scores	weighted average of scoring taxa
combination of multimetrics	-	„one out – all out" principle	-	-	additional criteria reduce RI by specific value	-	averaging	-
criteria of assessment validity	minimum number of taxa or abundance	at least 3 sites per water body	completeness of survey record	completeness of survey record	minimum abundance of indicator taxa	no criteria	at least 3 sites per water body	minimum number of taxa
pressure(s) assessed	eutrophication, flow pressure, hydromorphological impairment	non-specific	eutrophication and high organic pollution	eutrophication and high organic pollution	non-specific	eutrophication	non-specific	eutrophication
water body assessment	based on results of representative survey site	based on aggregated results of at least 3 survey sites selected by protocol based on stratified randomisation	based on results of representative survey site	based on results of representative survey site	based on results of representative survey site	based on results of representative survey site	based on aggregated data of at least 3 survey sites	based on results of representative survey site
How is a site with no macrophytes assessed?	clearly due to human influence: bad quality otherwise: cannot be assessed	due to human influence: bad quality; due to natural conditions: assessment may be based on riparian vegetation only	cannot be assessed	cannot be assessed	due to human influence: bad quality due to natural conditions: assessment may be based on phytobenthos assessment component	cannot be assessed	due to human influence: bad quality (referring to phytobenthos assessment component)	due to human influence: bad quality; due to natural conditions: research necessary to investigate reasons for macrophyte absence
role of "phytobenthos" in overall assessment	independent method	independent method for microphytobenthos; filamentous algae and some macroscopic genera included	independent method (filamentous algae and Cyanobacteria included in macrophyte assessment)	independent method (filamentous algae and Cyanobacteria included in macrophyte assessment)	combined with macrophyte assessment	independent method (filamentous algae included in macrophyte assessment)	combined with macrophyte assessment	independent method (filamentous algae included in macrophyte assessment)

3 Common Intercalibration Types

The stream typology underlying the macrophyte intercalibration exercise is based on the specifications according to ECOSTAT (2004) (Table 3). The majority of types is located in the lowlands (ecoregions Western, Central and Eastern Plains, Baltic Province, Great Britain, Ireland and parts of Italy and the Iberic Region). The mountainous areas are covered by one type including the ecoregions Western and Central Highlands, parts of the Western Plains, Great Britain, Ireland and the Iberic Region.

Table 3: CBrivGIG common intercalibration rivers types

IC type	river characterisation	catchment area [km^2]	altitude & geomorphology	alkalinity [meq/l]
R-C1	Small lowland siliceous sand	10-100	lowland, dominated by sandy substrate (small particle size), 3-8m width (bankfull size)	> 0,4
R-C2	Small lowland siliceous - rock	10-100	lowland, rock material, 3-8m width (bankfull size)	< 0,4
R-C3	Small mid-altitude siliceous	10-100	mid-altitude, rock (granite) - gravel substrate, 2-10m width (bankfull size)	< 0,4
R-C4	Medium lowland mixed	100-1000	lowland, sandy to gravel substrate, 8-25m width (bankfull size)	> 0,4
R-C5	Large lowland mixed	1000-10000	lowland, barbel zone, variation in velocity, max. altitude in catchment: 800m, >25m width (bankfull size)	> 0,4
R-C6	Small, lowland, calcareous	10-300	lowland, gravel substrate (limestone), width 3-10m (bankfull size)	> 2

To adapt the general typology to the specific requirements of river macrophyte assessment, lowland types were further sub-divided based on the descriptors altitude, alkalinity and geology. Table 4 shows the additional classification of typological factors. A sub-division of IC type R-C5 (large rivers) has not yet been carried out. A first proposal on the intercalibration of macrophyte methods at R-C5 rivers can be found in Annex II.

Table 4: Common sub-types established for the macrophyte intercalibration exercise

<table>
<tr><th>sub-type</th><th>IC type</th><th>altitude [m]</th><th>alkalinity [meq/l]</th><th>geology specification</th></tr>
<tr><td>R-C1.1.1</td><td rowspan="4">R-C1</td><td><80</td><td rowspan="2">< 1</td><td rowspan="8">-</td></tr>
<tr><td>R-C1.2.1</td><td>80-200</td></tr>
<tr><td>R-C1.1.2</td><td><80</td><td rowspan="2">> 1</td></tr>
<tr><td>R-C1.2.2</td><td>80-200</td></tr>
<tr><td>R-C4.1.1</td><td rowspan="4">R-C4</td><td><80</td><td rowspan="2">< 2</td></tr>
<tr><td>R-C4.2.1</td><td>80-200</td></tr>
<tr><td>R-C4.1.2</td><td><80</td><td rowspan="2">> 2</td></tr>
<tr><td>R-C4.2.2</td><td>80-200</td></tr>
<tr><td>R-C6.1</td><td rowspan="2">R-C6</td><td rowspan="2">0-200</td><td rowspan="2">> 2</td><td>soft limestone</td></tr>
<tr><td>R-C6.2</td><td>hard limestone (karst)</td></tr>
</table>

Countries sharing common (sub-)types are listed in Table 5. This listing has chiefly been derived on the basis of national data contributions to the common macrophyte database (Chapter 4.1). As additional countries will presumable join in the near future (e.g. Estonia), national assignments to common (sub-)types may change. Sub-types R-C1.1.1 and R-C1.2.1 have been identified as being not representative (no common types). Type R-C5 is not listed because intercalibration of this type has been postponed. For the intercalibration analyses (Chapters 5 and 6) sub-types of the lowland covering different altitude ranges have been subsumed (R-C1.1.2 and R-C1.2.2 to R-C1.x.2; R-C4.1.2 and R-C4.2.2 to R-C4.x.2).

Table 5: Countries sharing common (sub-)types (data derived from common database) Countries in *italic* currently not holding national assessment methods (for a specific type).

Sub-Type	country	comment
R-C1.1.2 R-C1.2.2	BE (FL), BE (WL), DE, *DK, IT*, *LT*, *LV*, NL, PL	French R-C1 sites are located in Aquitaine region: strong Atlantic influence put typological membership into question
R-C2	ES, *FR*, *UK*	-
R-C3	AT, BE (WL), *CZ*, DE, *ES*, FR, UK	-
R-C4.1.1 R-C4.2.1	*ES*, FR, *LU*, *SE*, UK	-
R-C4.1.2 R-C4.2.2	BE (FL), *BE (WL)*, DE, *DK*, FR, *LT*, *LU*, *LV*, NL, PL, UK	-
R-C6.1	*BE (WL)*, *DK*, FR, *LT*, *LU*, UK	-
R-C6.2	UK (Northern Ireland)	no common type (currently sub-type was only identified by Northern Ireland; also here: strong Atlantic influence)

4 Data Basis

4.1 Common international macrophyte database (MaPHYTE-DB)

The common international database of the CB GIG macrophyte intercalibration exercise currently comprises approx. 1400 macrophyte survey data from about 1200 river sites in 16 countries (Table 6). Data originate from national monitoring programmes or scientific projects[2].

The majority of data was recorded in the years 2002 to 2006 and covers 9 different IC (sub-)types. In Figure 1 the share of data from IC (sub-)types in the international database is illustrated: More than 60 % of surveys belong to the types R-C1.x.2, R-C3 and R-C4.x.2. Nevertheless, for some countries and (sub-)types data availability is scarce (see Table 6).

Table 6: Number of sites and in-channel surveys per IC (sub-)type and country stored in the common international database

IC type	site/ survey	AT	BE (FL)	BE (WL)	CZ	DE	DK	ES	FR	IT	LT	LU	LV	NL	PL	SE	UK
R-C1.x.1	#sites		2													4	
	#surveys		2													4	
R-C1.x.2	#sites		112	2		151	16	7		13	1		17	14	11		
	#surveys		112	2		151	16	23		32	1		17	14	11		
R-C2	#sites							14	19								28
	#surveys							37	19								28
R-C3	#sites	42		43	15	99		2	22								20
	#surveys	42		44	15	99		6	22								21
R-C4.x.1	#sites							4				15				10	36
	#surveys							15				15				10	38
R-C4.x.2	#sites		10	5		71	5	19	8		9	5	29	8	27		20
	#surveys		10	5		71	5	72	8		9	5	29	8	27		24
R-C5	#sites			2	4	19			2		6		2	18	1		13
	#surveys			2	4	19			12		6		2	18	1		20
R-C6.1	#sites			5			7				1	20					27
	#surveys			5			7				1	20					34
R-C6.2	#sites																86
	#surveys																86
other[3]	#sites	7	13			22	3	1	6		1						1
	#surveys	7	13			22	3	3	53		1						1
sum	#sites	49	137	57	19	362	31	47	57	13	18	40	48	40	39	14	231
	#surveys	49	137	58	19	362	31	156	114	32	18	40	48	40	39	14	252

The database contains three main categories of information:

- *Macrophyte data* including growth form information of individual taxon records (data available for approx. 35 % of records), survey location (only in-channel surveys are

[2] Several surveys taken in the EU-STAR project are included in the database covering river sites in AT, CZ, DE, DK, LV, PL, SE, UK.
[3] not belonging to any IC (sub-)type (e.g. catchment area smaller than 10km^2 or larger than 1000 km^2, different substrate etc.)

considered in intercalibration[4]), survey date, national and international taxa abundance (see Chapter 4.2). Table 7 gives an overview of the 5 most constantly recorded macrophyte taxa per IC (sub-)type.

- *Abiotic data* featuring site characteristics (typological data[5]: e.g. ecoregion, catchment area, altitude, geology, slope, substrate, channel width and depth, flow velocity, discharge) and pressure characteristics[6] (reference site, hydrological, morphological and chemical impairment, selected chemical variables).
- *National classifications* comprising the results of 8 national assessment methods (see Chapter 2). For the IC (sub-)types R-C1.x.2, R-C3 and R-C4.x.2 national quality classes are available of approx. 80 % of surveys. Lowest number of surveys were classified by the German method (on average 45 %) due to missing growth form information and strict assessment validity criteria (see Table 1). Dutch classification was applied to single survey data of other countries based on the approach described in Annexes III and IV.

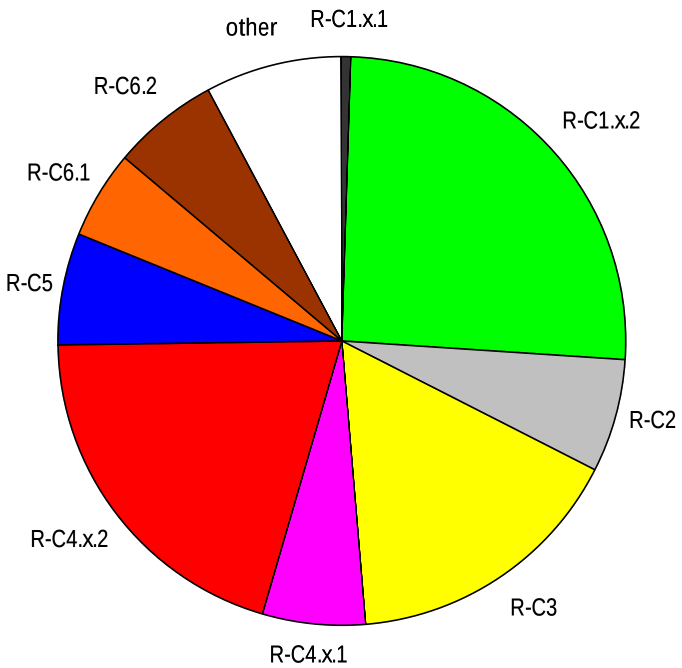


Figure 1: Share of data from IC types in common international database

[4] Approx. 175 surveys cover plant records at river banks (ES, BE (FL), LV) or complete water bodies (NL).
[5] Data availability ranges from 30 % (discharge) to 95 % (ecoregion) of sites.
[6] Data availability ranges from 20-40 % (chemical parameters) to 75 % (reference sites) of sites.

Table 7: Macrophyte taxa most constantly recorded in the common international database (constancy: percentage of the total number of surveys per IC type that hold records of that taxon)

IC type	Taxon	Constancy [%]
R-C1.x.2	*Sparganium emersum*	48
	Callitriche sp.	44
	Lemna minor	39
	Phalaris arundinacea	37
	Potamogeton natans	31
R-C2	*Oenanthe crocata*	38
	Chiloscyphus polyanthos	37
	Rhynchostegium riparioides	35
	Fontinalis antipyretica	33
	Fontinalis squamosa	30
R-C3	*Rhynchostegium riparioides*	42
	Fontinalis antipyretica	36
	Chiloscyphus polyanthos	25
	Amblystegium fluviatile	24
	Phalaris arundinacea	25
R-C4.x.2	*Phalaris arundinacea*	33
	Sparganium erectum	29
	Sparganium emersum	27
	Lemna minor	25
	Callitriche sp.	23
all	*Phalaris arundinacea*	46
	Sparganium erectum	32
	Lemna minor	30
	Sparganium emersum	29
	Fontinalis antipyretica	27

4.2 International abundance scale

To allow for common analysis of data national abundance values were assigned to one of five international abundance classes using expert judgement. Table 8 lists national scores and respective international classes. This harmonisation was enabled by agreeing on common verbal descriptions of taxon abundances that surveyors come across in the field.

Table 8: Assignment of national abundance value intervals to a harmonised international scale

international scale	1	2	3	4	5
verbal description	very rare, highly scattered	rare, scattered	widely spread, occasional	common, frequent	very common, plentiful, abundant
specification	only single plants, up to about 5 specimens (individual plants)	about 6 to 10 specimens (individual plants), scattered over investigated section; few small clumps	easily seen, but not abundant	frequent, but not in masses; very obvious, but gaps are greater than cover of individual species	dominant, more or less overall
AT	very rare	rare	widely spread	common, frequent	very common, plentiful, abundant
BE (FL)	less than 3 specimens	more specimens (not covering)	higher number of specimens; <5% cover	5-50%	>50%
BE (WL)**	<0.1%	0.1-1%	1-10%	10-50%	>50%
CZ	<0.1%	0.1-1%	1-5%	5-10%	>10%
DE*	1	8	27	64	125
DK	<0.1%	0.1-1%	1-10%	10-50%	>50%
ES1***	<0.1%	0.1-5%	5-25%	25-50%	>50%
ES2***	<1%	1-5%	5-25%	25-50%	>50%
ES3***	-	1-5%	5-33%	-	>33%
ES4***	<0.1%	0.1-1%	1-10%	10-25%	>25%
FR**	<0.1%	0.1-1%	1-10%	10-50%	>50%
IT**	<0.1%	0.1-1%	1-10%	10-50%	>50%
LT*	1	8	27	64	125
LU**	<0.1%	0.1-1%	1-10%	10-50%	>50%
LV	<0.1%	0.1-1%	1-5%	5-10%	>10%
NL	*see explanations below*				
UK****	<0.1%	0.1-1%	1-10%	10-25%	>25%
PL****	<0.1%	0.1-1%	1-10%	10-25%	>25%
STAR****	<0.1%	0.1-1%	1-10%	10-25%	>25%

* "Plant Quantity" according to Kohler (1978)
** IBMR survey procedure
*** Spain delivered four different datasets using individual abundance scales per dataset (ES4 corresponds to MTR scale).
**** MTR survey procedure

Conversion of Dutch abundance scales

In the Netherlands no standard abundance scale, but a variety of abundance schemes are applied. The Dutch assessment method operates on the basis of a 3-class scale, and common agreement about conversion of various modifications of the Tansley scale into percentages exist (see Footnote 1). For the international database Netherlands delivered abundance data converted into a 5-class scale based on the specifications given in Table 9.

Table 9: Conversion table of commonly used Dutch abundance scales to percent cover and international 5-class abundance scale

scale	Tansley			Stowa			Braun-Blanquet				
type of abundance	*code*	*Conv. %*	*Conv. 5-class*	*code*	*Conv. %*	*Conv. 5-class*	*code*	*Number of specimens*	*%cover*	*Conv. %*	*Conv. 5-class*
1st class	r,s,lo	1	1	1	1	1	r	1-2	<5%	1	1
2nd class	o,lf	3	2	2	2	1	+	3-20	<5%	2	1
3rd class	f	8	3	3	3	2	1	21-100	<5%	3	2
4th class	la	9	3	4	4	2	2m	>100	<5%	4	2
5th class	ld	22	4	5	8	3	2a		5-12%	8	3
6th class	a	15	4	6	18	4	2b		13-25%	18	4
7th class	cd	40	5	7	38	4	3		25-50%	38	4
8th class	d	60	5	8	63	5	4		50-75%	63	5
9th class				9	88	5	5		>75%	88	5

4.3 Common list of macrophyte taxa

To allow for various intercalibration analyses a common macrophyte list covering the operational taxa lists of all countries involved in intercalibration was build. Principal objective was to have a common basis for the selection of indicator taxa available as a reference for the comparison of national survey data and assessment methods.

In an initial approach a list of a 179 common macrophyte taxa was proposed (Figure 2). The list was enlarged by additional national contributions including up to 301 taxa. This reference document was intended to represent the “least common denominator” of macrophyte taxa in the CBrivGIG. However, first analyses based on the established list suggested reconsideration of the original approach. In a second approach a complete reference list was designed as an absolute common base. The main aim of this second list was to assure total completeness, transparency and objectivity in data sorting, screening and computation.

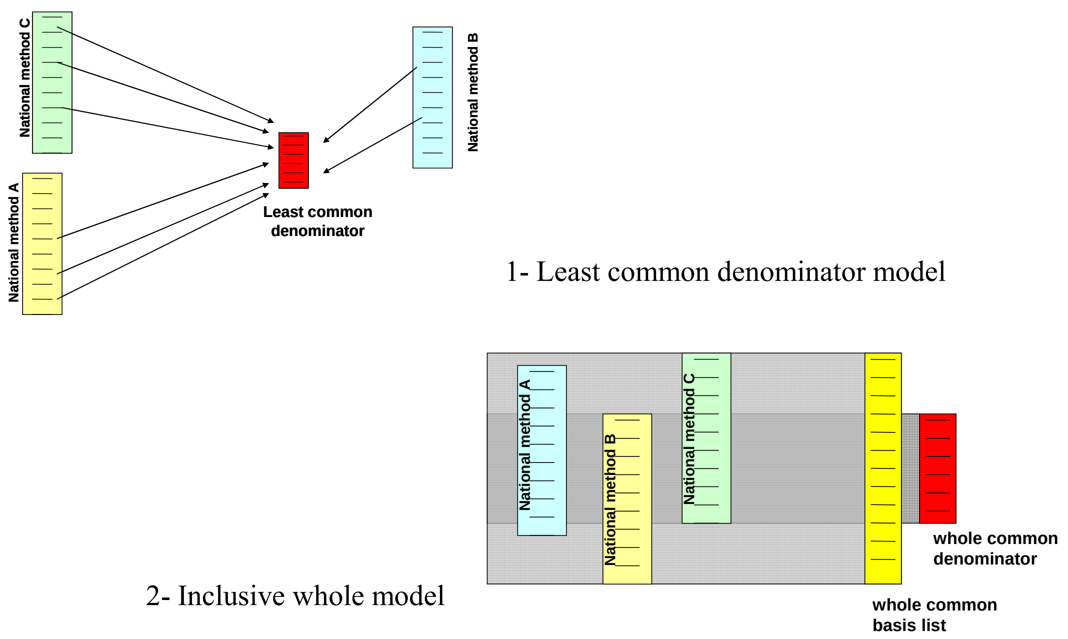


Figure 2: Two subsequent steps to establish a common list of macrophyte taxa.

Compilation of national taxa lists

The common list was established according to the following steps:

- ***Compiling national reference lists***

  For each of the 5 national methods[7], the GIG members provided the list of all taxa which can contribute to the national index calculation. For some methods which do not have a finite list, the list of all taxa to be found in the national database were provided.

- ***Checking problems of synonymy***

  The first data collection showed that the significant formal divergence concerning taxa denominations represents a major problem when combining data from different countries. For identical taxa several current names exist. A cross-check of all listed taxa was undertaken to highlight taxonomic synonyms. The reference nomenclature was taken as the Flora Europaea. The main practical reference documents used for this purpose were the Kerguelen synonymy lists available on the INRA Dijon website[8], and the synonyms BDNFF database hosted by the Tela-Botanica project website[9]. Some additional references were used for specific alien taxa or other floristic groups.[10]

An updating of the codes assigned to each taxon was performed. This codification was based on a simple 7 characters principle: GEN.SPE (GEN: first 3 letters of the genus, SPE: first 3 letters of the species), with any same GEN allowed for different species (subsequent letters used), and an XSP code for hybrids.

After amendments (removing synonyms and adding some taxa), the common list currently comprises 1059 taxa. Taxa names used in the list do not claim to comply with the up to date taxonomical specifications. Nevertheless, the harmonisation of taxonomic names aimed at establishing a common basis often using the current and authorized denomination. The identified synonyms were recorded and stored in the common macrophyte taxa list (MS Excel sheet format).

The taxonomic levels used in each national list were preserved keeping the raw information. This resulted in several different taxonomic levels of denomination for similar taxa, e.g. *Filamentous algae*, *Cladophora sp.*, *Cladophora aegagropila*, or *Callitriche sp.*, *Callitriche truncata*, *Callitriche truncata* subsp. *fimbriata*.

[7] The methods taken into account are from Austria, Belgium (Flanders), France, Germany, Netherlands and United Kingdom. The other GIG countries have either no method or employ methods of countries given above.
[8] National Agronomic Research Institute - http://www.dijon.inra.fr/flore-france
[9] Nomenclatural Database of French Flora - http://www.tela-botanica.org/site:eflore
[10] Global Invasive Species Database - http://www.issg.org/database/welcome/
Portail-Jardin.com - http://portail-jardin.com/plantes/liste-genres.html
AlgaeBase - http://www.algaebase.org/search/genus/
The International Plant Name Index - http://www.ipni.org/index.html

Assignment of specific information

Several characteristics were assigned to each taxon in the common list[11]:

- **Aquaticity**: 8 classes characterising the link to water in order to objectify the notion of "macrophyte":

1	Exclusively aquatic species (or mainly aquatic in regular conditions).
2	Aquatic taxon with common terrestrial forms or truly amphibious (common aquatic forms as well as terrestrial forms)
3	Supra-aquatic bryophytes and lichens. Commonly submersed a part of the hydrological cycle.
4	Helophytes or Amphiphytes. Erected forms with basis commonly inside water.
5	Hygrophylous taxa. Possibly submersed (at least the basis) a part of the year.
6	Bank, wood, grasslands or ruderal herbaceous species. May be found in water accidentally or in high flow conditions.
7	Woody riparian species. May be flooded temporarily.
8	Brackish water or salty marshes species.
NR	not relevant (generally for taxonomic level higher than species)
NA	not assigned (lack of information)

Except for a few exclusively aquatic genera and for algae, the "aquaticity" is filled-in only for species and sub-species level taxa.

- **Bioindication value**: For each taxon, a score of 0 (ubiquitous taxon), 1 (reference indicating taxon) or 2 (disturbance indicating taxon) was assigned. This assignment was done separately for each IC river type.
- **Relevance in national assessment**: For each country, taxa were scored 0 (not recorded), 1 (recorded but not contributing to index) or 2 (recorded and contributing).
- **Taxonomic level**
- **Morphological or floristic group**
- **Alien**: Taxa that are alien to the entire GIG are highlighted in the list.

Selected analyses of common taxa list

The number and floristic groups taken into account by the national assessment methods are different (Figure 3).

[11] Some of these notions are taken according to original and unpublished works of CEN group, especially J. Haury., CEN 2002, work documents.

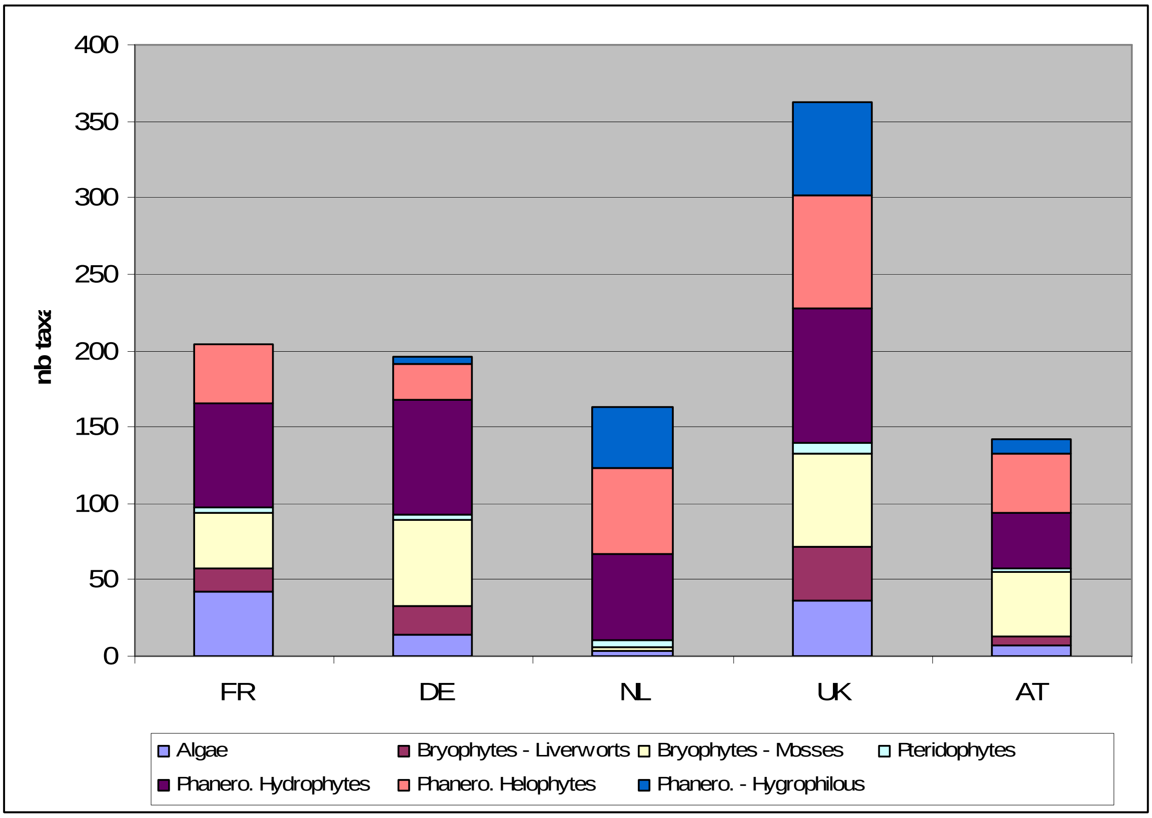


Figure 3: Total number and floristic groups taken into account by the national methods

One of the main differences lies in the consideration of the whole aquatic vegetation for certain protocols, or only certain plant types for others. For example, bryophytes are generally not considered by the Dutch method, but this method includes lots of hygrophilous species (bank vegetation). This is not the case for most of the other methods that consider only obligate aquatic vegetation.

Furthermore, the consideration of algae is very different. Only France and Great Britain use a larger number of taxa in this group to compute their assessment index. The British method also considers a very wide span of macrophytes (more than 350 taxa).

With regard to the link to water ("aquaticity" level, Figure 4) more than one-third of taxa are totally aquatic (class 1). The taxa directly linked to water, i.e. living completely submerged or at least with their stem basis under water (classes 1, 2 and 4), represent 49% of the list. The rest are more or less hygrophilous or brackish-water taxa (28%) or not assigned (22% to be not relevant for this criterion, or lacking information).

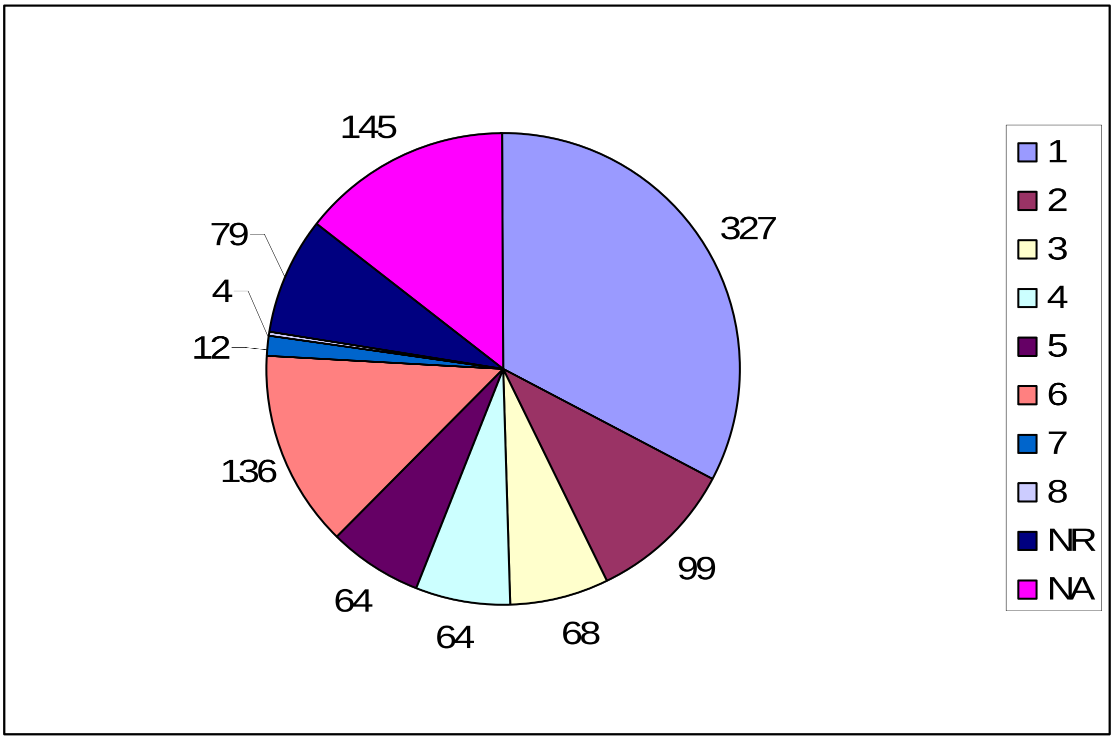


Figure 4: Share of taxa with different aquaticity scores in the common list (see above for an explanation of individual codes)

The taxa taken in account are mostly species (78%) and genera (16%, mainly for algae). See Figure 5 for more details.

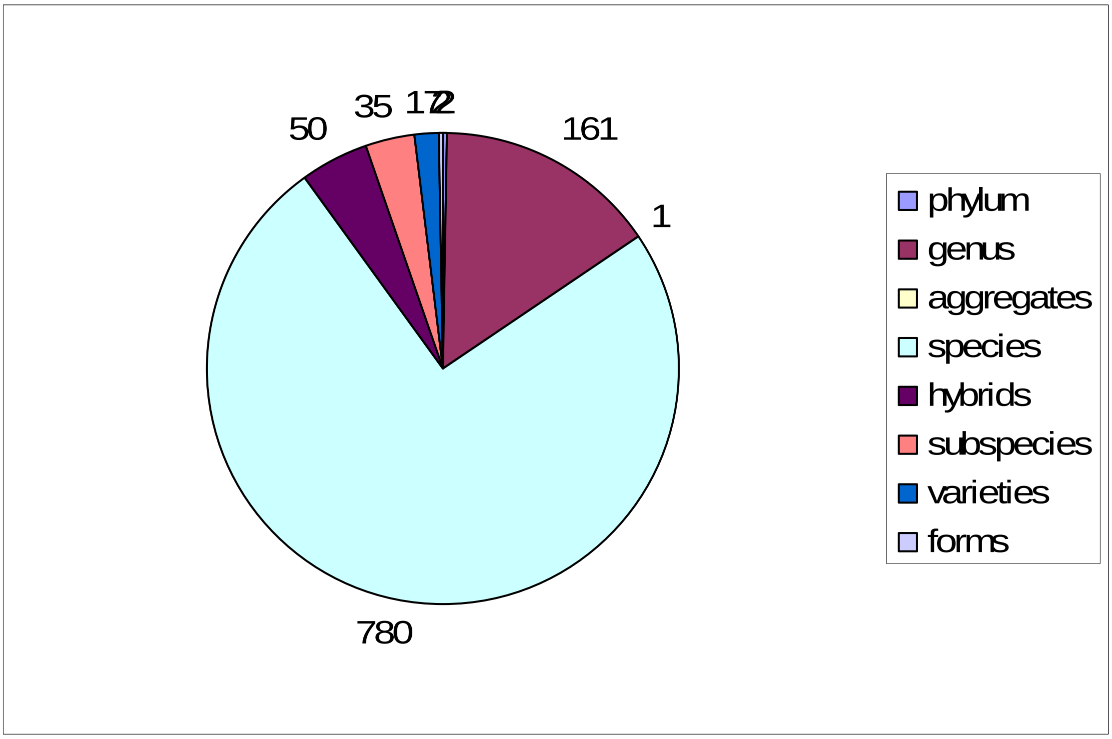


Figure 5: Share of taxonomic levels in the common list

General remarks

The centrally managed, common assignment of taxon characteristics in an all-embracing list is a practical way to harmonise the different national protocols without losing raw information, i.e. to be able to go back to this original information to avoid misinterpretation of results. However, the intended conservation of national information creates redundancies in the global information due to the presence of several taxonomic levels. This heterogeneity in floristic information is a major problem for comparisons: the more general the level of analysis (i.e. including all methods) the less precise it becomes.

In general, the complete common list of macrophyte taxa represents a useful tool for method comparisons: The differences between the assessment “philosophies” of each method is highlighted fairly well. These differences can be linked to the rivers types of each country, and to the national assessment concepts. This list is an important basis for the intercalibration activities.

5 Intercalibration Option 2: Use of Common Metrics

5.1 Introduction

The main focus of the intercalibration analyses was the development and application of Intercalibration Common Metrics (ICM, Buffagni et al. 2005) following the approaches of the invertebrate and phytobenthos intercalibration exercises (Olsauskyte & van de Bund 2007). Intercalibration basics were established by setting up international macrophyte indicator scores related to nutrient pressure, compiling a list of type-specific international species response groups, and developing a common intercalibration metric to compare class boundaries of national methods assessing eutrophication.

The following sections provide an overview of the major steps taken towards an implementation of Intercalibration Option 2. Besides the fundamentals on metric development the preliminary analyses of boundary comparison between national methods for IC types R-C2, R-C3 and R-C4.x.2 are presented. Furthermore, instruments for the validation of harmonised boundary setting are outlined (biological community aspects, pressure-impact relations).

To contribute to the pilot intercalibration exercise of R-C2 Spain tested the use of the common metric as national assessment method, including the proposal of national reference and boundary values.

5.2 Development of a common scoring system for European river plants based on sensitivity to nutrient enrichment

Various European countries already employ numerical ranking systems to score river plants according to their perceived sensitivity to nutrient enrichment. Within the CBrivGIG countries these systems include RMNI in UK (a replacement of MTR), IBMR in France, TIM[12] (Trophie-Index Makrophyten, Schneider et al. 2000) in Germany, MIR in Poland (a direct adaptation of the UK MTR system for Polish rivers) and AIM Rivers in Austria. These systems cover varying numbers of species, range from continuous to ordinal scaling, and run in different directions between different maxima and minima. To facilitate comparison all national systems were harmonised to run from 1 (most sensitive) to 10 (most tolerant). Following rescaling, cross comparison of these various systems indicated that they share a similar view of the rank position of individual taxa (e.g. Figure 6). Therefore we used a synthesis of these national scoring systems as the basis for formulating a pan-European common metric (ITEM = Index of Trophy for European Macrophytes) for assessing nutrient enrichment based on river plants.

A total of 433 taxa were ranked by at least one country (out of five countries with comparable ranking systems), with 123 taxa being ranked by 3 or more countries.

Scores were combined by averaging the rescaled values for taxa recorded by 3 or more countries. For more narrowly recorded taxa (i.e. taxa recorded by only one or two countries) a common score was derived for each based on the relationship between national score and European average score for more widely recorded species.

[12] Note: This index is different from RI used by Germany in the IC exercise.

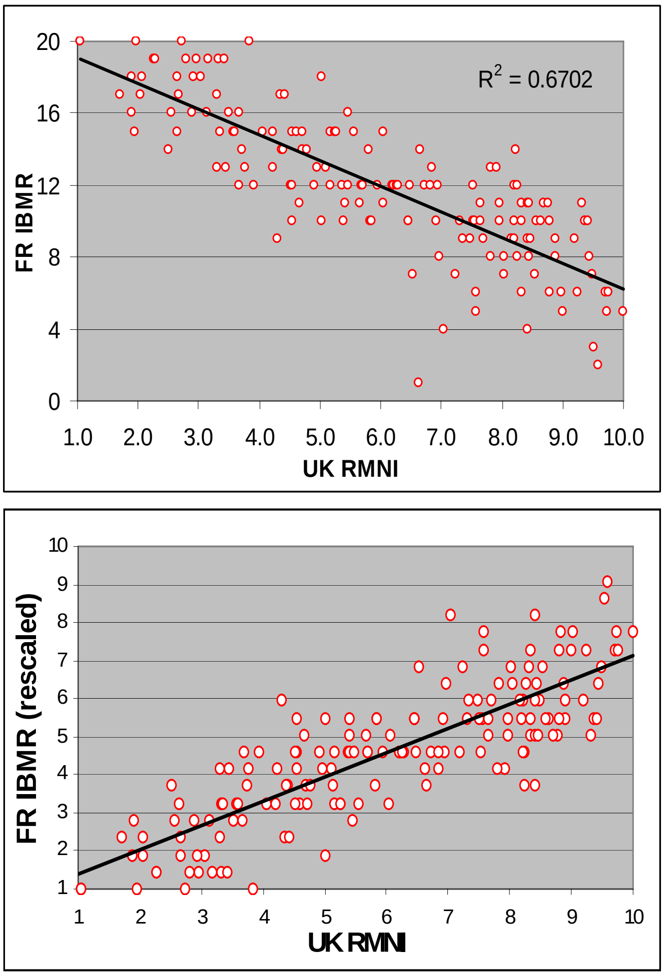


Figure 6: Cross comparison of original and rescaled UK (RMNI) and FR (IBMR) ranking systems

The final set of harmonised ITEM scores was scaled from 1-10, covering 433 taxa. 1 = *Nardia compressa*, with *Potamogeton polygonifolius* and *Juncus bulbosus* being the lowest scoring rooted vascular macrophytes, while 10 = sewage fungus *Sphaerotilus*, with *Ranunculus sceleratus* and *P. pectinatus* being the highest scoring rooted vascular macrophytes. A subset of 360 taxa was identified as being recorded consistently by national methods (or which would be recorded if present in a country). These taxa were regarded as 'ITEM scoring' taxa which contributed to the derivation of a site score. A range of representative scores are shown in Table 10 below.

The relationship between the harmonised score and the national score based on taxa scored by three or more countries was assessed graphically (Figure 7). All national systems were highly correlated (r^2 = 0.82-0.90) with the harmonised metric. However, the slope of these relationships was significantly lower for two countries (DE and AT) suggesting that in these countries the national systems tend to underscore lower scoring taxa (i.e. rate them as too sensitive), relative to the global perspective. In case of AT this may derive from differences in the definition of the trophic basic state.

Site scores were derived for all sites in the CBrivGIG dataset by calculating the weighted average of the ITEM scores of the taxa present where the weighting comprises the international abundance scoring system in which national abundance assessments are harmonised to a scale of 1-5.

Table 10: ITEM scores of a range of riverine macrophytes, following harmonisation of national scoring systems.

Taxon	RMNI (UK)	MIR (PL)	IBMR (FR)	TIM (DE)	AIM (AT)	average
Acorus calamus	9,49	9	6,85	10		8,84
Alisma plantago-aquatica	7,82	7	6,40		5,0	6,56
Amblystegium fluviatile	5,41	6	5,05		2,5	4,74
Amblystegium tenax	5,27	6	3,25		2,5	4,26
Berula erecta	8,24	7	3,70	7,70		6,66
Brachythecium plumosum	2,92	2	1,90		1,0	1,96
Brachythecium rivulare	3,56	3	3,25		2,5	3,08
Callitriche obtusangula	8,04		6,40	7,07	5,5	6,75
Chiloscyphus pallescens	4,78	4	3,70		7,0	4,87
Chiloscyphus polyanthos	4,05	3	3,25		1,0	2,83
Equisetum fluviatile	3,92	5	4,60		1,0	3,63
Equisetum palustre	4,55	6	5,50		4,0	5,01
Glyceria fluitans	5,81	6	3,70		2,5	4,50
Hygrohypnum ochraceum	2,96	2	1,45		1,0	1,85
Lemna minor	8,80	9	5,50		10,0	8,33
Myriophyllum verticillatum	7,53	6	4,60		5,5	5,91
Philonotis gr. fontana	2,66	2	1,90		1,0	1,89
Polygonum hydropiper	6,97	8	6,40		5,5	6,72
Racomitrium aciculare	1,89	1	1,90		1,0	1,45
Rhynchostegium riparioides	5,16	6	4,60		2,5	4,57
Scapania undulata	2,05	2	2,35		1,0	1,85
Thamnobryum alopecurum	4,22	4	3,25		2,5	3,49

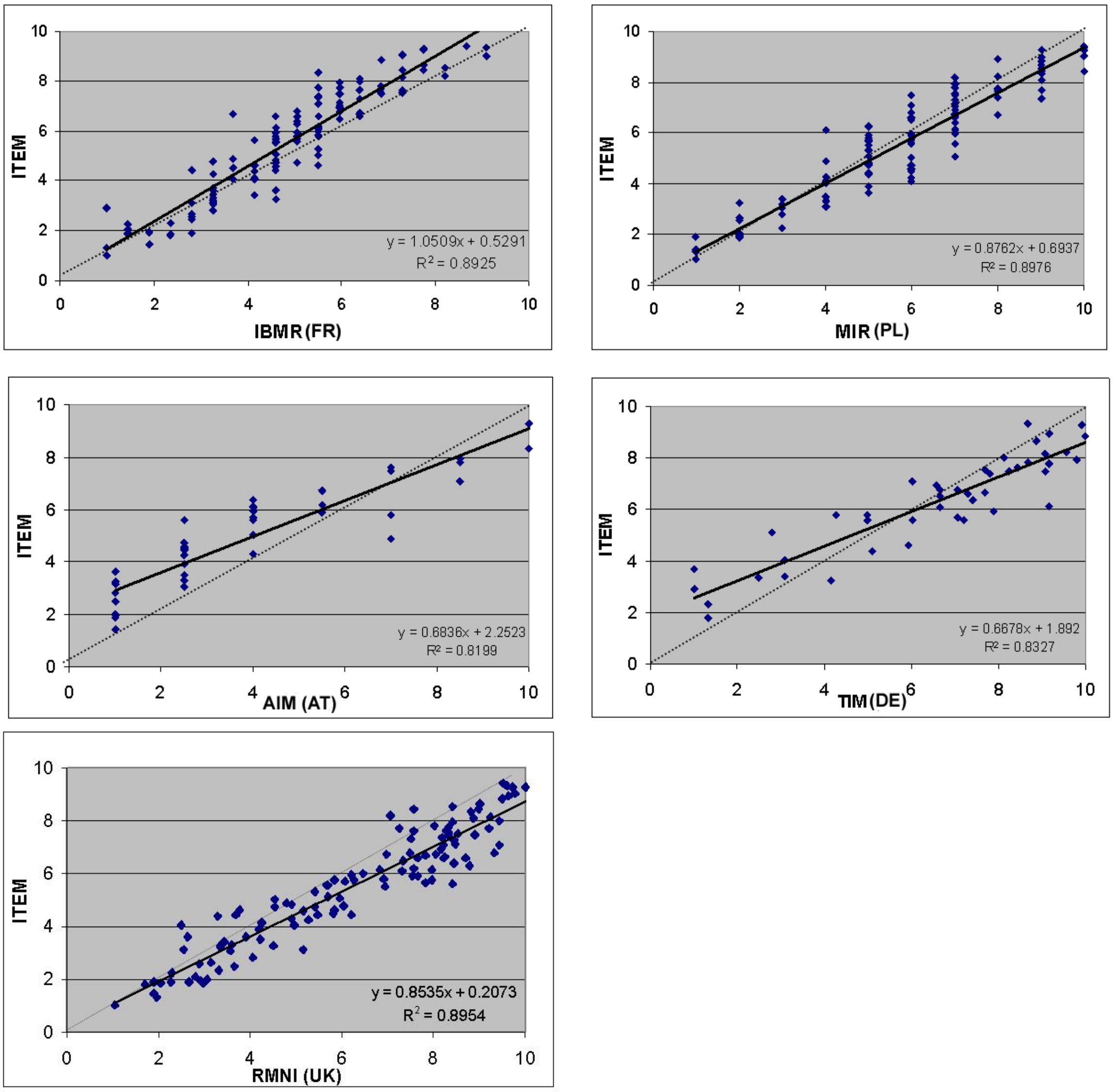


Figure 7: Comparison of harmonised national indices of nutrient sensitivity in river plants with global view of the same species. Based on taxa represented within scoring systems of three or more countries. Dotted lines indicate 1:1 relationship.

ITEM was evaluated by comparing site scores with annual mean water column soluble reactive phosphorus (SRP) concentrations. Since the common dataset was sparsely populated with nutrient data of a directly comparable form this comparison was undertaken using data from the UK only. Data were available for 2650 archived macrophyte surveys cross referenced to chemistry data. These surveys were not undertaken for metric development or WFD purposes and chemistry data is derived from routine monitoring sites (mean of typically 12 values). Consequently the thresholds for spatial and temporal cross matching of biology and chemistry data are necessarily broad (chemistry site up to 5km upstream of biology site and up to 5 year time lag between biology and chemistry data collection) and this comparison should therefore be regarded only as indicative. It is clear from Figure 8 that ITEM values in this dataset are correlated with average SRP values (with ITEM performing only fractionally less well than the national metric). While this should not be construed as a cause-effect relationship it confirms a necessary association between the common metric and a key pressure on which the GIG is intercalibrating.

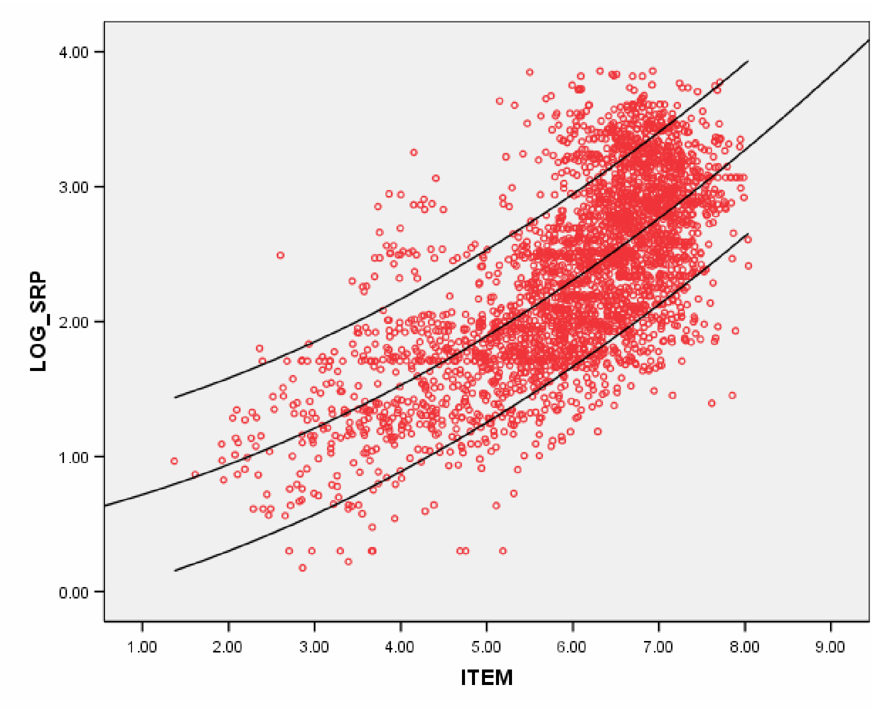


Figure 8:. Global relationship between ITEM scores and cross-matched soluble reactive phosphorus (SRP) concentrations from 2650 archived macrophyte surveys in the UK. r^2 for best fit line (cubic function) = 49% compared with 51% for national metric. Outer most lines indicate 90% confidence limits.

5.3 International species response groups

To explore biological interpretations of reference condition and the placement of class boundaries within the context of the normative definitions we assessed the use of response groups to discriminate between species sharing contrasting responses to a general gradient of degradation. Experts from participating countries were invited to nominate macrophyte taxa that they considered to reflect reference and impacted conditions in a given river type. 'Reference' taxa were defined as taxa that would be expected to have their greatest relative abundance under unimpacted conditions and would therefore be sensitive to anthropogenic disturbance. 'Disturbance' taxa were defined as taxa that would achieve their greatest relative abundance in degraded sites and that would therefore be considered disturbance tolerant. 'Indifferent' taxa were defined as those that showed no clear response to a general pressure gradient. The specific sources of degradation were unspecified.

National views were compiled for each type. These showed some significant differences between countries. In an attempt to provide a harmonised view of each response group the distribution of ITEM scores of the global population of each group were analysed. ITEM values were used since these should reflect pressures from nutrient enrichment, probably the single most pervasive cause of degradation of European rivers, and because they will also to some extent assimilate the effects of other pressures.

On the basis of an examination of the percentile distribution of ITEM scores from each country it was suggested that species with ITEM values lying above the global median ITEM value for disturbance taxa would be regarded as mutually agreed ‘highly disturbance tolerant’ taxa while those lying below the global median ITEM value for reference taxa would be regarded as ‘highly sensitive’ taxa. At this level there was no, or virtually no overlap between response groups based on the views of individual countries. Species lying between the 50th and 25th percentiles of the distribution of ITEM scores of disturbance taxa or between the 50th and 75th percentiles of the distribution of ITEM scores of sensitive taxa were labelled as ‘disturbance tolerant’ or ‘sensitive’ respectively. Between the lower 25th percentile of the distribution of scores of disturbance taxa and the upper 25th percentile of the scores of reference taxa there was considerable overlap between response groups and species with ITEM scores falling within this band were therefore considered to be indifferent or ubiquitous. This classification is illustrated in Figure 9 below, using RC1.x.2 as an example.

The table showing ITEM scores and classification of taxa can be found in Annex I.

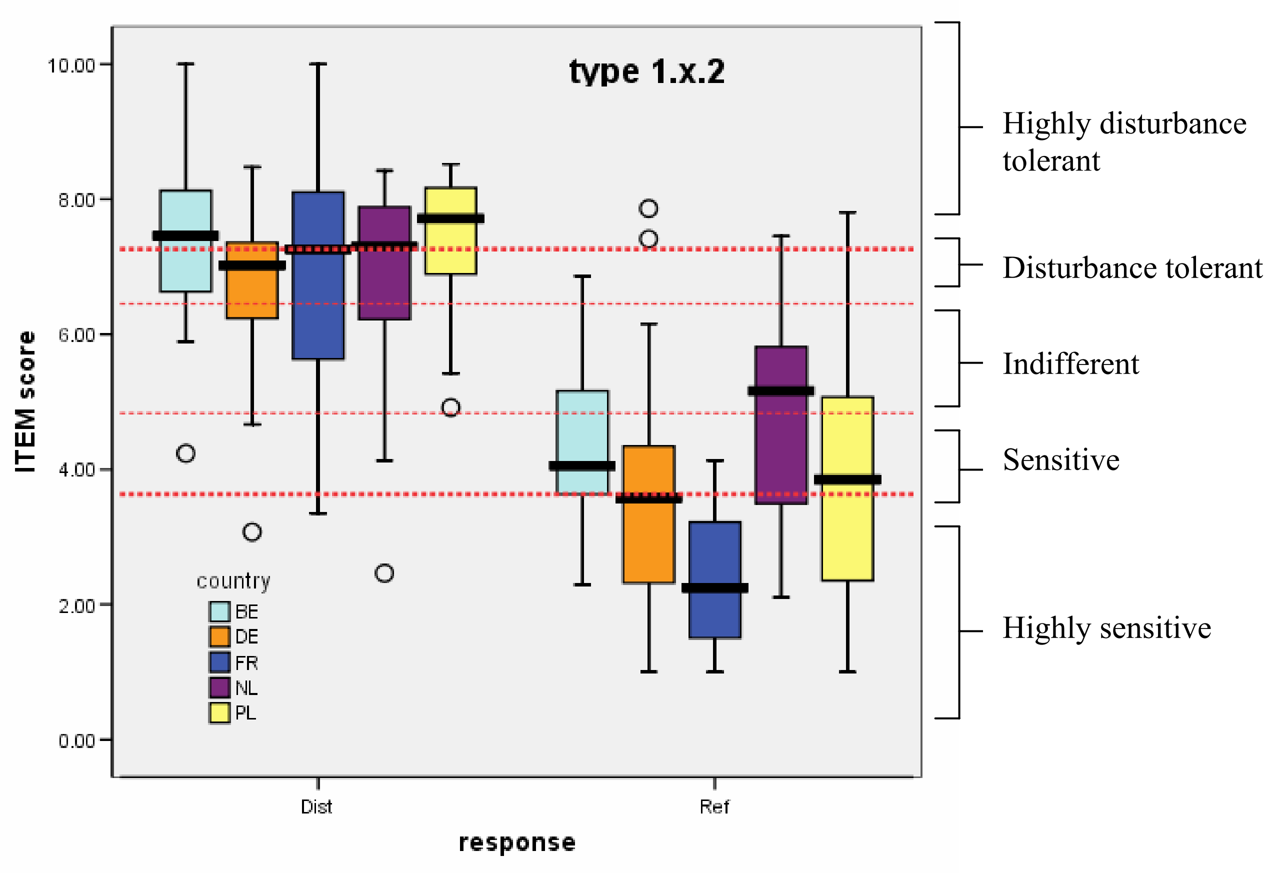


Figure 9: Distribution of ITEM scores of disturbance tolerant and reference condition taxa as voted for five countries participating in the intercalibration of RC 1.x.2. Heavy red dashed upper line signifies 50th percentile of ITEM scores of global population of voted Disturbance species. Taxa with ITEM scores greater than this have been interpreted as being ‘Highly disturbance tolerant’. Light red dashed upper line signifies lower 25th percentile of distribution of global population of voted disturbance species. Taxa with ITEM scores lying between the 25th and 50th percentiles have been interpreted as ‘Disturbance tolerant’. Heavy red dashed lower line signifies 50th percentile of ITEM scores of global population of voted Reference species. Taxa with ITEM scores lower than this have been interpreted as being ‘Highly disturbance sensitive’. Light red dashed lower line signifies upper 25th percentile of distribution of global population of voted Reference species. Taxa with ITEM scores lying between the 25th and 50th percentiles have been interpreted as ‘Sensitive’.

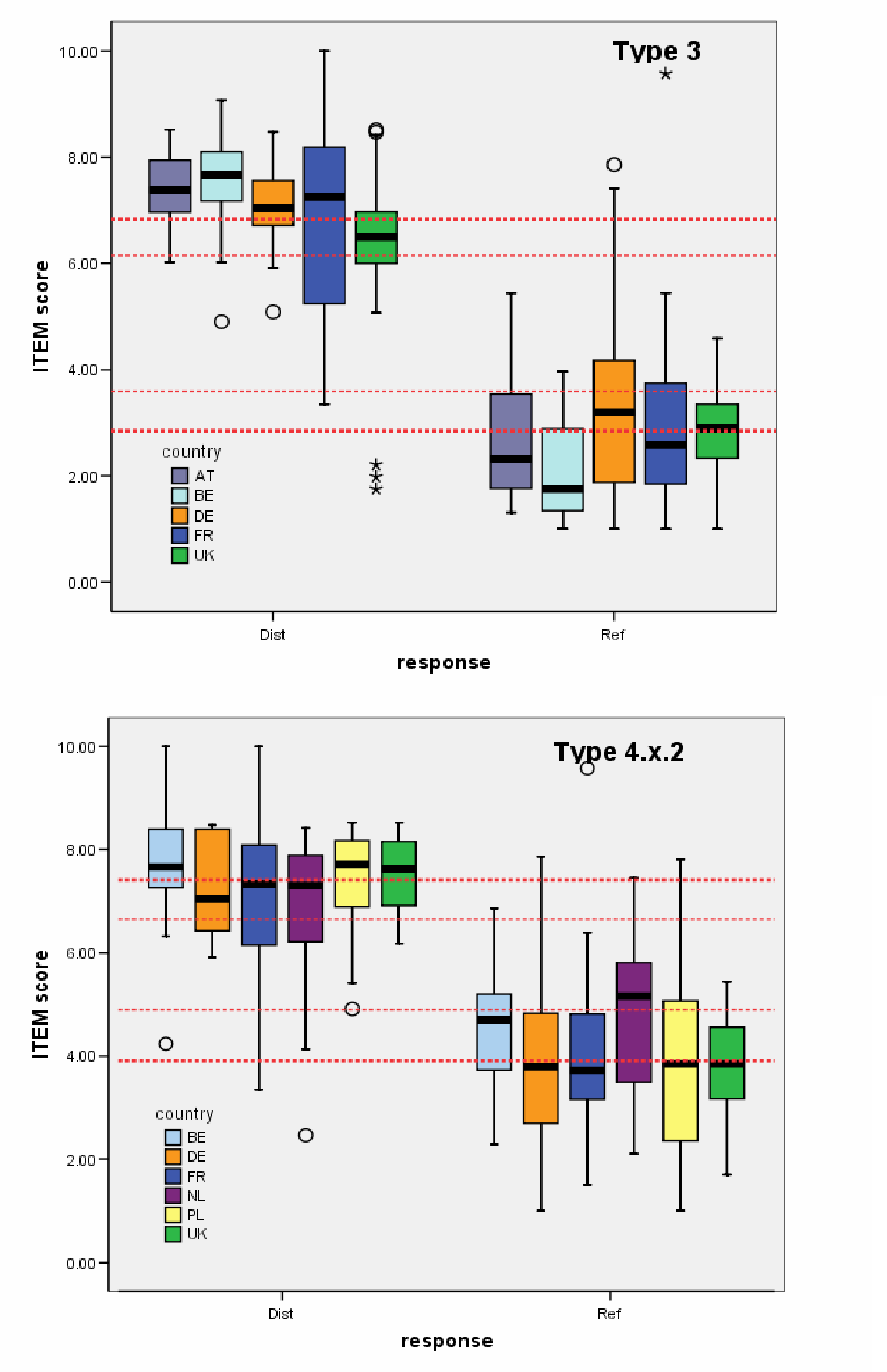


Figure 10: Distribution of ITEM scores of disturbance tolerant and reference condition taxa as voted for by countries participating in the intercalibration of types R-C3 (top) or R-C 4.x.2 (bottom). See caption in Figure 9 for full details.

5.4 Use of response groups for visualisation and boundary setting

Having harmonised the members of each response group for the various river types we explored the change in representation of response groups along a putative enrichment gradient as represented by ITEM scores. To allow the representation of response groups to be visualised in terms of percentage cover we back-calculated the international cover scores to the percentage value equivalent to the mid range of each class and also recalculated the site ITEM scores weighting on the basis of percentage cover rather than the international cover score. The summed cover of the members of each response group was then modelled in relation to site ITEM scores using logistic regression. Examples are shown in Chapter 5.5 for R-C3 and R-C4.x.2. On the basis of this relationship it is possible to interpret the relative abundance of different response groups, for example at particular ITEM values proposed by individual countries as reference values or class boundaries. Thus ITEM values of 3, which are typical of R-C3 reference values proposed by most countries, would generally be associated with negligible cover of tolerant taxa, dominance of Highly sensitive taxa, and 75% cover of all sensitive taxa (i.e. Highly sensitive and sensitive combined). This profile supports the view of these opinions of reference condition in the light of the normative definitions. Similarly it is possible to establish from this relationship the metric value at which potentially critical changes in the representation of different groups occurs. Thus, in R-C3, the replacement of sensitive by tolerant taxa, first occurs at an ITEM score of about 4.7.

These analyses have been undertaken for IC types R-C3 and R-C4.x.2. The outputs are presented as bar graphs that illustrate the relative proportions of tolerant, sensitive and indifferent taxa at the ITEM values associated with the national class boundary in each country and with the harmonised boundary (see Chapter 5.5).

5.5 IC Option 2 Analytical Procedure

The main steps of the analytical procedure are listed below including a short summary of the points of critique.

(1) DATA BASIS: macrophyte surveys at relevant common types (all countries) covering all taxonomic groups required by national method (e.g. including algae for FR, PL, UK methods),

(2) CORRELATION of national indices and ICM excluding indices showing weak correlation (Table 11),

(3) TRANSLATION of national reference values and good status boundaries based on linear regression analysis,

(4) ICM NORMALISATION by ICM value corresponding to national reference,

(5) COMPARISON
(a) of absolute ICM values corresponding to national reference,
(b) of national ICM EQR boundary values

(6) HARMONISATION using mean ICM EQR of corresponding national HG and GM boundary values +/- 5% confidence interval,

(7) VALIDATION of reference and boundary settings by
(a) Species Response Group ratios,
(b) Nutrient – ICM relationship.

Table 11: Spearman Rank Correlation Coefficients of national indices and ITEM based on combined data (all countries) per common type (n.s. - not significant).

	R-C1.x.2	R-C2	R-C3	R-C4.x.1	R-C4.x.2	R-C6.1
AT	-	-	-0,79	-	-	-
BE (FL)	n.s.	-	-	-	n.s.	-
BE (WL)	-	-	-0,91	-	-	-
DE	-0,19	-	-0,74	-	-0,27	-
ES	-	1,00	-	-	-	-
FR	-	-0,96	-0,91	-0,74	-0,71	-0,74
NL	n.s.	-	-	-	n.s.	-
PL	-0,67	-	-	-	-0,73	-
UK	-	-0,98	-0,94	-0,85	-0,89	-0,88

Points of Critique

- Merging of heterogeneous datasets in analysis (difference in survey protocols, biogeographical variability).
- Use of national reference definitions: inconsistent basis, not allowing for use of ICM as absolute measure. The use of a common reference in macrophyte intercalibration is discussed in Annex V.

5.6 IC Option 2 Pilot Exercise

Intercalibration analyses according to Option 2 using ITEM were carried out for R-C2 (ES, FR, UK), R-C3 (AT, BE (WL), DE, FR, UK) and R-C4.x.2 (FR, PL, UK). Details on analytical procedure and results are given in Tables 12 to 14.

Figures 11 to 15 depict the results of applying validation criteria for reference and boundary setting (Species Response Group ratios, relationship of nutrients and common metric).

Table 12: Details on the R-C2 Pilot Intercalibration Exercise using ITEM according to Option 2

<table>
<tr><td colspan="12">GENERAL</td></tr>
<tr><td colspan="3">IC Type</td><td colspan="9">R-C2</td></tr>
<tr><td colspan="3">National Methods</td><td colspan="9">FR, ES, UK</td></tr>
<tr><td colspan="3">IC Option</td><td colspan="9">2 using ITEM</td></tr>
<tr><td colspan="12">COMPARISON</td></tr>
<tr><td colspan="3">National Method</td><td colspan="3">FR</td><td colspan="3">ES</td><td colspan="3">UK</td></tr>
<tr><td rowspan="4">Regression with ITEM</td><td colspan="2">#Surveys</td><td colspan="3">40</td><td colspan="3">60</td><td colspan="3">40</td></tr>
<tr><td colspan="2">Surveys' Origin</td><td colspan="3">MTR and IBMR survey data</td><td colspan="3">ES, UK, FR</td><td colspan="3">MTR and IBMR survey data</td></tr>
<tr><td colspan="2">R-square</td><td colspan="3">0,86</td><td colspan="3">1</td><td colspan="3">0,97</td></tr>
<tr><td colspan="2">Regression Equation</td><td colspan="3">ITEM = 9,6169 - 0,4193*x</td><td colspan="3">ITEM = 5,736 - 1,819*x</td><td colspan="3">ITEM = 8,4402 - 5,4246*x</td></tr>
<tr><td rowspan="4">Reference
+ Boundaries</td><td colspan="2"></td><td>national</td><td>ITEM</td><td>EQR_ITEM</td><td>national</td><td>ITEM</td><td>EQR_ITEM</td><td>national</td><td>ITEM</td><td>EQR_ITEM</td></tr>
<tr><td colspan="2">Ref (EQR=1)</td><td>13,20</td><td>4,08</td><td>1,00</td><td>1,000</td><td>3,92</td><td>1,00</td><td>1,00</td><td>3,02</td><td>1,00</td></tr>
<tr><td colspan="2">HG</td><td>12,50</td><td>4,38</td><td>0,95</td><td>0,958</td><td>3,99</td><td>0,99</td><td>0,91</td><td>3,50</td><td>0,93</td></tr>
<tr><td colspan="2">GM</td><td>11,60</td><td>4,75</td><td>0,89</td><td>0,719</td><td>4,43</td><td>0,92</td><td>0,79</td><td>4,15</td><td>0,84</td></tr>
<tr><td colspan="12">HARMONISATION</td></tr>
<tr><td colspan="3">Methods participating in harmonisation</td><td colspan="9">FR, PL, UK</td></tr>
<tr><td rowspan="6">Harmonisation Band</td><td rowspan="3">HG</td><td>upper</td><td colspan="9">1,01</td></tr>
<tr><td>mean</td><td colspan="9">0,96</td></tr>
<tr><td>lower</td><td colspan="9">0,91</td></tr>
<tr><td rowspan="3">GM</td><td>upper</td><td colspan="9">0,93</td></tr>
<tr><td>mean</td><td colspan="9">0,88</td></tr>
<tr><td>lower</td><td colspan="9">0,83</td></tr>
</table>

Table 13: Details on the R-C3 Pilot Intercalibration Exercise using ITEM according to Option 2

<table>
<tr><td colspan="18">GENERAL</td></tr>
<tr><td colspan="3">IC Type</td><td colspan="15">R-C3</td></tr>
<tr><td colspan="3">National Methods</td><td colspan="15">AT, BE (WL), DE, FR, UK</td></tr>
<tr><td colspan="3">IC Option</td><td colspan="15">2 using ITEM</td></tr>
<tr><td colspan="18">COMPARISON</td></tr>
<tr><td colspan="3">National Method</td><td colspan="3">AT</td><td colspan="3">DE</td><td colspan="3">FR</td><td colspan="3">UK</td><td colspan="3">BE (WL)</td></tr>
<tr><td rowspan="4">Regression with ITEM</td><td colspan="2">#Surveys</td><td colspan="3">156</td><td colspan="3">93</td><td colspan="3">74</td><td colspan="3">74</td><td colspan="3">74[13]</td></tr>
<tr><td colspan="2">Surveys' Origin</td><td colspan="3">AT, BE (WL), DE, FR, UK</td><td colspan="3">AT, BE (WL), DE, FR, UK</td><td colspan="3">MTR and IBMR survey data</td><td colspan="3">MTR and IBMR survey data</td><td colspan="3">MTR and IBMR survey data</td></tr>
<tr><td colspan="2">R-square</td><td colspan="3">0,51</td><td colspan="3">0,56</td><td colspan="3">0,88</td><td colspan="3">0,91</td><td colspan="3">0,88</td></tr>
<tr><td colspan="2">Regression Equation</td><td colspan="3">ITEM = 9,7141 - 6,1736*x</td><td colspan="3">ITEM = 6,8159 - 3,9725*x</td><td colspan="3">ITEM = 9,7174 - 0,4341*x</td><td colspan="3">ITEM = 8,2833 - 5,4458*x</td><td colspan="3">ITEM = 9,7174 - 0,4341*x</td></tr>
<tr><td rowspan="4">Reference + Boundaries</td><td colspan="2"></td><td>national</td><td>ITEM</td><td>ITEM_EQR</td><td>national</td><td>ITEM</td><td>ITEM_EQR</td><td>national</td><td>ITEM</td><td>ITEM_EQR</td><td>national</td><td>ITEM</td><td>ITEM_EQR</td><td>national</td><td>ITEM</td><td>ITEM_EQR</td></tr>
<tr><td colspan="2">REF</td><td>1,00</td><td>3,54[14]</td><td>1,00</td><td>1,00</td><td>2,84</td><td>1,00</td><td>14,70</td><td>3,34</td><td>1,00</td><td>1,00</td><td>2,84</td><td>1,00</td><td>15,00</td><td>3,21</td><td>1,00</td></tr>
<tr><td colspan="2">HG</td><td>0,875</td><td>4,31</td><td>0,88</td><td>0,75</td><td>3,84</td><td>0,86</td><td>13,30</td><td>3,94</td><td>0,91</td><td>0,91</td><td>3,33</td><td>0,93</td><td>14,25</td><td>3,53</td><td>0,95</td></tr>
<tr><td colspan="2">GM</td><td>0,625</td><td>5,86</td><td>0,64</td><td>0,50</td><td>4,83</td><td>0,72</td><td>12,00</td><td>4,51</td><td>0,82</td><td>0,79</td><td>3,98</td><td>0,84</td><td>11,07</td><td>4,91</td><td>0,75</td></tr>
<tr><td colspan="18">HARMONISATION</td></tr>
<tr><td colspan="3">Harmonisation Procedure</td><td colspan="15">mean of ITEM_EQR values corresponding to national HG and GM boundary +/- 5% confidence interval</td></tr>
<tr><td colspan="3">Methods participating in harmonisation</td><td colspan="15">AT, BE (WL), DE, FR, UK</td></tr>
<tr><td rowspan="6">Harmonisation Band</td><td rowspan="3">HG</td><td>upper</td><td colspan="15">0,96</td></tr>
<tr><td>mean</td><td colspan="15">0,91</td></tr>
<tr><td>lower</td><td colspan="15">0,86</td></tr>
<tr><td rowspan="3">GM</td><td>upper</td><td colspan="15">0,81</td></tr>
<tr><td>mean</td><td colspan="15">0,76</td></tr>
<tr><td>lower</td><td colspan="15">0,71</td></tr>
</table>

[13] differing from Galoux (2007) due to use of broader database
[14] AT assumes higher trophic basic state of national R-C3 typ. Further research is carried out to validate this assumption.

Table 14: Details on the R-C4.x.2 Pilot Intercalibration Exercise using ITEM according to Option 2

<table>
<tr><td colspan="12">GENERAL</td></tr>
<tr><td colspan="3">IC Type</td><td colspan="9">R-C4.x.2</td></tr>
<tr><td colspan="3">National Methods</td><td colspan="9">FR, PL, UK</td></tr>
<tr><td colspan="3">IC Option</td><td colspan="9">2 using ITEM</td></tr>
<tr><td colspan="12">COMPARISON</td></tr>
<tr><td colspan="3">National Method</td><td colspan="3">FR</td><td colspan="3">PL</td><td colspan="3">UK</td></tr>
<tr><td rowspan="4">Regression with ITEM</td><td colspan="2">#Surveys</td><td colspan="3">100</td><td colspan="3">243</td><td colspan="3">170</td></tr>
<tr><td colspan="2">Surveys' Origin</td><td colspan="3">MTR and IBMR survey data</td><td colspan="3">PL (national dataset)</td><td colspan="3">UK (national dataset)</td></tr>
<tr><td colspan="2">R-square</td><td colspan="3">0,58</td><td colspan="3">0,46</td><td colspan="3">0,82</td></tr>
<tr><td colspan="2">Regression Equation</td><td colspan="3">ITEM = 8,5424 - 0,2388*x</td><td colspan="3">ITEM = 7,7225 - 0,0374*x</td><td colspan="3">ITEM = -0,5063 + 0,8869*x</td></tr>
<tr><td rowspan="4">Reference
+ Boundaries</td><td colspan="2"></td><td>national</td><td>ITEM</td><td>EQR_ITEM</td><td>national</td><td>ITEM</td><td>EQR_ITEM</td><td>national</td><td>ITEM</td><td>EQR_ITEM</td></tr>
<tr><td colspan="2">Ref (EQR=1)</td><td>11,80</td><td>5,72</td><td>1,00</td><td>48,4</td><td>5,91</td><td>1,00</td><td>6,95</td><td>5,66</td><td>1,00</td></tr>
<tr><td colspan="2">HG</td><td>10,75</td><td>5,98</td><td>0,94</td><td>44,5</td><td>6,06</td><td>0,96</td><td>7,22</td><td>5,90</td><td>0,94</td></tr>
<tr><td colspan="2">GM</td><td>9,50</td><td>6,27</td><td>0,87</td><td>35,0</td><td>6,41</td><td>0,88</td><td>7,59</td><td>6,23</td><td>0,87</td></tr>
<tr><td colspan="12">HARMONISATION</td></tr>
<tr><td colspan="3">Harmonisation Procedure</td><td colspan="9">mean of ITEM values corresponding to national HG and GM boundary +/- 5% confidence interval</td></tr>
<tr><td colspan="3">Methods participating in harmonisation</td><td colspan="9">FR, PL, UK</td></tr>
<tr><td rowspan="6">Harmonisation Band</td><td rowspan="3">HG</td><td>upper</td><td colspan="9">1,00</td></tr>
<tr><td>mean</td><td colspan="9">0,95</td></tr>
<tr><td>lower</td><td colspan="9">0,90</td></tr>
<tr><td rowspan="3">GM</td><td>upper</td><td colspan="9">0,92</td></tr>
<tr><td>mean</td><td colspan="9">0,87</td></tr>
<tr><td>lower</td><td colspan="9">0,82</td></tr>
</table>

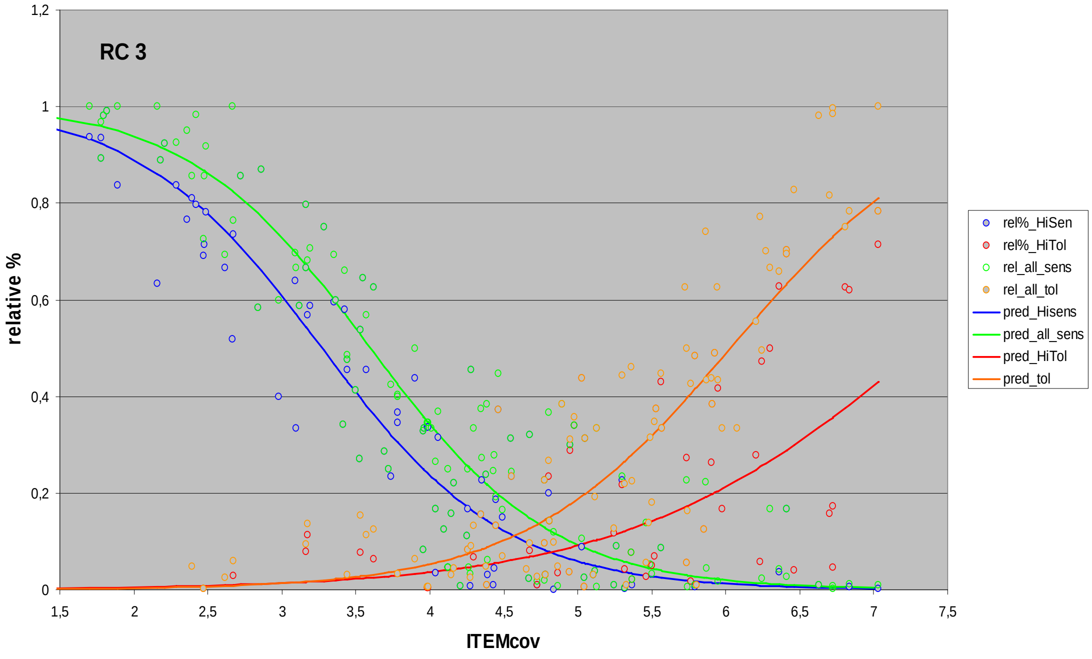


Figure 11: Change in representation of four response groups along a putative enrichment gradient within R-C3 rivers. ITEM scores were calculated using percentage cover weighted species scores. The summed representation of each group was modelled in relation to the parent ITEM value using logistic regression.

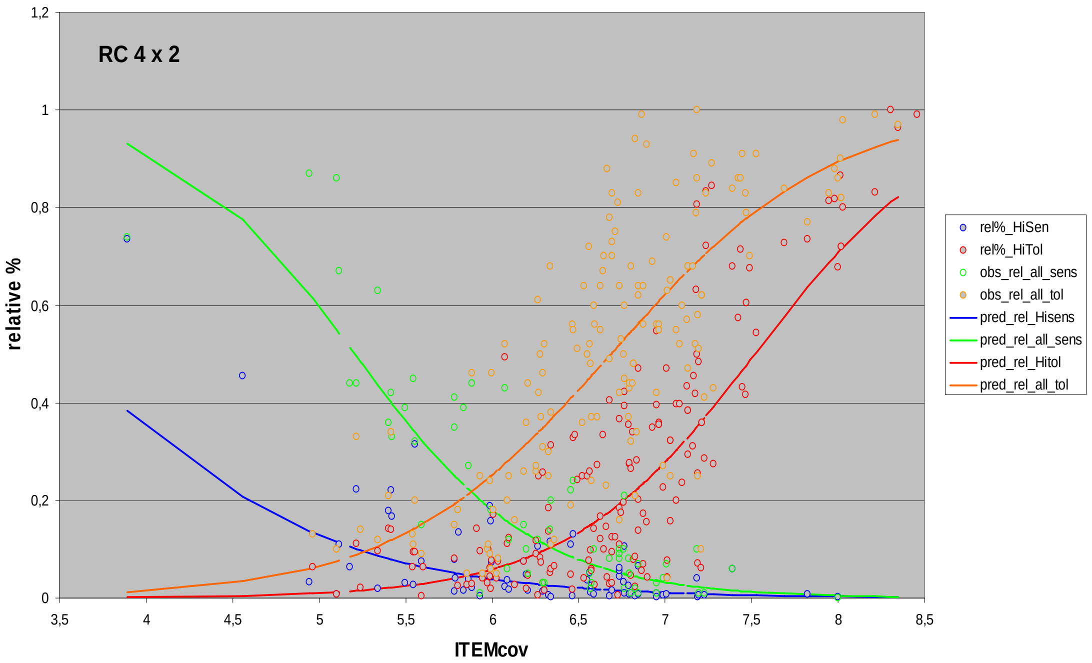


Figure 12: Change in representation of four response groups along a putative enrichment gradient within R-C4.x.2 rivers. ITEM scores were calculated using percentage cover weighted species scores. The summed representation of each group was modelled in relation to the parent ITEM value using logistic regression.

Figure 13: Species Response Group ratios at national reference and boundary definitions for R-C3[15].

[15] AT assumes higher trophic basic state of national R-C3 typ. Further research is carried out to validate this assumption.

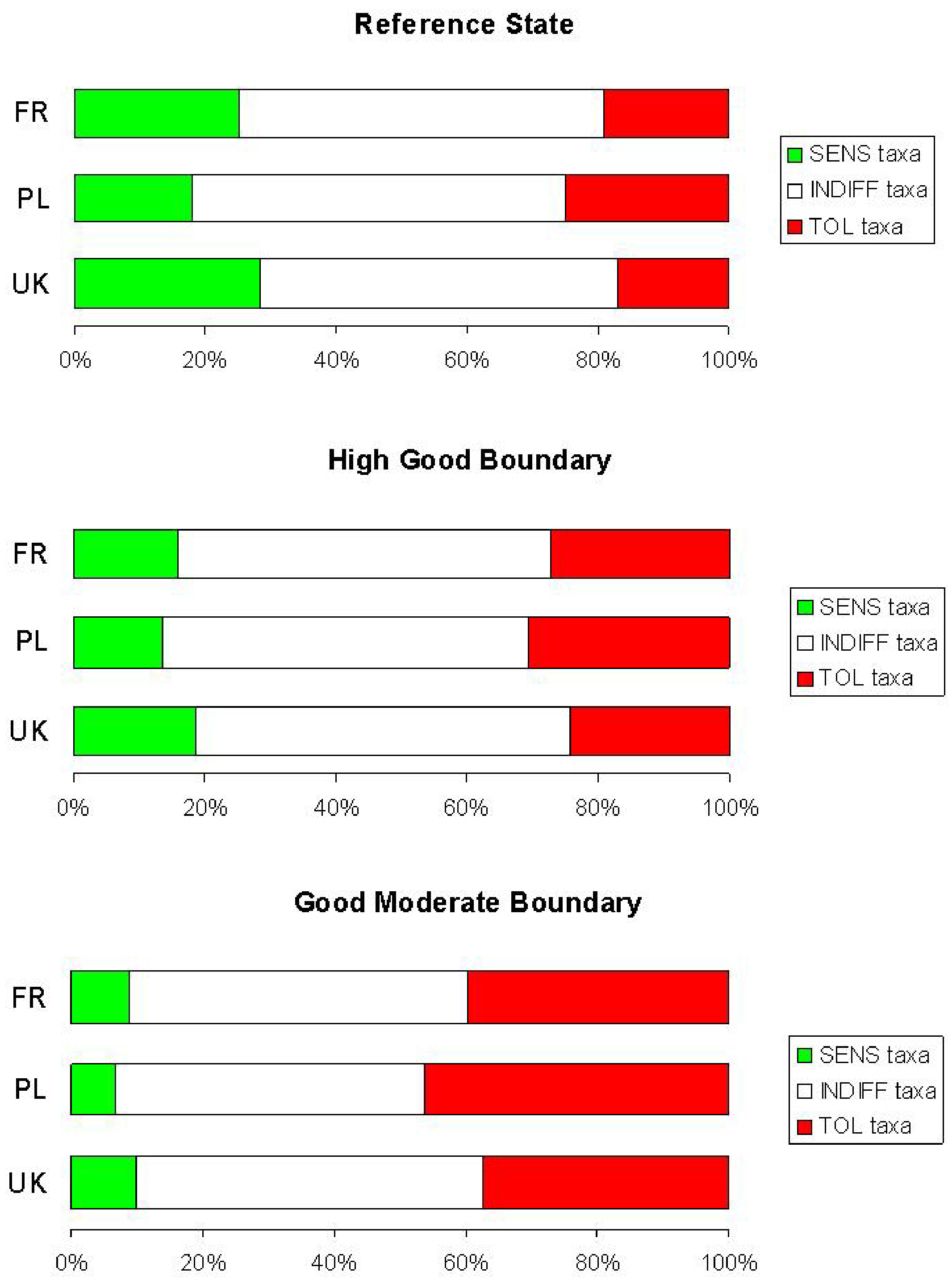


Figure 14: Species Response Group ratios at national reference and boundary definitions for R-C4.x.2.

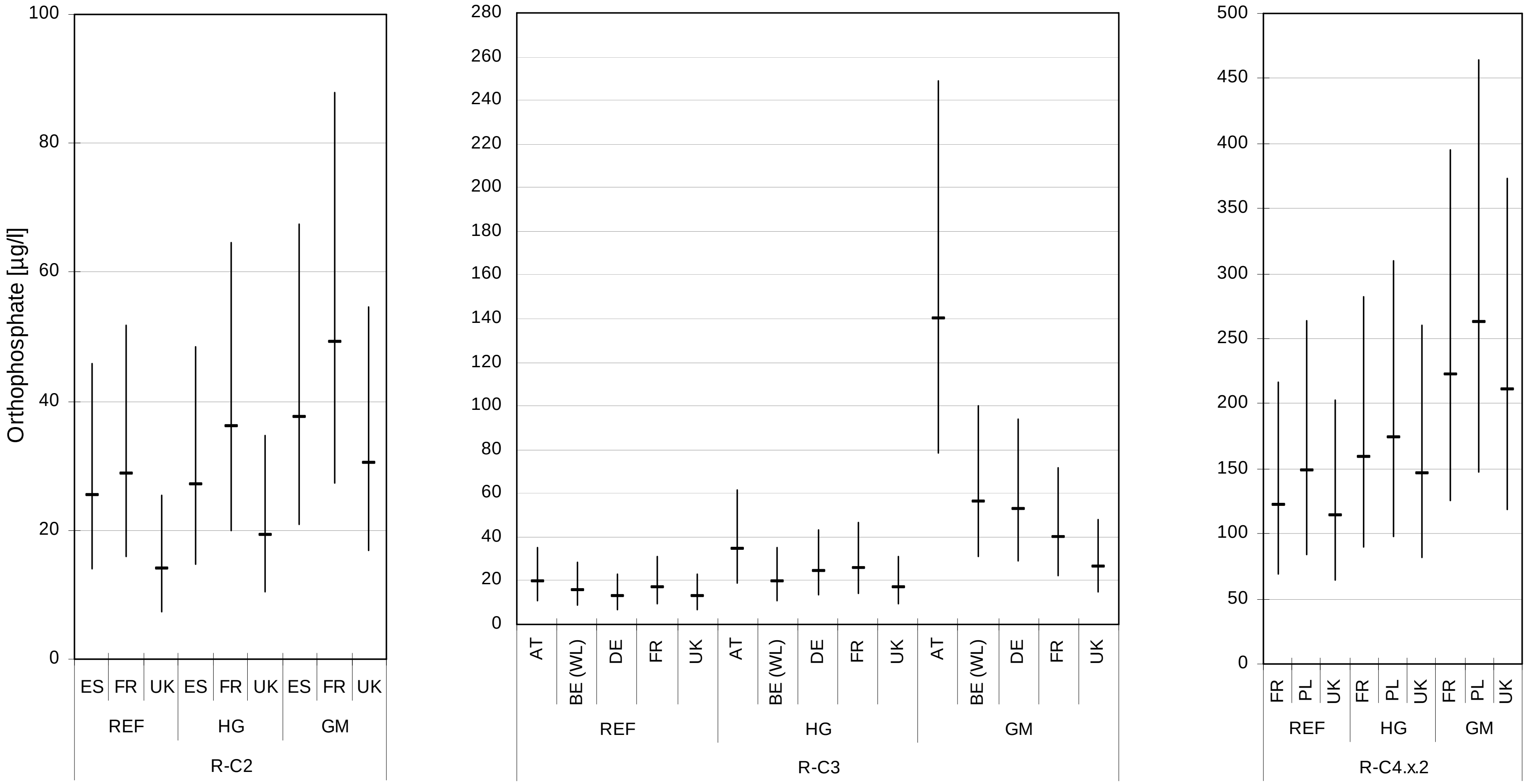


Figure 15: Predicted SRP (=Ortho-Phosphate) ranges (mean +/- standard error) at ITEM values corresponding to national reference (REF), high-good (HG) and good-moderate (GM) boundaries of IC Types R-C2, R-C3 and R-C4.x.2. SRP - ITEM relationship derived on the basis of British datasets[16].

[16] AT assumes higher trophic basic state of national R-C3 typ. Further research is carried out to validate this assumption.

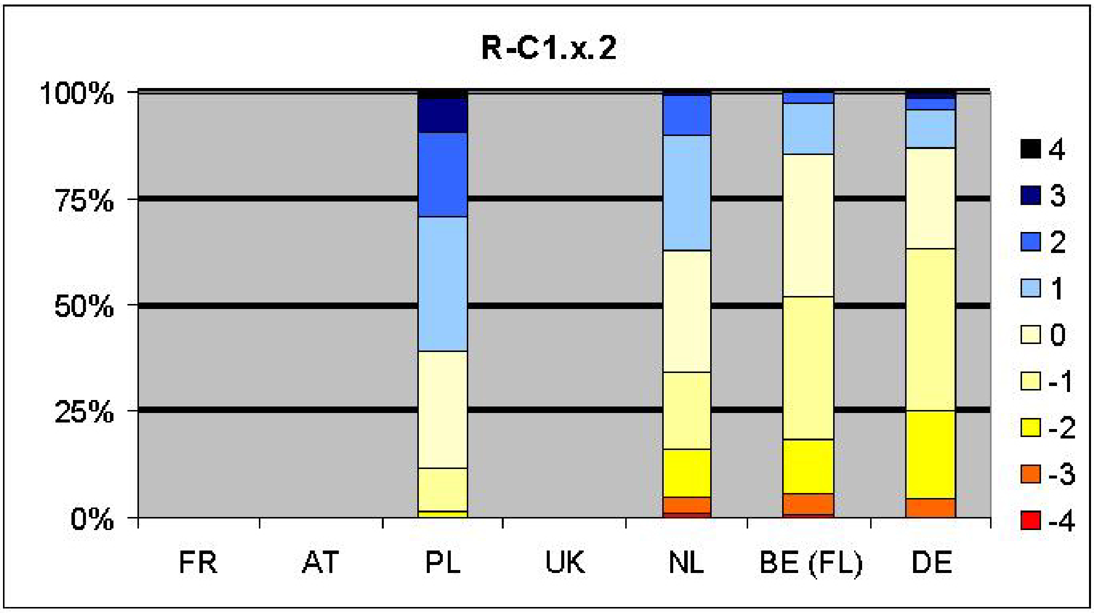
6 Intercalibration Option 3: Direct Comparison

6.1 Application of the CB lakes GIG approach

In an attempt to circumvent difficulties in applying Option 2 due to weak correlations between some national classifications and the common metric we applied Option 3 to three types, R-C1.x.2, R-C3 and R-C4.x.2. The first approach is the same as developed for Option 3 in the CB lakes GIG macrophyte intercalibration. This approach takes the class awarded to all water bodies in a common dataset by each of the participating countries, recodes this to a numerical value, and then assesses, for each pair of countries, the numerical difference in class (e.g. 5= High, 1=Bad, difference = 4). The distribution of pairwise comparisons can then be assessed as the % of comparisons with no difference, through to +4 (4 classes better) or -4 (4 classes worse). A high % of comparisons (e.g. 75%) falling within one class (i.e. -1 to +1), coupled with a low weighted average class difference (e.g. -0.25 to +0.25) indicating a low directional bias, could be deemed to provide successful intercalibration.

The results of applying Option 3 in this format are illustrated below.

R-C1.x.2

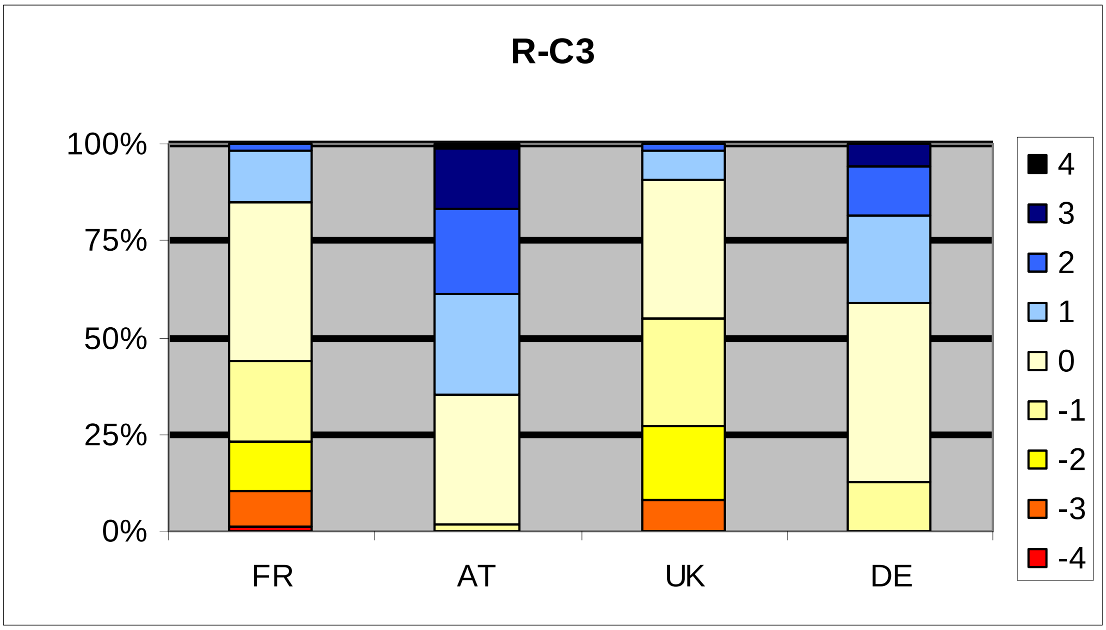


	FR	AT	PL	UK	NL	BE	DE
WA			0.88354		-0.068966	-0.588353	-0.72956
|DC|<=1			0.694099		0.730408	0.789157	0.704403
n			644		638	498	318

In the above figure the distribution of outputs of pairwise comparisons (n in the above table) is shown for each country. Increasing amounts of blue in a bar indicate that the country is more relaxed in its classification relative to the other countries while increasing yellow indicates that it is relatively more precautionary. Thus in the above table the WA figure expresses the weighted average class difference between that country and the other countries (currently with a threshold acceptability of ±0.25) while the DC<=1 figure indicates the proportion of pairwise comparisons that lie within one class of each other (with a threshold acceptability of >0.75).

The overall position for R-C1.x.2 is that all countries are non-compliant in their view. BE (FL), DE and – somewhat less - NL show reasonable agreement, but PL assesses sites on average 0.88 of a class higher than the others. Overall, no countries reach the required standard.

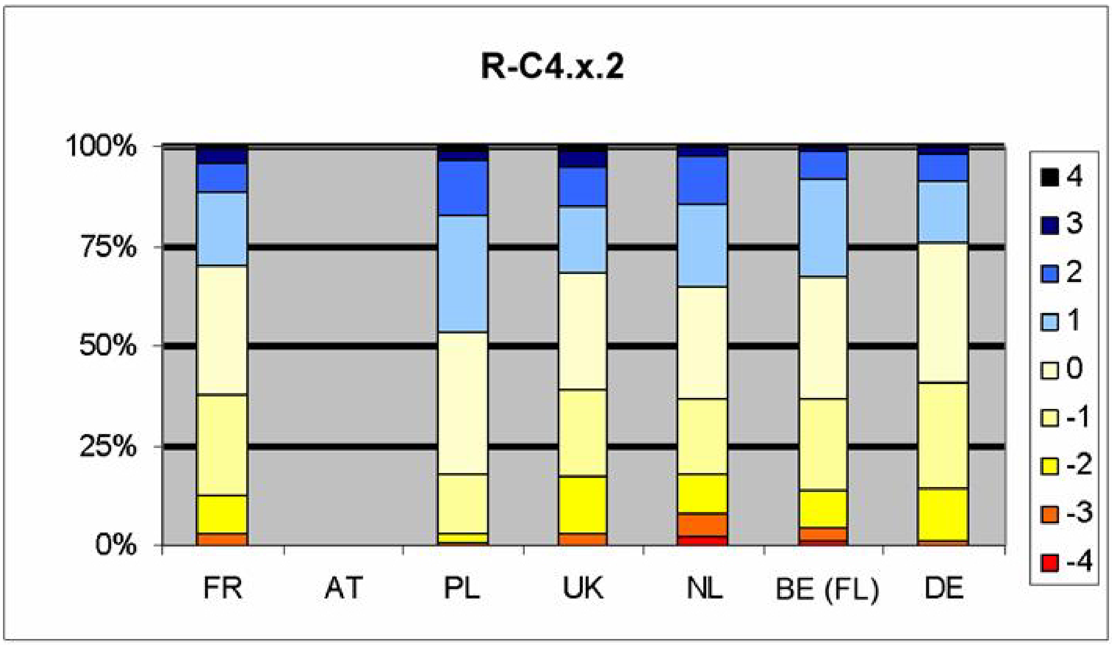
R-C3



	FR	AT	PL	UK	NL	BE	DE
WA	-0.613963	1.192308		-0.798768			0.522727
|DC|<=1	0.75154	0.615385		0.712526			0.814935
n	487	442		487			308

The immediate feature of this analysis is that one country (AT) adopts a relatively highly relaxed view, two countries a highly precautionary view (FR and UK) and one country (DE) an intermediate view. In such circumstances, while the proportion of comparisons falling within one class are typically fairly high, the weighted average class differences are widely contrasting and well outside the acceptable limits. Thus AT, on average, classifies a site 1.2 classes higher than the other countries, while UK classifies a site 0.8 classes lower.

R-C4.x.2



	FR	AT	PL	UK	NL	BE	DE
WA	-0.069		0.466	-0.059	-0.123	-0.143	-0.222
|DC|<=1	0.757		0.797	0.677	0.678	0.785	0.767
n	779		775	779	674	455	460

The results for R-C4.x.2 are somewhat more encouraging than R-C1.x.2 in so far as most countries have a weighted average class difference between -0.25 and +0.25 and/or are close to the 0.75 threshold for comparisons within one class. However, these results must remain questionable if PL is retained in the analysis. The more relaxed position of this country effectively creates an impression of relative precaution by the other countries which would be removed on exclusion of PL from the analysis.

6.2 Application of class-by-class approach

Although the present approach has a number of attractions it has several weaknesses. Among these are the following;

(1) The method makes comparisons across the range of classifications (i.e. high to bad), not just those classes or boundaries on which IC is supposed to focus.

(2) It is not readily evident from the results where the major differences in classification lie, e.g. whether between specific classes or specific countries.

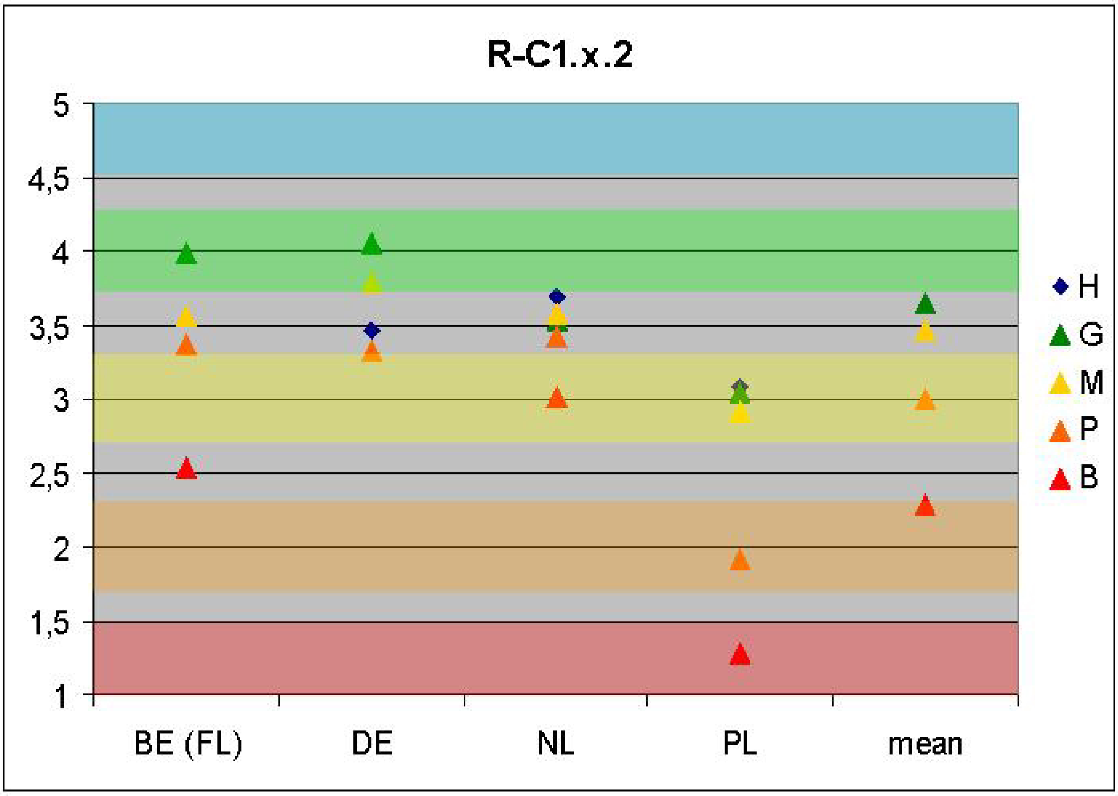
(3) In contrast to Option 2 it is not immediately clear, if and by how much, countries need to change their classification in order to successfully intercalibrate. Hence this approach highlights the problem but not the solution.

The revised approach presented here is built on the basics of the earlier Option 3 approach and attempts to deal with some of the above problems. This approach takes the classification of a single country and compares the classification of each site with the average view of the other countries of that site, on a class by class basis. Thus if country A classifies a site as 5 (high) and three other countries classify that site as 5, 4 and 3 (high, good and moderate) respectively, the average view of country A’s classification of that site is 4 (good). This is repeated for all sites classified as high, good, etc. by country A and the global average of the view of the other three countries is calculated for all sites classified as high, good etc. This step is then repeated for each of the other 3 countries in turn, this time including the view of country A in the averaging. Although expressing class on an ordinal scale is highly simplistic, the average of such values can be interpreted in a normal numerical sense. For example, if the average view of country B of sites classified by country A as high (5) is 4.5, this implies that country B considered half the sites high and half good. By contrast, if all countries share exactly the same view then the average view of High status sites will be 5, good status sites will be 4, etc. Similarly, it is possible to set fixed values of what an acceptable average view would be. For example, if 50% of sites must be classified the same, 35% up to one class different and 15% up to 2 classes different, the *minimum* average view by other countries of a national classification of good sites would be 0.5*4+0.35*3+0.15*2 = 3.35. Another approach, which is advocated here, is to set fixed band widths for harmonisation of ±0.25 of the class. Thus, for sites classified as good the harmonisation band would lie between 3.75 and 4.25.

The advantage of this approach is that points of deviation in classification and the scale of this deviation become more readily apparent. Thus it is more clear where countries need to consider revising their class boundaries and by how much.

The results of applying Option 3 in the revised format are illustrated below.

R-C1.x.2

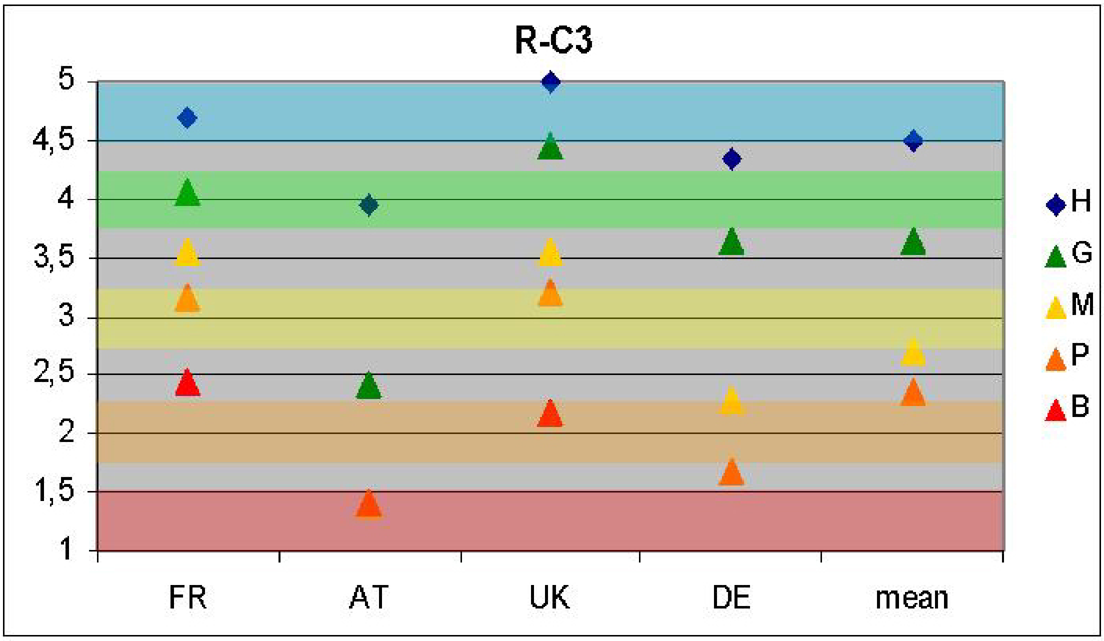


Class	BE	DE	NL	PL	MEAN	accept. min	accept. max
H		3,46	3,69	3,09	3,41	4,5	5
G	3,98	4,06	3,53	3,04	3,65	3,75	4,25
M	3,57	3,79	3,58	2,92	3,47	2,75	3,25
P	3,36	3,32	3,42	1,92	3,01	1,75	2,25
B	2,54		3,02	1,28	2,28	1	1,5
weighted mean diff all	*0,60*	*0,72*	*0,32*	*-0,98*	*0,01*	*-0,25*	*0,25*
weighted mean diff H-M	*0,33*	*0,27*	*-0,16*	*-1,02*	*-0,36*	*-0,25*	*0,25*

In the above figure the y axis is the average view of the other countries of sites placed in that class by each country on the x axis. The shaded area, which might be envisaged as a harmonisation band, is fixed at 0.25 class width units of the national view. Note that for H and B status the band width runs from the limit of the range for 0.5 units in order to achieve comparable band widths and to allow for the fact that the numerical scale is constrained to run from 1 to 5. The average assessments are reproduced in the above table with the acceptable upper and lower limits, plus the mean difference (weighted by the number of sites in that class for each country) between the international and national view. This average is expressed firstly across all classes and secondly across the upper three classes only. Negative values indicate that the international view is lower than the national view (i.e. the national view is relaxed) while positive values indicate that the international view is higher than the national view (i.e. the national view is precautionary).

In this instance no countries have a consistent view of High status and there is no emergent view that is endorsed by other countries. In such an event it is plain that intercalibration cannot proceed further. In assessing the remaining classes both BE and DE have a view of good status sites that falls within the thresholds of acceptability. PL only have an acceptable view of the three lower status classes. Several countries have values for individual classes that are higher rather than lower than the value for the next class up. In terms of the overall mean NL have the lowest value but this lies outside the levels of acceptability (if these are set at ± 0.25 class) for all classes and NL clearly does not discriminate effectively between classes based on the assessment of other countries. Like several other countries this position is largely achieved through being precautionary, in the view of other countries, in the assessment of Poor or Bad status sites. In terms of the upper three classes NL has the strongest position even though no classes individually fall within the acceptability range and PL is clearly too lenient in its classification at H and G status while DE and BE perform intermediately.

R-C3

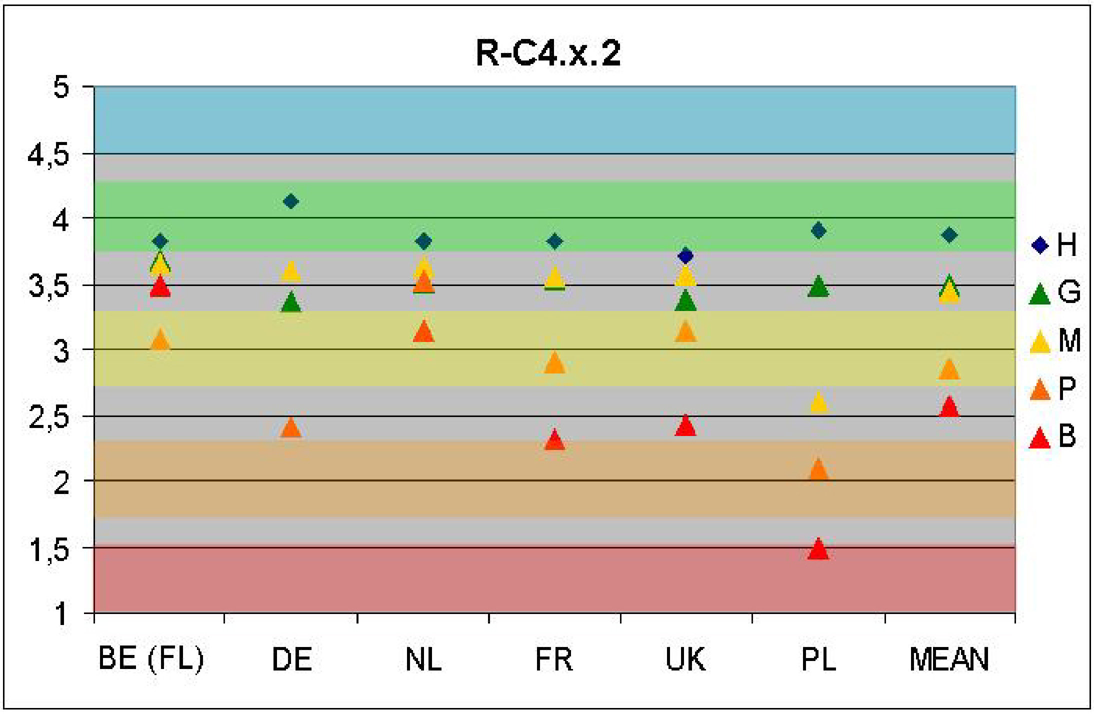


Class	FR	AT	UK	DE	accept. min	accept. max
H	4,67	3,94	4,89	4,29	4,5	5
G	3,96	2,53	4,46	3,68	3,75	4,25
M	3,58	1,49	3,56	2,49	2,75	3,25
P	3,14	1,5	3,16	1,65	1,75	2,25
B	2,53		2,34		1	1,5
weighted mean diff all	*0,62*	*-1,25*	*0,73*	*-0,5*	*-0,25*	*0,25*
weighted mean diff H-M	*-0,02*	*-1,26*	*0,36*	*-0,51*	*-0,25*	*0,25*

In the case of R-C3 rivers there is an emergent shared view of High status with the mean across all countries falling inside the band of acceptability. However AT has an extremely relaxed view, notably in relation to Good status sites. Consequently there is no agreement at a common level in relation to G and FR is the only country to fall inside the band for this class. In terms of M status, although the common view lies inside the band, no individual countries meet this requirement because the very relaxed position of AT offsets the more precautionary position of the other countries. FR, UK and DE are too conservative with regard to the lower classes.

The weighted mean difference across all classes shows considerable variation and reflects the contrast between a relaxed and several more precautionary views. In such instances it is impossible for any one country, with the possible exception of FR, to achieve an acceptable view. The analysis would be best repeated with AT excluded. The resultant values could then be set as the fixed target for AT to achieve. The degree of discrepancy between the view of AT and the other countries might suggest that the IC type definition has not been interpreted sufficiently robustly.

R-C4.x.2



Class	BE	DE	NL	FR	UK	PL	MEAN	accept. min	accept. max
H	3,83	4,13	3,83	3,99	3,8	4	3,93	4,5	5
G	3,69	3,37	3,51	3,66	3,67	3,53	3,57	3,75	4,25
M	3,65	3,62	3,63	3,55	3,63	2,62	3,45	2,75	3,25
P	3,18	2,53	3,55	2,97	3,15	1,95	2,89	1,75	2,25
B	4,13		3,38	2,33	2,51		3,09	1	1,5
weighted mean diff all	*0,07*	*0,17*	*-0,03*	*0,17*	*0,22*	*-0,51*	*0,00*	*-0,25*	*0,25*
weighted mean diff H-M	*-0,11*	*0,12*	*-0,30*	*-0,20*	*-0,27*	*-0,54*	*-0,25*	*-0,25*	*0,25*

In this instance no countries have a view of high status that is within the threshold of acceptability. DE hold the closest to a view that is endorsed by other countries but even this is well below the threshold required. In no case does the average view across all countries for any one class fall inside the window of acceptability. The average view across all classes shows acceptably low values in most cases but this is distorted by the relaxed view of PL in the highest three classes. Consequently, when assessing the top three classes only, the degree of deviation is much higher.

While PL have the least precautionary overall view they are the only country to fall within the harmonisation band for any single class, and arguably provide the most useful classification in terms of the ability to discriminate between classes.

Arguably, the thresholds of acceptability may be set too stringently for this approach. However, relaxing these to ± 0.33 or ± 0.40 would make little difference in this particular case.

6.3 Joint evaluation of lowland datasets

The results of the class-by-class approach suggest that there is no common view at all on High status and only an emerging common view of some countries on Good status in R-C1.x.2. In RC-3 and R-C4.x.2 the situation is a little better but the deviation is far too high for agreement and much stronger than expected, especially if comparing Option 2 and 3 in R-C3.

Joint evaluation of individual sites from the lowland dataset within the CBrivGIG intercalibration exercise revealed general agreement about type-specific biological communities at high status. This common view was not always reproduced by the classification results of national schemes. It became clear that the application of national methods on other county's data is a very strong source of error. Incomplete data lead to misinterpretation and misassessment up to several classes difference. In the subsequent discussions it also became evident that community aspects other than taxonomical composition (e.g. as measured by the computation of the weighted average of indicator species scores) are decisive.

The discussion revealed an overall potential weakness of Option 3 fully exposed in this exercises: It strongly depends on correct application of each other's data. For every national assessment method several adjustments were suggested to cope with the misassessment problems. Among them were adjustments of indicator values of certain species and provisional adjustments for partially missing information, but also exclusion of certain samples with unsolvable lack of information for certain countries' assessment methods.

6.4 General points in relation to IC Option 3

Among the conclusions of implementing Option 3 in the CBrivGIG common dataset are the following:

(1) Option 3 will not produce intercalibration if national methods are measuring different aspects of the BQE or reflecting different pressures to which the BQE responds. However, from the joint evaluation exercise it appeared that most countries' assessment methods reflect a combination of pressures with varying emphasis, generally focussing on the most significant pressure. Correlation between the effects of the different pressures lead to a common view of High status; there are diverse views on lower quality status.

(2) Refinements to the Option 3 approach are useful for highlighting major areas of difference between countries or classes that are particularly problematic.

(3) When Option 3 is applied across all classes there is a risk that classifications which are relatively precautionary within the lower classes will compensate for the effect of classifications that are too relaxed in the higher classes. Option 3 should therefore focus on the higher classes and should secure harmonisation at individual class level rather than an average view across classes.

(4) A band width for harmonisation of ± 0.25 class may be too stringent for the application of this approach. It is impossible to assimilate the distribution of EQR values within a class and transferring the rationale used for CBrivGIG invertebrate classification (i.e. an ICM EQR harmonisation band based on the global mean ± 0.05 since 0.05 is 25% of a class width if the EQR range from 0-1 is divided equally into 5 classes) may not therefore be appropriate. A wider harmonisation band (± 0.33 or ± 0.40) should be considered, although in practice this would have made little difference in the above examples.

(5) Successful harmonisation will involve both downgrading by the most precautionary countries and upgrading by the most relaxed countries. Upgrading alone will not achieve intercalibration by this route. Forcing precautionary countries that have interpreted the normative definitions correctly to reassess their classifications to achieve a consensus view could be politically dangerous. Thus the Option 3 approach in general might be improved by removing the country with the most deviant view at the first iteration, proceeding with remaining countries and presenting their combined view as a target for the country that was removed. Retaining countries which, it might be argued, have misinterpreted the normative definition, or, are submitting sites that do not match the general view of that IC type, is likely to demand large, and probably unjustified adjustments by other countries.

(6) In comparison to Option 2, it appears that countries falling outwith the bands of acceptability in Option 3 must make quite substantial changes to their classifications in order to harmonise (based on the thresholds currently set). If these changes do not involve some reciprocal accommodation by other countries it seems that the scale of change in class boundary value that is required is considerably greater than would be needed in order to fall inside a harmonisation band constructed through Option 2. In this respect Option 3 is highly conservative. To make the approaches more comparable the thresholds currently operated within Option 3 could be relaxed slightly.

7 Discussion

Review of macrophyte assessment concepts in the context of WFD intercalibration

According to Annex V WFD macrophytes and phytobenthos represent two components of a single biological quality element. The macrophyte part of the normative definitions refers to taxonomic composition and abundance as key parameters of ecological status assessment. At high status composition (nearly) totally corresponds to undisturbed conditions, and changes in average abundance are not detectable. Both parameters show slight changes at good status, but no accelerated growth that may impair other quality elements is observable. The moderate status features significantly more distortion of the macrophyte composition, and moderate changes in the average abundance are evident.

The normative definitions specify biological response to anthropogenic disturbance and classify this impact by the degree of deviation from undisturbed conditions. The reference concept thus plays a central role in ecological status assessment. No specification is given with regard to the cause of disturbance, and identification of pressures is not considered in the classification of ecological status.

However, the idea of pressure-related assessment is included in the design of numerous classification schemes. Pressure-impact relationships are basis for the selection of bioindicators and used to confirm the performance of assessment indices. Pressure-specific monitoring also assists in the implementation of the programme of measures. In this respect, many European macrophyte methods currently focus on the assessment of **eutrophication** pressure.

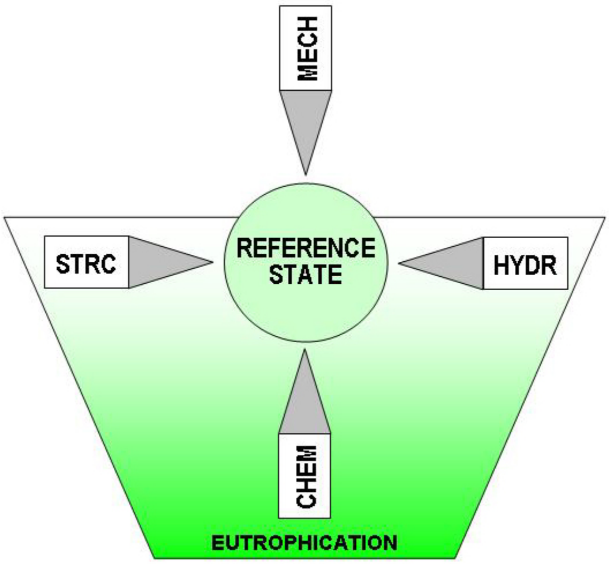


Figure 16: Main pressures influencing the macrophyte community at a river site. Eutrophication results from nutrient enrichment (CHEM) and depends on hydrological (HYDR) and structural (STRC) integrity at both channel and floodplain level (MECH – mechanical disturbance).

The macrophyte community at river sites is shaped by abiotic factors such as light availability, flow conditions and dynamics, hydromorphology (sediment composition, bank structure) and nutrient supply. Main biological factor is the competition for resources (space, light, nutrients). Various anthropogenic activities can directly or indirectly manipulate these parameters and thus exert influence on macrophytic composition and abundance. The four major types of pressure, to which river vegetation responds at the site-scale, are: hydrological, structural, chemical and mechanical.

Eutrophication is defined as accelerated production of organic matter usually caused by an increase in the amount of nutrients being discharged to the water body. Contributing factors emerge from reduced current velocity, accumulation of fine sediments (e.g. due to damming) and impaired hydromorphological conditions (e.g. distorted riparian corridor). Therefore, the appraisal of eutrophication represents an integrative assessment concept combining the effects of chemical, hydrological and structural pressures (Figure 16).

Compared to mountain streams the trophic gradient in lowland river systems is narrowed. The latter feature more fertile conditions already in the natural state (Figure 17). Along with increasing nutrient enrichment species-turnover is less pronounced, resulting in a comparatively small range of potential trophic indication. In addition, almost all lowland river sites in Europe are disturbed by a multitude of pressures. Besides diffuse nutrient pollution, stream modification and mechanical disturbance (e.g. weed cutting, navigation, recreation activities) are co acting, directly influencing the macrophyte community.

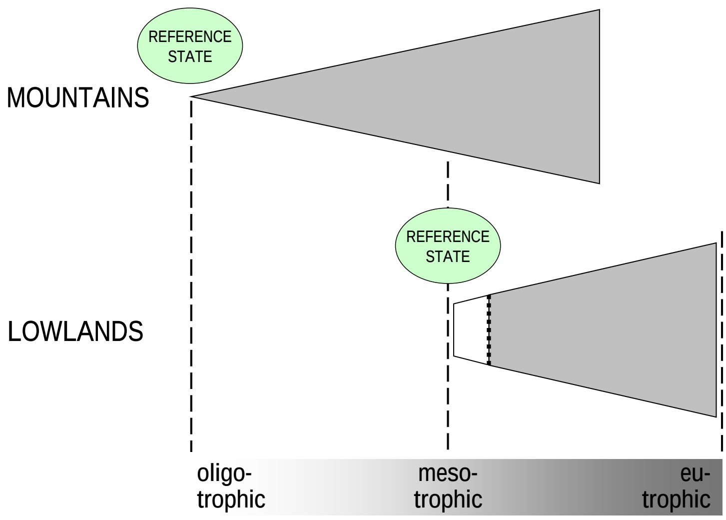


Figure 17: Trophic gradients in mountain and lowland river systems. For European lowlands the actual gradient (right of dotted line) might even be smaller due to large scale agricultural influence and the lack of existing reference sites.

Against this background recent lowland assessment concepts focus on a more holistic and less diagnostic appraisal of river macrophyte communities. Methods are oriented towards a non-specific indication of pressures, including eutrophication among other factors of impairment. A novel aspect in quality classification is the consideration of macrophytic growth forms. The combination of taxonomical composition measures and functional community attributes renders statements of ecological status different from eutrophication assessments. Use of functional groups/life forms reflects key biological traits that determine response to a range of multiple pressures rather than species level metrics linked to discrete pressures.

Implications for intercalibration

Different assessment concepts account for the use of divergent classification schemes. Among methods participating in intercalibration two groups of schemes can clearly be distinguished according to the explanations given above. At the moment intercalibration tools are available to compare schemes focussing on nutrient pressure, or to intercalibrate at common types in which eutrophication gradients play the major role (mountain rivers). Compositional measures focussing on eutrophication pressures are integrated in holistic lowland assessment methods, either in the general metric design or as discrete part of the multi-metric appraisal. These measures are thus only representing some "least common denominator" when intercalibrating lowland schemes.

Joint evaluation of lowland datasets within the CBrivGIG intercalibration exercise revealed general agreement about type-specific biological communities at high status. This common view was not always reproduced by the classification results of national schemes[17]. In the subsequent discussions it became evident that community aspects other than taxonomical composition (e.g. as measured by the computation of the weighted average of indicator species scores) are decisive. This suggests that a harmonisation of assessment concepts will facilitate the completion of intercalibration: Countries employing schemes focussing on the effects of nutrient pressure are recommended to additionally consider aspects of community richness and function. In this regard the development of an integrative common multi-metric index for lowland rivers has to be tackled, enabling an intercalibration according to Option 2. The above mentioned agreement about high status' conditions is encouraging and underlines its general feasibility.

Anticipated work plan

Against this background it is planned to continue the work of the CBrivGIG macrophyte group. During its almost 2 years of existence the group established an active forum for international cooperation comprising exchange of ideas including the development and discussion of harmonised approaches.

The work ahead shall cover

- Compilation of additional data (2007 monitoring cycle),
- Definition of a common reference basis (see also Annex V),
- Development of integrative common multi-metric index,
- Analysis of amended national assessment methods,
- Parallel continuation/advancement of IC Option 3 approach.

A tentative work schedule is given in Table 15.

Table 15: Tentative work plan for the continuation of the CBrivGIG macrophyte intercalibration exercise

date	task
December 2007	- additional data delivery incl. reference screening - update on national macrophyte methods
April 2008	- preliminary intercalibration results
September 2008	- final intercalibration results

[17] However, most of the deviation seemed to be caused by misinterpretation of data because of incompleteness for the national assessment method of other countries. Future adjustments of the analysis will most probably improve intercalibration according to Option 3.

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Annex I: List of ITEM scoring taxa and (sub-)type specific response groups

ITEM: Index of Trophy for European Macrophytes
Group: ALG – Algae; BRh - Liverworts; BRm – Mosses; PHe – Helophytes; PHg - Hygrophytes; PHy – Hydrophytes; PHx – Other forms (wetland taxa); PTE – Pteridophytes
Aquaticity: 1 - Exclusively aquatic species (or mainly aquatic in regular conditions); 2 - Aquatic taxon with common terrestrial forms or truly amphibious (common aquatic forms as well as terrestrial forms); 3 - Supra-aquatic bryophyta and lichens. Commonly submersed a part of the hydrological cycle; 4 - Helophytes or Amphiphytes. Erected forms with basis commonly inside water; 5 - Hygrophilous taxa. Possibly submersed (at least the basis) a part of the year; 6 - Bank, wood, grasslands or ruderal herbaceous species. May be found in water accidentally or in high flow conditions; 7 - Woody riparian species. May be flooded temporarily; 8 - Brackish water or salty marshes species; NA – not assigned (no information); NR – not relevant (higher taxonomic level); NR – not relevant; NA – not assigned
IC (sub-)type: 1.x.2 - Sub-type of R-C1 with alkalinity >1 meql/l CaCO3; 4.x.1 - Sub-type of R-C4 with alkalinity <2 meql/l CaCO3; 4.x.2 - Sub-type of R-C4 with alkalinity >2 meql/l CaCO3; 6.1 - Sub-type of R-C6 on soft limestone
Response group: 0 – indifferent taxon/not relevant for this (sub-)type; 1 – highly sensitive common (sub-)type specific taxon; 2 – sensitive common (sub-)type specific taxon; 3 – tolerant common (sub-)type specific taxon; 4 – highly tolerant common (sub-)type specific taxon

NEW_CODE	NAME	GROUP	AQUAT.	ITEM	IC (SUB-)TYPE					
					1.x.2	2	3	4.x.1	4.x.2	6.1
ACO.CAL	Acorus calamus	PHe	4	8,02	4	4	4	4	4	4
AGR.STO	Agrostis stolonifera	PHe	4	4,23	0	0	0	0	2	2
ALI.LAN	Alisma lanceolatum	PHe	4	6,50	0	3	3	0	0	0
ALI.PLA	Alisma plantago-aquatica	PHe	4	6,09	0	0	0	0	0	0
ALO.GEN	Alopecurus geniculatus	PHg	NA	5,61	0	0	0	0	0	0
AMB.FLU	Amblystegium fluviatile	BRm	1	4,35	2	0	0	0	2	2
AMB.RIP	Amblystegium riparium	BRm	2	7,67	4	4	4	4	4	4
AMB.SPX	Amblystegium sp.	BRm	NR	5,29	0	0	0	0	0	0
AMB.TEN	Amblystegium tenax	BRm	1	3,91	2	0	0	0	1	1
AMB.VAR	Amblystegium varium	BRm	3	6,41	0	0	0	0	0	0
ANL.TEN	Anagallis tenella	PHg	5	3,00	0	2	2	0	0	0
ANE.PIN	Aneura pinguis	BRh	2	4,71	0	0	0	0	0	0
ANT.JUL	Anthelia julacea	BRh	NA	2,34	0	0	1	0	0	0
API.GRA	Apium graveolens	PHg	4	7,34	0	0	0	4	0	0
API.INU	Apium inundatum	PHy	1	3,19	1	2	2	1	1	1
API.NOD	Apium nodiflorum	PHy	2	6,33	0	3	3	3	0	0
AZO.FIL	Azolla filiculoides	PTE	1	7,58	4	4	4	4	4	4
BAL.RAN	Baldellia ranunculoides	PHe	NA	4,55	0	0	0	0	0	0
BAL.RAR	Baldellia ranunculoides subsp. ranunculoides	PHe	NA	4,55	0	0	0	0	0	0
BER.ERE	Berula erecta	PHe	2	6,07	0	0	0	0	0	0
BLI.ACU	Blindia acuta	BRm	NA	1,30	1	1	1	1	1	0
BOL.MAR	Bolboschoenus maritimus	PHe	8	6,57	3	0	3	0	0	0
BRA.PLU	Brachythecium plumosum	BRm	1	1,84	1	1	1	1	1	0
BRA.RIV	Brachythecium rivulare	BRm	2	2,85	1	1	1	1	1	1
BRY.ALP	Bryum alpinum	BRm	NA	3,21	0	2	2	1	0	0
BRY.ARG	Bryum argenteum	BRm	NA	4,68	0	0	0	0	0	2
BRY.BIC	Bryum bicolor	BRm	NA	4,28	0	0	0	0	0	0
BRY.PSE	Bryum pseudotriquetrum	BRm	NA	2,35	0	1	1	1	0	0
BUT.UMB	Butomus umbellatus	PHe	4	6,81	3	4	3	3	3	3

NEW_CODE	NAME	GROUP	AQUAT.	ITEM	IC (SUB-)TYPE					
					1.x.2	2	3	4.x.1	4.x.2	6.1
CAA.PAL	Calla palustris	Phe	NA	4,64	2	0	0	0	2	0
CAI.COR	Calliergon cordifolium	BRm	NA	4,57	2	0	0	0	2	0
CAI.CUS	Calliergonella cuspidata	BRm	NA	3,01	1	2	2	1	1	1
CAL.COP	Callitriche cophocarpa	Phy	1	5,20	0	0	0	0	0	0
CAL.HAM	Callitriche hamulata	Phy	1	3,01	1	2	2	1	1	1
CAL.HER	Callitriche hermaphroditica	Phy	1	4,68	0	0	0	0	2	2
CAL.MAC	Callitriche hermaphroditica var microcarpa	Phy	1	4,68	0	0	0	0	2	2
CAL.MIC	Callitriche hermaphroditica var. macrocarpa	Phy	1	4,68	0	0	0	0	2	2
CAL.OBT	Callitriche obtusangula	Phy	1	6,15	0	3	3	0	0	0
CAL.PAL	Callitriche palustris	Phy	1	4,64	0	0	0	0	0	0
CAL.PLA	Callitriche platycarpa	Phy	1	5,64	0	0	0	0	0	0
CAL.SPX	Callitriche sp.	Phy	NR	5,80	0	0	0	0	0	0
CAL.STA	Callitriche stagnalis	Phy	1	5,07	0	0	0	0	0	0
CAL.TRU	Callitriche truncata	Phy	1	5,95	0	0	0	0	0	0
CAL.FIM	Callitriche truncata subsp. fimbriata	Phy	1	5,49	0	0	0	0	0	0
CAL.OCC	Callitriche truncata subsp. occidentalis	Phy	1	5,49	0	0	0	0	0	0
CAH.PAL	Caltha palustris	Phe	4	3,59	0	0	2	2	1	1
CAM.AMA	Cardamine amara	PHg	5	4,52	0	0	0	0	2	2
CAR.ACU	Carex acuta	Phe	NA	5,61	0	0	0	0	0	0
CAR.ACT	Carex acutiformis	Phe	NA	6,39	0	3	3	3	0	0
CAR.AQU	Carex aquatilis	Phe	4	3,27	0	2	2	2	1	0
CAR.ELA	Carex elata	Phe	NA	3,75	0	0	0	0	1	1
CAR.LAS	Carex lasiocarpa	PHg	4	2,88	0	0	2	0	0	0
CAR.PAN	Carex paniculata	Phe	NA	5,72	0	0	0	0	0	0
CAR.PEN	Carex pendula	Phe	NA	5,88	0	0	0	0	0	0
CAR.PSE	Carex pseudocyperus	Phe	NA	5,68	0	0	0	0	0	0
CAR.REC	Carex recta	PHx	4	4,43	0	0	0	0	2	0
CAR.RIP	Carex riparia	Phe	NA	6,72	0	4	3	3	3	3
CAR.ROS	Carex rostrata	Phe	4	3,35	1	2	2	2	1	0
CAR.VES	Carex vesicaria	Phe	4	4,06	2	0	0	0	2	2
CAT.AQU	Catabrosa aquatica	Phe	2	6,00	0	0	0	0	0	0
CER.DEM	Ceratophyllum demersum	Phy	1	8,42	4	4	4	4	4	4
CER.API	Ceratophyllum demersum var. apiculatum	Phy	1	8,42	4	4	4	4	4	4
CER.SUB	Ceratophyllum submersum	Phy	1	8,15	4	0	4	4	4	4
CHM.SPX	Chamaesiphon sp.	ALG	1	3,39	0	2	2	2	0	0
CHA.ASP	Chara aspera	ALG	1	3,69	2	0	2	2	1	1
CHA.CON	Chara contraria	ALG	1	5,29	0	0	2	2	0	0
CHA.GLO	Chara globularis	ALG	1	4,03	2	0	2	2	2	0
CHA.HIS	Chara hispida	ALG	1	3,42	1	0	2	2	1	1
CHA.MAJ	Chara hispida var. major	ALG	1	3,42	1	0	2	2	1	1
CHA.INT	Chara intermedia	ALG	1	4,52	2	0	2	2	2	0
CHA.SPX	Chara sp.	ALG	1	3,22	0	0	2	2	1	0
CHA.VIR	Chara virgata	ALG	1	4,12	2	0	2	2	2	0
CHA.VUL	Chara vulgaris	ALG	1	4,24	2	0	2	2	2	0
CHI.PAL	Chiloscyphus pallescens	BRh	1	4,46	2	0	0	0	2	0
CHI.POL	Chiloscyphus polyanthos	BRh	1	2,62	1	1	1	1	1	1
CIC.VIR	Cicuta virosa	Phe	NA	4,64	2	0	0	0	2	0
CIN.AQU	Cinclidotus aquaticus	BRm	1	3,63	0	0	0	0	1	0
CIN.DAN	Cinclidotus danubicus	BRm	1	4,48	2	0	0	0	2	0

NEW_CODE	NAME	GROUP	AQUAT.	ITEM	IC (SUB-)TYPE					
					1.x.2	2	3	4.x.1	4.x.2	6.1
CIN.FON	Cinclidotus fontinaloides	BRm	1	4,64	2	0	0	0	2	2
CIN.RIP	Cinclidotus riparius	BRm	1	4,48	0	0	0	0	0	0
CLD.MAR	Cladium mariscus	Phe	4	2,40	0	0	1	0	0	0
CRA.COM	Cratoneuron commutatum	BRm	1	3,72	0	0	0	2	1	1
CRA.FIL	Cratoneuron filicinum	BRm	1	3,24	1	0	2	2	1	1
CRY.LAM	Cryphae lamyana	BRm	NA	4,15	0	0	0	0	0	0
DIH.FLA	Dichodontium flavescens	BRm	NA	2,40	1	1	1	1	1	0
DIH.PEL	Dichodontium pellucidum	BRm	NA	1,90	1	1	1	1	1	0
DIC.PAL	Dicranella palustris	BRm	NA	1,53	1	1	1	1	1	0
DER.ADU	Drepanocladus aduncus	BRm	3	3,63	1	0	0	0	1	0
DER.FLU	Drepanocladus fluitans	BRm	3	3,59	0	0	2	2	0	0
DER.REV	Drepanocladus revolvens	BRm	NA	2,21	0	1	1	1	0	0
ELA.HEX	Elatine hexandra	PHg	2	3,47	0	2	0	0	0	0
ELE.ACI	Eleocharis acicularis	Phe	5	5,45	0	0	0	0	0	0
ELE.MUL	Eleocharis multicaulis	PHg	NA	2,39	0	0	1	0	0	0
ELE.PAL	Eleocharis palustris	Phe	4	4,32	2	0	0	0	2	2
ELE.PAP	Eleocharis palustris subsp. palustris	Phe	NA	4,32	2	0	0	0	2	2
ELE.VUL	Eleocharis palustris subsp. vulgaris	Phe	NA	4,32	2	0	0	0	2	2
ELO.CAN	Elodea canadensis	Phy	1	6,02	0	0	0	0	0	0
ELO.NUT	Elodea nuttallii	Phy	1	7,26	4	4	4	4	3	3
EPI.HIR	Epilobium hirsutum	PHg	5	6,69	3	4	3	3	0	0
EQU.FLU	Equisetum fluviatile	PTE	2	3,35	1	2	2	2	1	1
EQU.PAL	Equisetum palustre	PTE	2	4,59	2	0	0	0	2	2
ERI.AQU	Eriocaulon aquaticum	PHx	NA	1,55	0	0	1	0	0	0
FIS.CRA	Fissidens crassipes	BRm	1	4,07	2	0	0	0	2	2
FIS.CUR	Fissidens curnovii	BRm	2	3,29	0	0	2	0	2	0
FIS.GRA	Fissidens gracilifolius	BRm	3	4,05	0	0	0	0	2	0
FIS.GRN	Fissidens grandifrons	BRm	2	3,63	0	0	0	2	1	1
FIS.OSM	Fissidens osmundoides	BRm	3	2,62	0	0	1	0	2	0
FIS.POL	Fissidens polyphyllus	BRm	3	2,36	0	1	1	0	2	0
FIS.PUS	Fissidens pusillus	BRm	2	4,05	0	0	0	0	2	0
FIS.RIV	Fissidens rivularis	BRm	2	4,83	2	0	0	0	2	0
FIS.RUF	Fissidens rufulus	BRm	2	3,97	2	0	0	0	2	2
FIS.SER	Fissidens serrulatus	BRm	3	4,31	0	0	0	0	2	0
FIS.SPX	Fissidens sp.	BRm	NR	4,72	0	0	0	0	2	0
FIS.VIR	Fissidens viridulus	BRm	3	4,59	0	0	0	0	2	2
FON.ANT	Fontinalis antipyretica	BRm	1	4,85	0	0	0	0	2	0
FON.ANI	Fontinalis antipyretica var. antipyretica	BRm	1	4,33	0	0	0	0	0	0
FON.GRA	Fontinalis antipyretica var. gracilis	BRm	1	3,34	0	2	2	2	0	0
FON.DUR	Fontinalis hypnoides var. duriaei	BRm	1	4,05	2	0	0	0	2	0
FON.SQU	Fontinalis squamosa	BRm	1	2,32	1	1	1	1	1	1
GAL.PAL	Galium palustre	PHg	4	3,05	0	2	2	1	1	1
GLY.AQU	Glyceria aquatica	Phe	4	8,11	4	4	4	4	4	4
GLY.DEC	Glyceria declinata	Phe	5	5,37	0	0	0	0	0	0
GLY.FLU	Glyceria fluitans	Phe	2	4,13	2	0	0	0	2	0
GLY.NOT	Glyceria notata	Phe	4	6,62	0	3	3	3	0	0
GLY.PED	Glyceria x pedicellata	PHx	NA	5,73	0	0	0	0	0	0
GRO.DEN	Groenlandia densa	Phy	1	5,26	0	0	0	0	0	0
HEL.PAL	Helodes palustris	Phe	4	2,55	1	1	1	0	1	0

NEW_CODE	NAME	GROUP	AQUAT.	ITEM	IC (SUB-)TYPE					
					1.x.2	2	3	4.x.1	4.x.2	6.1
HIP.VUL	Hippuris vulgaris	Phy	2	4,65	0	0	0	0	2	2
HOT.PAL	Hottonia palustris	Phy	1	5,04	0	0	0	0	0	0
HYD.MOR	Hydrocharis morsus-ranae	Phy	1	5,72	0	0	0	0	0	0
HYR.VUL	Hydrocotyle vulgaris	Phe	5	3,74	0	0	0	0	1	0
HYR.LAX	Hygrobiella laxifolia	BRh	NA	2,39	0	1	1	0	0	0
HYG.DUR	Hygrohypnum duriusculum	BRm	2	2,38	1	0	1	0	1	0
HYG.EUG	Hygrohypnum eugyrium	BRm	NA	3,64	2	0	0	0	1	0
HYG.LUR	Hygrohypnum luridum	BRm	2	1,96	1	1	1	1	1	1
HYG.OCH	Hygrohypnum ochraceum	BRm	1	1,75	1	1	1	1	1	1
HYG.SMI	Hygrohypnum smithii	BRm	NA	2,85	0	0	1	0	0	0
HYG.SPX	Hygrohypnum sp.	BRm	NR	2,52	1	1	1	1	1	1
HYO.ARM	Hyocomium armoricum	BRm	3	1,27	1	1	1	1	1	0
IRI.PSE	Iris pseudacorus	Phe	4	5,30	0	0	0	0	0	0
ISO.LAC	Isoetes lacustris	PTE	1	2,59	0	1	1	0	0	0
JUN.ACU	Juncus acutiflorus	PHg	5	3,11	0	2	2	1	1	1
JUN.ART	Juncus articulatus	PHg	5	2,65	0	1	1	1	1	1
JUN.BUL	Juncus bulbosus	Phy	4	1,79	1	1	1	1	1	0
JUN.EFF	Juncus effusus	Phe	4	3,41	0	2	2	2	1	1
JUN.INF	Juncus inflexus	Phe	4	6,04	0	0	0	0	0	0
JUN.SUB	Juncus subnodulosus	Phe	4	2,18	0	1	1	0	0	0
JUG.ATR	Jungermannia atrovirens	BRh	2	2,10	1	1	1	1	1	0
JUG.EXE	Jungermannia exsertifolia	BRh	NA	3,24	0	1	2	2	0	0
JUG.COR	Jungermannia exsertifolia subsp. cordifolia	BRh	NA	3,24	0	1	2	2	0	0
JUG.GRA	Jungermannia gracillima	BRh	2	1,51	0	1	1	1	1	0
JUG.OBO	Jungermannia obovata	BRh	NA	2,55	0	1	1	1	0	0
JUN.PAR	Jungermannia paroica	BRh	NA	3,34	0	1	2	1	0	0
JUG.PUM	Jungermannia pumila	BRh	NA	2,80	0	1	1	1	0	0
JUG.SPX	Jungermannia sp.	BRh	NA	2,12	0	1	1	1	0	0
JUG.SPH	Jungermannia sphaerocarpa	BRh	NA	2,63	0	1	1	1	0	0
LEM.GIB	Lemna gibba	Phy	1	8,39	4	4	4	4	4	4
LEM.MIN	Lemna minor	Phy	1	7,56	4	4	4	4	4	0
LEM.MIU	Lemna minuscula	Phy	1	7,33	4	4	4	4	3	4
LEM.TRI	Lemna trisulca	Phy	1	6,02	0	0	0	0	0	0
LIT.UNI	Littorella uniflora	Phy	1	3,23	1	2	2	2	0	0
LOB.DOR	Lobelia dortmanna	Phy	4	2,16	0	1	1	0	0	0
LUN.CRU	Lunularia cruciata	BRh	5	5,24	0	0	0	0	0	0
LUR.NAT	Luronium natans	Phy	2	4,13	2	0	0	0	2	0
LYC.EUR	Lycopus europaeus	Phe	4	5,99	0	0	0	0	0	0
LYS.THY	Lysimachia thyrsiflora	Phe	4	4,10	2	0	0	0	2	0
LYS.VUL	Lysimachia vulgaris	Phe	5	5,56	0	0	0	0	0	0
LYT.POR	Lythrum portula	Phe	5	4,54	0	0	0	0	0	0
LYT.LON	Lythrum portula subsp. longidentata	Phe	5	4,54	0	0	0	0	0	0
LYT.POP	Lythrum portula subsp. portula	Phe	5	4,54	0	0	0	0	0	0
LYT.SAL	Lythrum salicaria	Phe	5	5,89	0	0	0	0	0	0
MAR.AQU	Marsupella aquatica	BRh	2	2,32	1	1	1	1	1	0
MAR.EMA	Marsupella emarginata	BRh	2	1,00	1	1	1	1	1	0
MAR.SPX	Marsupella sp.	BRh	NR	1,00	1	1	1	1	1	0
MEN.AQU	Mentha aquatica	Phe	4	5,27	0	0	0	0	0	0
MEY.TRI	Menyanthes trifoliata	Phe	2	2,46	1	1	1	1	1	1

NEW_CODE	NAME	GROUP	AQUAT.	ITEM	IC (SUB-)TYPE					
					1.x.2	2	3	4.x.1	4.x.2	6.1
MIM.GUT	Mimulus guttatus	PHg	NA	4,71	0	0	0	0	2	2
MIM.GXL	Mimulus guttatus x luteus	PHg	NA	3,76	0	2	2	2	0	1
MIM.MOS	Mimulus moschatus	PHg	NA	3,98	0	0	0	0	0	0
MIM.SPX	Mimulus sp.	PHg	NR	4,56	0	0	0	0	0	0
MIM.XGU	Mimulus x guttatus	PHg	NA	3,43	0	2	2	2	0	0
MON.FON	Montia fontana	Phe	2	2,96	1	2	2	1	1	1
MON.FOF	Montia fontana subsp. fontana	Phe	2	2,96	1	2	2	1	1	1
MYO.LAX	Myosotis laxa	Phe	NA	3,97	0	0	0	0	2	2
MYO.PAL	Myosotis scorpioides	Phe	2	5,61	0	0	0	0	0	0
MYO.SEC	Myosotis secunda	Phe	NA	3,91	0	0	0	0	1	1
MYO.SPX	Myosotis sp.	Phe	NR	5,64	0	0	0	0	0	0
MYS.AQU	Myosoton aquaticum	PHg	4	6,69	0	4	3	3	0	0
MYR.ALT	Myriophyllum alterniflorum	Phy	1	3,16	1	2	2	1	1	1
MYR.SPX	Myriophyllum sp.	Phy	1	4,79	0	0	0	0	2	0
MYR.SPI	Myriophyllum spicatum	Phy	1	6,93	3	4	4	4	3	3
MYR.VER	Myriophyllum verticillatum	Phy	1	5,39	0	0	0	0	0	0
NAJ.MAR	Najas marina (N. major)	Phy	1	7,46	0	0	0	4	4	4
NAJ.INT	Najas marina subsp. intermedia	Phy	1	7,46	0	0	0	4	4	4
NAJ.MAM	Najas marina subsp. marina	Phy	1	7,46	0	0	0	4	4	4
NAJ.MIN	Najas minor	Phy	1	7,45	0	0	0	0	0	4
NAR.COM	Nardia compressa	BRh	NA	1,00	1	1	1	1	1	0
NAR.SCA	Nardia scalaris	BRh	NA	1,94	1	1	1	0	0	0
NAR.SPX	Nardia sp.	BRh	NR	1,35	1	1	1	1	1	0
NAS.OFF	Nasturtium officinale	Phe	2	5,12	0	0	0	0	0	0
NEC.CRI	Neckera crispa	BRm	NA	4,14	0	0	0	0	0	0
NIT.FLE	Nitella flexilis	ALG	1	3,85	2	2	2	2	1	0
NIT.FLX	Nitella flexilis var. flexilis	ALG	1	3,04	1	2	2	2	1	0
NIT.GRA	Nitella gracilis	ALG	1	3,84	0	0	0	2	1	0
NIT.MUC	Nitella mucronata	ALG	1	5,39	0	0	0	2	1	0
NIT.OPA	Nitella opaca	ALG	1	3,58	1	0	2	2	1	0
NIT.SPX	Nitella sp.	ALG	1	3,79	0	0	0	2	1	0
NIT.TRA	Nitella translucens	ALG	1	3,47	0	2	0	2	1	0
NUP.LUT	Nuphar lutea	Phy	1	7,21	3	4	4	0	0	0
NYM.ALB	Nymphaea alba	Phy	1	4,67	2	0	0	0	2	2
NYP.PEL	Nymphoides peltata	Phy	1	6,60	0	0	0	3	0	0
OCT.FON	Octodiceras fontanum	BRm	1	6,16	0	3	0	0	0	0
OEN.AQU	Oenanthe aquatica	Phe	1	5,21	0	0	0	0	0	0
OEN.CRO	Oenanthe crocata	Phe	2	4,97	0	0	0	0	0	0
OEN.FIS	Oenanthe fistulosa	Phe	5	6,61	0	0	3	0	0	0
OEN.FLU	Oenanthe fluviatilis	Phe	1	6,30	0	3	3	3	0	0
ORT.AFF	Orthotrichum affine	BRm	NA	4,54	0	0	0	0	0	0
ORT.RIV	Orthotrichum rivulare	BRm	NA	3,76	0	0	0	2	0	0
OSM.REG	Osmunda regalis	PTE	5	5,01	0	0	0	0	0	0
PEL.END	Pellia endiviifolia	BRh	2	4,95	0	0	0	0	0	0
PEL.EPI	Pellia epiphylla	BRh	2	3,03	1	2	2	1	1	1
PEL.SPX	Pellia sp.	BRh	NR	3,85	0	0	0	0	0	0
PET.HYB	Petasites hybridus	PHg	5	5,45	0	0	0	0	0	0
PEU.PAL	Peucedanum palustre	PHg	5	5,43	0	0	0	0	0	0
PHA.ARU	Phalaris arundinacea	Phe	4	6,68	3	0	3	0	3	0

NEW_CODE	NAME	GROUP	AQUAT.	ITEM	IC (SUB-)TYPE					
					1.x.2	2	3	4.x.1	4.x.2	6.1
PHI.CAL	Philonotis calcarea	BRm	1	2,32	1	0	0	0	1	1
PHI.CAE	Philonotis ceaespitosa	BRm	2	2,37	0	1	1	0	0	0
PHI.FOG	Philonotis gr. fontana	BRm	1	1,78	1	1	1	1	1	1
PHI.SER	Philonotis seriata	BRm	2	3,22	0	0	2	0	0	0
PHR.AUS	Phragmites australis	Phe	4	6,18	0	3	3	0	0	0
POL.AMP	Polygonum amphibium	Phe	2	6,42	0	3	3	3	0	0
POL.HYD	Polygonum hydropiper	Phe	4	6,12	0	0	0	0	0	0
POL.MIT	Polygonum mite	PHg	5	5,49	0	0	0	0	0	0
POR.COR	Porella cordaeana	BRh	2	4,06	0	0	0	0	0	0
POR.PIN	Porella pinnata	BRh	2	4,43	0	0	0	0	0	0
POT.ACU	Potamogeton acutifolius	Phy	1	5,20	0	0	0	0	0	0
POT.ALP	Potamogeton alpinus	Phy	1	3,73	2	0	0	2	1	1
POT.BER	Potamogeton berchtoldii	Phy	1	5,91	0	0	0	0	0	0
POT.COL	Potamogeton coloratus	Phy	1	2,69	1	0	1	1	1	1
POT.COM	Potamogeton compressus	Phy	1	6,86	0	0	0	3	3	3
POT.CRI	Potamogeton crispus	Phy	1	7,10	3	4	4	4	3	3
POT.FIL	Potamogeton filiformis	Phy	1	4,51	0	0	0	0	2	0
POT.FRI	Potamogeton friesii	Phy	1	6,71	3	0	3	0	3	0
POT.GRA	Potamogeton gramineus	Phy	1	3,79	2	0	0	2	1	1
POT.LUC	Potamogeton lucens	Phy	1	6,84	3	4	4	0	3	0
POT.NAT	Potamogeton natans	Phy	1	5,09	0	0	0	0	0	0
POT.NOD	Potamogeton nodosus	Phy	1	7,46	4	0	4	4	4	4
POT.OBT	Potamogeton obtusifolius	Phy	1	5,28	0	0	0	0	0	0
POT.PAN	Potamogeton panormitanus	Phy	1	6,17	0	0	3	0	0	0
POT.PEC	Potamogeton pectinatus	Phy	1	8,47	4	4	4	4	4	4
POT.PER	Potamogeton perfoliatus	Phy	1	6,30	0	3	3	3	0	0
POT.POL	Potamogeton polygonifolius	Phy	1	1,70	1	1	1	1	1	0
POT.PRA	Potamogeton praelongus	Phy	1	5,16	0	0	0	0	0	0
POT.TRI	Potamogeton trichoides	Phy	1	7,00	3	0	4	0	3	0
POT.XBO	Potamogeton x bottnicus	Phy	1	5,18	0	0	0	0	0	0
POT.XCP	Potamogeton x cooperi	Phy	1	4,93	0	0	0	0	0	0
POT.XLA	Potamogeton x lanceolatus	Phy	1	3,52	0	0	0	2	0	0
POT.XNI	Potamogeton x nitens	Phy	1	5,00	0	0	0	0	0	0
POT.XOL	Potamogeton x olivaceus	Phy	1	4,45	0	0	0	0	0	0
POT.XSA	Potamogeton x salicifolius	Phy	1	5,15	0	0	0	0	0	0
POT.XSP	Potamogeton x sparganifolius	Phy	1	3,24	0	2	2	0	0	0
POT.XUE	Potamogeton x suecicus	Phy	1	4,89	0	0	0	0	0	0
POT.XVA	Potamogeton x variifolius	Phy	1	5,27	0	0	0	0	0	0
POT.ZIZ	Potamogeton zizii	Phy	1	3,49	0	0	0	0	0	0
POE.PAL	Potentilla palustris	Phe	NA	2,39	1	1	1	1	1	0
PRE.QUA	Preissia quadrata	BRh	NA	3,05	0	0	2	1	0	0
RAC.ACI	Racomitrium aciculare	BRm	3	1,39	1	1	1	1	1	0
RAC.AQU	Racomitrium aquaticum	BRm	3	1,04	1	1	1	1	1	0
RAN.AQU	Ranunculus aquatilis	Phy	1	5,10	0	0	0	0	0	0
RAN.BAU	Ranunculus baudotii	Phy	1	7,22	0	0	0	0	0	0
RAN.CIR	Ranunculus circinatus	Phy	1	6,45	0	0	0	3	0	0
RAN.FLA	Ranunculus flammula	Phy	4	2,89	1	1	2	1	1	0
RAN.FLF	Ranunculus flammula subsp. flammula	Phe	5	2,89	1	1	2	1	1	0
RAN.FLU	Ranunculus fluitans	Phy	1	5,59	0	0	0	0	0	0

NEW_CODE	NAME	GROUP	AQUAT.	ITEM	IC (SUB-)TYPE					
					1.x.2	2	3	4.x.1	4.x.2	6.1
RAN.FXA	Ranunculus fluitans x aquatilis	Phy	1	4,56	0	0	0	0	0	0
RAN.HED	Ranunculus hederaceus	Phy	1	4,69	2	0	0	0	2	0
RAN.LIN	Ranunculus lingua	Phe	5	4,59	2	0	0	0	2	0
RAN.OLO	Ranunculus ololeucos	Phy	1	1,93	0	1	0	0	0	0
RAN.OMI	Ranunculus omiophyllus	Phy	1	2,42	1	1	1	1	1	0
RAN.PEL	Ranunculus peltatus	Phy	1	5,42	0	0	0	0	0	0
RAN.PLP	Ranunculus peltatus subsp. peltatus	Phy	1	5,42	0	0	0	0	0	0
RAN.PEN	Ranunculus penicillatus	Phy	1	5,75	0	0	0	0	0	0
RAN.PSE	Ranunculus penicillatus subsp. pseudofluitans	Phy	1	5,41	0	0	0	0	0	0
RAN.VER	Ranunculus penicillatus subsp. vertumnus	Phy	1	4,77	0	0	0	0	2	0
RAN.PNP	Ranunculus penicillatus var. penicillatus	Phy	1	5,00	0	0	0	0	0	0
RAN.SCE	Ranunculus sceleratus	PHg	5	7,81	0	0	4	4	4	4
RAN.SPX	Ranunculus sp.	Phy	NR	5,89	0	0	0	0	0	0
RAN.TRI	Ranunculus trichophyllus	Phy	1	5,40	0	0	0	0	0	0
RAN.KEL	Ranunculus x kelchoensis	Phy	NA	4,89	0	0	0	0	0	0
RHO.ROS	Rhodobryum roseum	BRm	NA	3,06	0	2	2	0	0	0
RHY.ALO	Rhynchostegium alopecuroides	BRm	NA	3,61	1	0	0	0	1	0
RHY.RIP	Rhynchostegium riparioides	BRm	1	4,19	0	0	0	0	2	2
RIC.CHA	Riccardia chamaedryfolia	BRh	2	3,97	2	0	0	0	0	0
RIC.MUL	Riccardia multifida	BRh	2	4,08	0	0	0	0	0	0
RIC.SPX	Riccardia sp.	BRh	NR	4,04	0	0	0	0	0	0
RII.FLU	Riccia fluitans	BRh	2	6,02	0	0	0	0	2	0
RII.SPX	Riccia sp.	BRh	2	4,00	0	0	0	0	2	0
ROR.AMP	Rorippa amphibia	Phe	4	7,02	3	4	4	4	3	3
ROR.PAL	Rorippa palustris	PHx	NA	5,88	3	0	0	0	0	0
ROR.SPX	Rorippa sp.	Phe	NR	6,55	3	0	0	0	0	0
RUM.AQU	Rumex aquaticus	PHg	NA	4,34	0	0	0	0	0	0
RUM.HYD	Rumex hydrolapathum	Phe	5	6,56	3	3	3	3	0	0
SAG.SAG	Sagittaria sagittifolia	Phe	2	7,41	0	4	4	4	4	4
SCA.PAL	Scapania paludosa	BRh	NA	1,51	1	1	1	1	0	0
SCA.SPX	Scapania sp.	BRh	2	1,92	0	0	1	1	0	0
SCA.SUB	Scapania subalpina	BRh	NA	2,74	0	0	1	1	0	0
SCA.ULI	Scapania uliginosa	BRh	NA	2,31	0	0	1	1	0	0
SCA.UND	Scapania undulata	BRh	1	1,75	1	1	1	1	1	0
SCS.AGA	Schistidium agassizii	BRm	NA	1,98	1	1	1	1	1	1
SCS.APO	Schistidium apocarpum	BRm	NA	3,75	0	2	2	2	0	1
SCS.RIV	Schistidium rivulare	BRm	3	2,91	0	2	2	1	0	1
SCI.FLU	Scirpus fluitans	Phy	1	2,11	1	1	1	1	1	0
SCI.LAC	Scirpus lacustris	Phe	1	6,62	3	3	3	3	0	0
SCI.TAB	Scirpus tabernaemontani	PHg	NA	5,97	0	0	0	0	0	0
SCR.AUR	Scrophularia auriculata	PHg	5	6,58	0	3	3	3	0	0
SIU.LAT	Sium latifolium	PHg	NA	4,78	2	0	0	0	2	0
SOA.DUL	Solanum dulcamara	PHg	5	6,50	3	3	3	3	0	0
SPA.ANG	Sparganium angustifolium	Phy	2	1,80	1	1	1	0	1	0
SPA.EME	Sparganium emersum	Phy	2	6,81	3	4	3	3	3	3
SPA.EMC	Sparganium emersum fo. brevifolium	Phy	2	4,48	0	0	0	0	0	0
SPA.EML	Sparganium emersum fo. longissimum	Phy	2	7,03	3	4	4	4	3	3
SPA.ERE	Sparganium erectum	Phe	4	7,05	3	4	4	4	0	0
SPA.ERR	Sparganium erectum subsp. erectum	Phe	4	7,05	3	4	4	4	0	0

NEW_CODE	NAME	GROUP	AQUAT.	ITEM	IC (SUB-)TYPE					
					1.x.2	2	3	4.x.1	4.x.2	6.1
SPA.MIC	Sparganium erectum subsp. microcarpum	PHe	4	7,05	3	4	4	4	0	0
SPA.NEG	Sparganium erectum subsp. neglectum	PHe	4	7,05	3	4	4	4	0	0
SPA.OOC	Sparganium erectum subsp. oocarpum	PHe	4	7,05	3	4	4	4	0	0
SPA.NAT	Sparganium natans	PHx	2	3,07	1	2	2	1	1	0
SPH.DEN	Sphagnum denticulatum	BRm	1	1,51	1	1	1	1	1	0
SPH.PAL	Sphagnum palustre	BRm	2	1,51	1	1	1	1	1	0
SPH.SPX	Sphagnum sp.	BRm	2	1,30	1	1	1	1	1	0
SPR.POL	Spirodela polyrhiza	PHy	1	7,66	4	4	4	4	4	4
STA.PAL	Stachys palustris	PHe	NA	6,78	3	0	3	0	3	0
STR.ALO	Stratiotes aloides	PHy	1	5,72	0	0	0	0	0	0
THA.ALO	Thamnobryum alopecurum	BRm	2	3,22	1	2	2	2	1	0
TOL.GLO	Tolypella glomerata	ALG	1	5,34	0	0	0	0	0	0
TOL.PRO	Tolypella prolifera	ALG	1	3,63	1	0	0	0	0	1
TRA.NAT	Trapa natans	PHy	1	6,43	0	0	3	0	0	0
TYP.ANG	Typha angustifolia	PHe	4	6,93	0	0	4	0	0	0
TYP.LAT	Typha latifolia	PHe	4	7,35	4	4	4	4	3	0
UTR.INT	Utricularia intermedia	PHy	1	2,38	0	1	1	0	0	0
UTR.MIN	Utricularia minor	PHy	1	2,55	0	1	1	1	1	0
UTR.OCH	Utricularia ochroleuca	PHy	1	1,04	0	0	2	0	0	0
UTR.SPX	Utricularia sp.	PHy	1	3,58	0	0	2	0	0	0
UTR.STY	Utricularia stygia	PHy	1	1,85	0	0	2	0	0	0
UTR.VUL	Utricularia vulgaris	PHy	1	4,82	2	0	2	0	2	0
VAL.SPI	Vallisneria spiralis	PHy	1	6,60	0	0	0	0	0	0
VER.ANA	Veronica anagallis-aquatica	PHe	2	5,82	0	0	0	0	0	0
VER.BEC	Veronica beccabunga	PHe	2	5,56	0	0	0	0	0	0
VER.CAT	Veronica catenata	PHe	2	6,18	0	3	3	0	0	0
VER.SCU	Veronica scutellata	PHg	4	2,97	1	2	2	1	1	0
VER.LAC	Veronica x lackschewitzii	PHx	NA	6,67	0	3	3	0	0	0
WOL.ARH	Wolffia arhiza	PHy	1	7,23	3	0	0	4	3	0
ZAN.PAL	Zannichellia palustris	PHy	1	7,86	4	4	4	4	4	4
ZAN.PAE	Zannichellia palustris subsp. pedicellata	PHy	1	7,86	4	4	4	4	4	4
ZAN.SPX	Zannichellia sp.	PHy	1	7,86	4	4	4	4	4	4

Annex II: Towards Macrophytes IC in large rivers - First reflections (by Christian Chauvin)

The IC type R-C5, corresponding to large lowland rivers (i.e. catchment area > 1000 km², width > 25 m), was discarded from this first round of macrophyte intercalibration. In fact, the current IC process faces two major problems for these large watercourses: There is no possibility to observe a non-impacted situation to estimate the reference, since these basins are widely populated and, in Western Europe, concentrate a large amount of human activities. Furthermore, most of the national assessment methods are dealing fairly badly (or not at all) with this type of habitat.

Thus, it was admitted that a specific approach has to be used for this type of hydrosystems. The first reflections synthesized in this chapter are not to be taken as a well established framework, but just as a collection of ideas giving a starting point for a large rivers IC definition.

What is a large river?

Analyzing the main characteristics of large rivers is a preliminary step to understand how to chose criteria for a typology and intercalibration.

We can be inspired by the first reflections presented on this topic to the Central GIG steering group in 2005[18]:

A matter of size.

A static status can be defined by:

- Stream order ≥ 5 or 6,
- Width ≥ 30 to 50 m,
- Mean annual discharge ≥ 50 to 100 m^3/s,
- Basin area > 2.500 km².

A matter of hydrosystem complexity.

The complex structure is an essential characteristic of most types of large rivers:

- Several functional compartments,
- Presence of transitional zones,
- Habitat distribution pattern,
- Lateral relationship between habitats as important as longitudinal functional flow (main channel vs. secondary channels, hydraulic annexes, secondary arms).

A matter of functioning.

This dynamic aspect is very important and one of the most specific to characterize the status of large hydrosystems. Observed functioning renders the link and the balance between the status and the physical constraining parameters of the basin.

- Fluvial dynamics (channel complexity and mobility, *flood pulse concept* - functional relationship with floodplain, *disturbance regime*- regular impact of high-flow events),

[18] Wasson, J.-G.: Large Rivers Intercalibration: How to deal with? River Intercalibration Central GIG steering group and GIGs coordinators meeting. *Discussion paper*. Lyon, 18-19 May 2005.

- Lateral connectivity (complex processes influencing physical and biological diversity),
- Hydrosystem integrity (*4D hydrosystem concept*).
- Often 'unpredictable' local conditions.

Why are large rivers so different from others types?

Regarding IC exercise, several major and structural differences distinguish the case of large river assessment:

- The lack of reference sites (according to WFD requirements) is general. Thus the reference conditions cannot be derived from observation and actual measurements.
- The reference models based on small rivers cannot be safely extrapolated, because of the specific functioning of large hydrosystems (difference of suitable scale, importance of lateral relationships),
- No existing or commonly agreed assessment methods for approaching large hydrosystems,
- *Good status* not only matching to biological, physical and chemical parameters status, but also to functional descriptors.

Considering these particularities, the comparison of results derived from large rivers surveys must be exploited with specific frameworks concerning reference, IC metrics, and computing protocol.

Deriving a large river typology

When comparing different river sites, if we cannot assign true reference conditions (RC) to each site, we make implicitly the assumption that these unknown RC are the same for all the sites under comparison (Wasson, 2005).

For unknown type-specific reference conditions, the definition of the types is a crucial point, still more than in the other cases.

What are the criteria for a relevant typology?

- Functional parameters are needed to highlight the status, but obligatorily based on fairly simple features. Indeed, in the IC framework the aim is to compile homogeneous data across Member States, thus the data type must be realistically available.
- Water chemistry is not a prevalent parameter for such a typology. In large watersheds, geochemical characteristics are homogenized by the diversity of water origins. Except for few specific cases in the northern countries, this type of parameters is not a relevant discriminant.
- The trophic level varies within a narrow range for these large and rich hydrosystems. Since the water characteristics are often quite similar in high, good and moderate quality, whole potamon is included in the eutrophic domain. Thus, this is not a good typologic entry, oppositely to smaller hydrosystems.

Main aims

Despite that the main aim is obvious, preliminary screening is needed, keeping in mind realistic and pragmatic targets. A few principles can be the following ones:

- Proposing a framework for organizing the data,
- Classifying assessment methods,
- Defining main traits of hydrosystems functioning,

- Helping to built reference concept.

Mains requirements

- Meeting the WFD (of course…),
- Based on realistically measurable parameters (available data bases?),
- Integrating only (or mainly) abiotic elements that exert direct influence on the biology,
- European scale to be GIG-useful, but suitable at national level with enough accuracy (consistency in site assignment),
- Adjusted range of types: too broad = too heterogeneous (loss of site-consistency), too narrow = not useful for a general purpose (1 narrow type = 1 basin?).
- Allowing for comparison of information from different BQEs.

This latest point is to be attentively considered. Indeed, a type-specific sub-typology must include all BQEs, in order to be useable for the future multi-BQE metric calculations. In this way, an inter-BQE reflection seems to be indispensable, at least for defining the most structuring axis.

Some tracks for defining ecological and biological typology features

Low-water flow morphology

- "Fast" and shallow type
    - Speed = 0.5 to 1 m/s
    - Depth = 1.5 to 3 m
    - Whole bed is vegetated (*Ranunculion* domain)

The bed morphology is similar to smaller rivers (like a large "small river"), but the hydrological and side-linking parameters is large-hydrosystems specific.

Examples in France: Garonne, Dordogne, Allier, Loire, Cher.

- Low and deep type
    - Speed < 0.2 m/s
    - Channel depth > 3 m
    - Channel without macrophytic vegetation, macrophytic populations widely developed along lateral bands.

These larges rivers, representing the mostly common "large river morphology", present a longitudinal juxtaposition of two facies (channel vs. side zones), and a high ecological importance of the annexed habitat links.

Example: all large lowland hydrosystems, like Rhine, Pô, Saône/Rhône, Danube, Ebro, Thames, etc.

Four dimensional structure

Morphological structure gives an ecological structure.

- Presence of active secondary arms,
- Presence of disconnected side arms,
- Importance of underflow communication,
- Evolution cycle time (equilibrium mobility).

“Disturbance” regime

High flow events impacts the structuring of habitats.

- Low and regular flooding,
- Violent and frequent floods,
- Flooding effect (importance of flood plain) or rearrangement effect (high energy rivers).

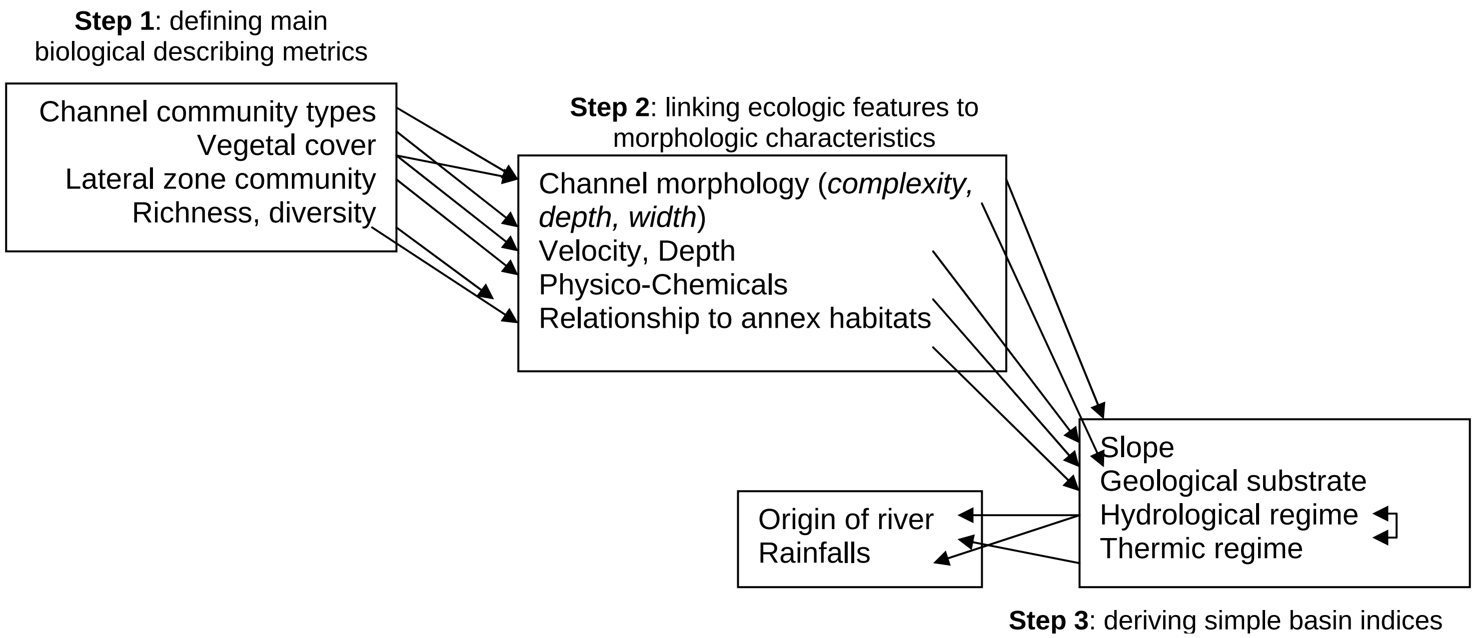
Main criteria: events’ frequency, events’ effects and events’ power.

“Flood pulse concept”

Role and functionality of relationship with floodplain is constrained by the presence of annexed habitats, hydrological and biological connectivity (Junk et al. 1989[19]).

How to translate ecological features into general typology?

Once the main ecological structuring parameters are defined, the problem lies in deriving simple-to-collect parameters. In other words, how to link precise ecological and morphological characteristics to main simple basin parameters? The principle of such a bottom-up approach can be synthesized by the diagram below:



In a first view, usable general basin features could be focused on fairly few control parameters like:

- Hydrological characterization (discharge variation, maximum bankfull flow),
- Basin geology,
- Rainfalls (quantity and distribution),

[19] Junk, W. J., P. B. Bayley & Sparks, R.E., 1989. The flood pulse concept in river-floodplain systems. International large river symposium, Canadian Special Publication Fisheries Aquatic Sciences 106, 110-127.

- Temperature cycle,
- River origin, mean altitude of "maxiumum altitude zone" of the catchment,
- Stretch slope
- *to be complemented…*

A basic tool: European Hydro-Eco-Regions

The definition of the European HydroEcoRegions (EHER) was undertaken by Cemagref (France), in the framework of REBECCA programme *Relationship between ecological and chemical status of surface waters*. The final report is available since May 2007[20].

A total of 133 regions were identified, corresponding to 173 geographical polygons in the GIS, as some regions can be constituted by non contiguous areas […]. Each region is differentiated from the neighbouring ones by at least one identifiable key parameter related to geology, relief or climate; in most cases, a combination of characteristics makes a clear distinction between two adjacent HERs.

[20] Wasson J-G., Chandesris A., Garcia-Bautista A, Pella H, Villeneuve B. 2007: European Hydro-Ecoregions. EU project REBECCA. - http://www.lyon.cemagref.fr/bea/lhq/dossiers_pdf/D14_WP4_A5_Chapter%201.pdf

The main geographical layers used for the EHER delineation by GIS analyzes are:

- Altitude (D.E.M.),
- Geology,
- Hydrogeology,
- Climate,
- Geography (administrative and physical information),
- Natural vegetation,
- Organic carbon in topsoils.

Deriving typology

A typology for large rivers in Central Europe could be derived from crossing European HER and functional metrics. 5 to 8 large rivers types can be expected, like:

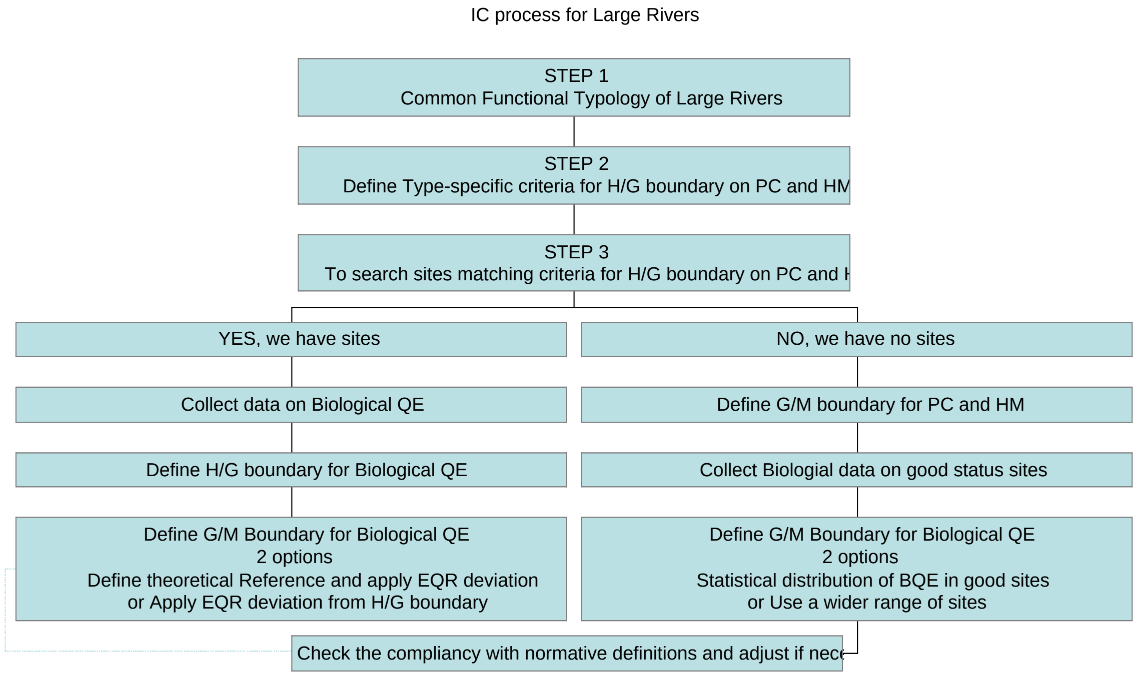
- "Alpine" rivers (like Rhône or upper Rhine)
    - flowing from alpine massifs,
    - nival component (high flow and low temperature in summer).
- Nordic rivers
    - At least 1 cold month (mean T. = -2°),
    - Granitic substrate basin,
    - Low summer temperature.
- Low mountains origin
    - French Central Massif, Bohemia, Ardennes, Rhenan schists.
- Piedmont rivers
    - Shallow and rather fast flow, gravel substrate more or less mobile.
- Lowland large rivers
    - slow and deep, very low dynamics.
- *and others…*

Functional indicators as common metrics?

There is a need to adapt reference concepts for these river types, since there is few chances to observe and measure actual reference conditions. One of the proposals done in *macroinvertebrates* Eastern Continental GIG, is to define good status rather than reference status. In order to precise these basic considerations, the parameters taken into account could be like:

- Number of flood days,
- Lateral gradient of moisture (*aquaticity* gradient),
- Number of macrophytic vegetation layers in side zones,
- Trophic level of populations,
- Population balance (presence of invasive species, diversity per layer,…),
- *and others*

A schematic overview is given by Wasson (2005):



Problems to face:

In this exercise some crucial issues may arise from the following points:

- Complexity of a relevant ICM,
- Assessment methods to be developed,
- No suitable data,
- Macrophytes classified as non-relevant BQE for large rivers assessment,
- Reference to be constructed,
- One river, one type?
- *Other problems to be discovered …*

It's clearly appearing that the IC exercise will be specific for large rivers. For macrophytes, we have seen during the first IC round that the national methods are not yet totally meeting the WFD requirements, and that they are hardly comparable to each other (at least for a part). A proper work about assessment methods will have to be carried out as a preliminary reflection, to be able to work correctly about reference definition and quality boundaries comparison.

Annex III: Correction factor to apply Dutch method to single site data (by Roelf Pot)

The Dutch assessment method was designed to assess aggregated water body data (multiple samples combined or areal surveys) rather than assessing individual sites. The assessment is based on the sum of scores for each characteristic taxon found in these samples, divided by the expected maximum score for reference water bodies. When applied to individual samples - which are then regarded as extremely small water bodies - the scores are consistently lower than the aggregated scores for water bodies.

The original boundaries of the metric were set by expert judgement in 2004. In December 2006 all reference values were recalculated on the basis of a stochastical approach. The expected chance that the species could be found in samples was derived from the database of samples of well developed vegetation in the Netherlands. These new values were lower than the original values based on expert judgement (Pot, 2006).

The estimation of the expected chance to be found in samples was done for each species and for single samples as well as increasing number of multiple samples. The reference scores were set on the summarized chance of species to be found in five representative samples from a water body. The summarized chance of species to be found in only one of those samples was calculated to get an estimate for the correction needed for the expected maximum score for reference water bodies, to apply the assessment method for single site samples. The correction factor showed to be +/- 3 for most NL types and is suitable for assessing randomly selected samples.

Hugo Coops did some analyses of the variability within site samples of waterbodies, both on species richness and on assessment results (see Annex IV). In the analyses of variability of species richness some samples of other Member States were also involved. He found that the variability was at least a factor 2 between the minimum and the maximum, both in species richness and in Dutch assessment score. The samples from the Netherlands added to the GIG database were the site samples of the selected waterbodies with the highest Dutch assessment score. Because the difference between mean and maximum was roughly 1.5, the correction factor for single site assessment should be 3/1.5 = 2.

We assumed that the samples provided by the other Member States for the GIG database were also best sites of a waterbody and therefore also can be assessed using the correction factor 2.

It is very difficult to estimate the confidence boundaries round the correction factor on a sound statistical basis, but a crude estimation is the following: I expect that the 90% confidence limits lay at +/- 1.3 and 3, which means that the assessment confidence is +/- one quality class.

Annex IV: Intercalibration of water body metrics (by Hugo Coops)

1. Introduction

The current intercalibration of macrophyte metrics for rivers focuses on the assessment of individual sites rather than on water bodies. This is in contrast to the general assessment approach for lakes, which has a water-body wide approach; but in concordance with the intercalibration of methods for macroinvertebrates.

Since existing national assessment methods are mostly based on site indications, it is clear that comparison of metrics that produce site scores is a necessary element of the intercalibration. Moreover, almost every monitoring scheme is based on sampling of sites, and thus the available data restrict the intercalibration to site comparison. However, evaluation of site-based assessment methods ignores the issue of where and how many sites should be sampled within a water body to allow a statistically sound derivation of ecological quality of a water body.

There could be confusion about “sites” and “water bodies”, as the text of the WFD makes no clear distinction between these two terms. At the start of the intercalibration, a “register of sites” has been made that includes water bodies. Perhaps the assumption was that water bodies can be represented by a single site, but in that case the nationally assigned water bodies in the EU should have been much smaller units. Still, if a single site is assumed to be representative of a water body, this should be clearly indicated, and it should be taken into account during intercalibration.

Hence, it should be concluded that intercalibration will not be complete without comparison at a water body scale. Indeed, it is the good ecological status of water bodies, and not of individual sites, that is the principal objective of the EU Water Framework Directive.

Table 1: Suitability of national metrics for water body assessment.

country	site based assessment?	method for assessment of water body status?
Austria	yes	not decided
Belgium – Flanders	yes	Combination of submetrics sampled at sites; water body score defined as lowest score of at least 3 sites
Belgium – Wallonie	yes	not decided
France	yes	not decided
Germany	yes	not decided
Great Britain	yes	not decided
Latvia	yes	not decided
Netherlands	no	Species composition and abundance assembled from entire water body (>6 representative sites)
Poland	yes	not decided

2. Data

Most suveys consist of sampling of single sites, and do not take into account the assessment of ecological quality of river reaches. Macrophyte data from river sites compiled for the intercalibration of river macrophytes in the Central/Baltic GIG was used. The common dataset consists of individual samples that are mostly unique for a water body. Therefore the data availability for water body assessment is very limited. Data that take into account temporal variations is even more scarce.

Given the limited availability of data, the NL method (for species composition) was applied to all sites in water bodies with > 3 sites, including relevee data from the Netherlands and additional sampling data from Flanders and Germany. Additionally, to assess a score for each water-body, species data of the individual sites were merged into frequency classes (1: <10%, 2: 10-50%, 3: >50%). For calculating EQR scores, the program QBWAT was used for calculation of the metric for aquatic macrophyte composition

Data from the Netherlands were from a number of small rivers, and based on minimally 4 samples that were combined. Abundances of species in water bodies were calculated based on sampling frequency (<10%, 10-50% and >50%).

Additional data were obtained from the Dutch national monitoring programme MWTL (2004), survey data from 4 streams in Nordrhein-Westfalen and 2 rivers in Flanders.

Furthermore the ITEM scores for the Dutch sites, as well as for the water bodies (aggregated sites), were used.

3. Variability of sites within water bodies

As a first step, site scores (according to national methods) as delivered by the member states were used to assess the amount of variation present within water bodies. From the IC-dataset, only 3 water bodies were available for which 3 or more samples were available, and minimum and maximum scores according to the national method were compared (Figure 1).

Based on this step it can be concluded that the lowest and highest scores of sites within a water body can be very different and none of the cases indicated the same ecological quality class. Further analysis is not possible because of lack of suitable data.

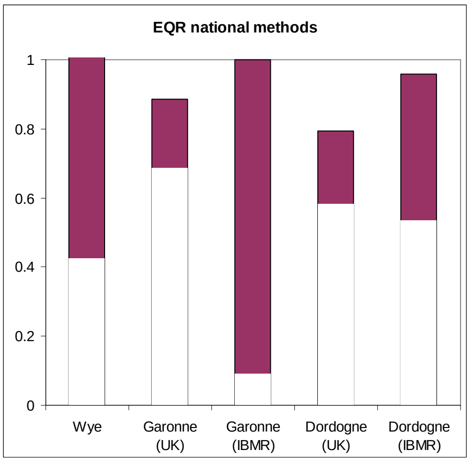


Figure 1

A larger dataset of 24 rivers in the Netherlands, 2 in Belgium (Flanders) and 4 in Nordrhein-Westfalen (Germany) is used here to present variability of water bodies as based on the samples.

Variation in species number within water bodies appeared to be large (Figure 2).

The potential relationship between the maximum species richness in a site and the total species number found in all sites in a water body is shown in Figure 3. From this figure an indication is derived that the point where the total water body species number becomes independent from individual sites is at about 20 sites in a water body. Possibly this also indicates the number of sites necessary to assess water body quality.

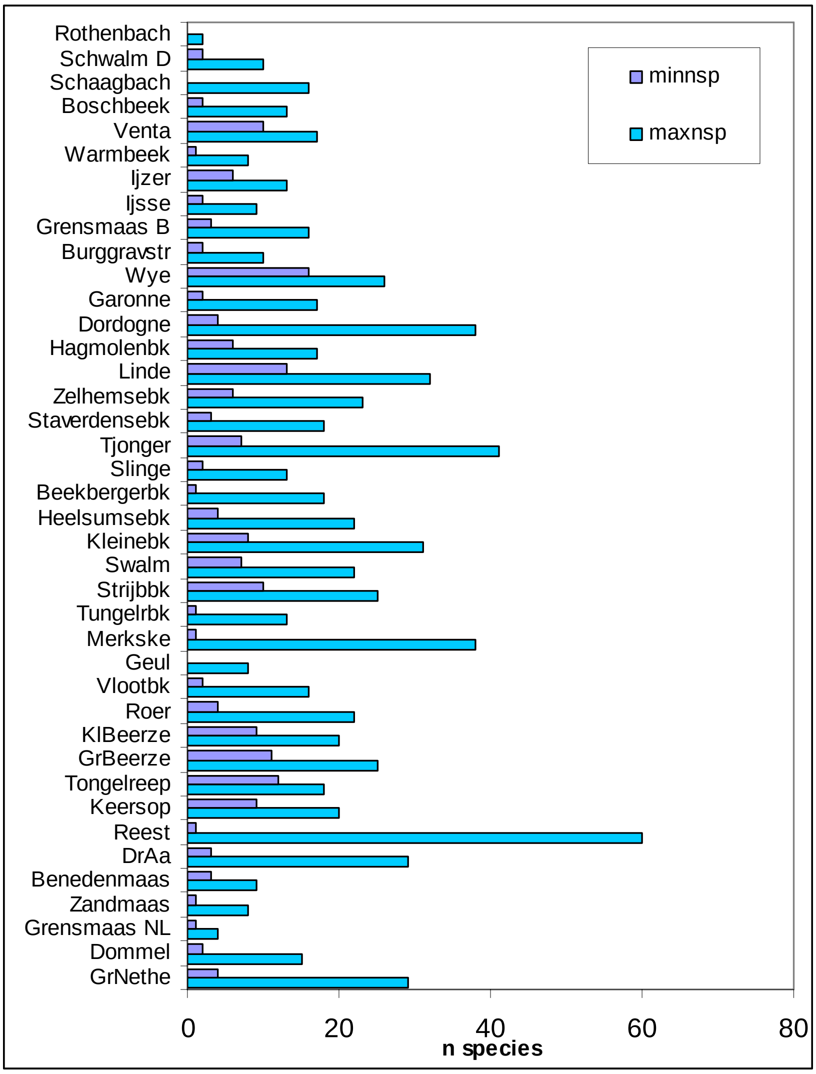


Figure 2: Minimum and maximum species richness per site in water bodies with at least 3 sampled sites.

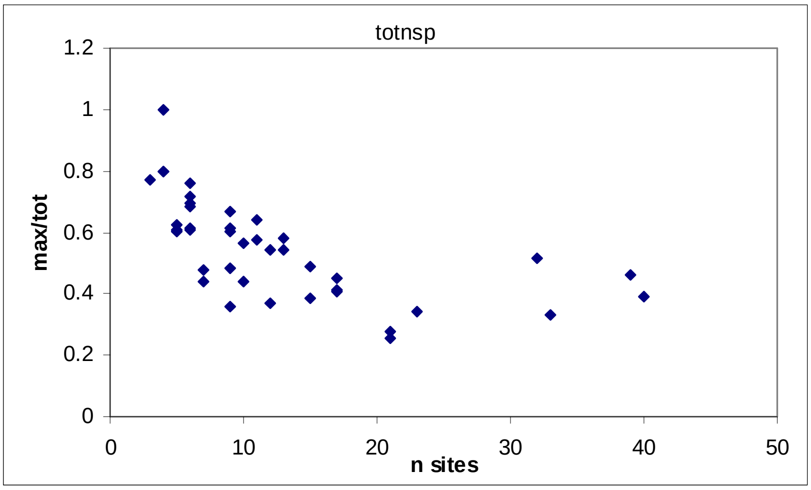


Figure 3: Relationship between the ratio (maximum site richness : aggregated richness) and number of sites assessed within a water body.

3. Variability of site scores (ITEM-scores) within water bodies

ITEM scores have been calculated for the sites in the Dutch water bodies. Similar to the national scores, ITEM scores show a wide variability within water bodies. As most countries have not indicated in which way site scores will be aggregated, intercalibration is not possible.

In the Dutch data, there is no relationship between the number of sampled sites and the width of the range. This indicates that the range in ITEM scores for sites within a water body reflects the heterogeneity within that water body. Consequently this means that a single site does not represent a whole water body.

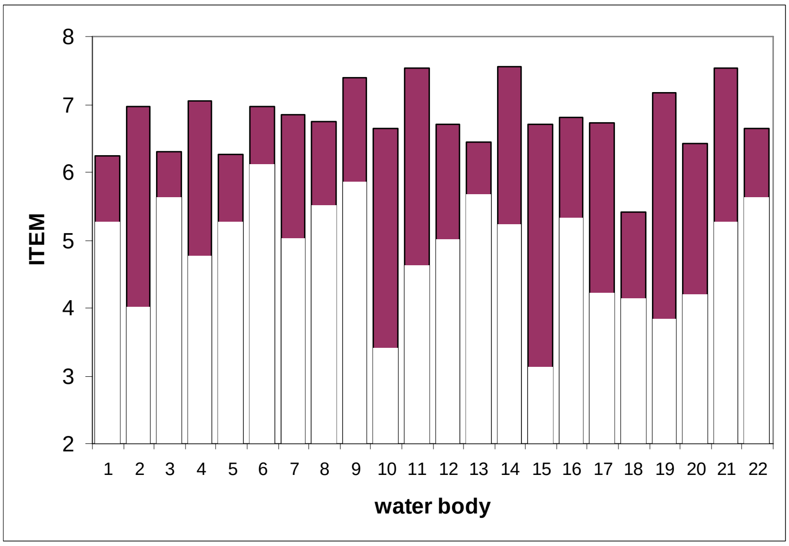


Figure 4: Ranges of ITEM scores for sites within water bodies in the Netherlands. Water bodies are sorted by number of samples (from low to high).

4. Water body scores using NL metric of species composition

It is clear that scores derived by the NL method are substantially lower than the scores obtained by national methods. The NL method was designed to assess aggregated water body data (multiple samples combined or areal surveys) rather than assessing individual sites. In this way the NL approach overcomes the problem of integrating different samples. When applied to individual samples (which are then regarded as extremely small water bodies), the scores are consistently lower than the aggregated scores for water bodies (figure 5). Also, it is obvious that the class assessment can have different results depending on which aggregate value is used. Maximum, minimum and aggregated scores in the same quality class are only found in the lowest class.

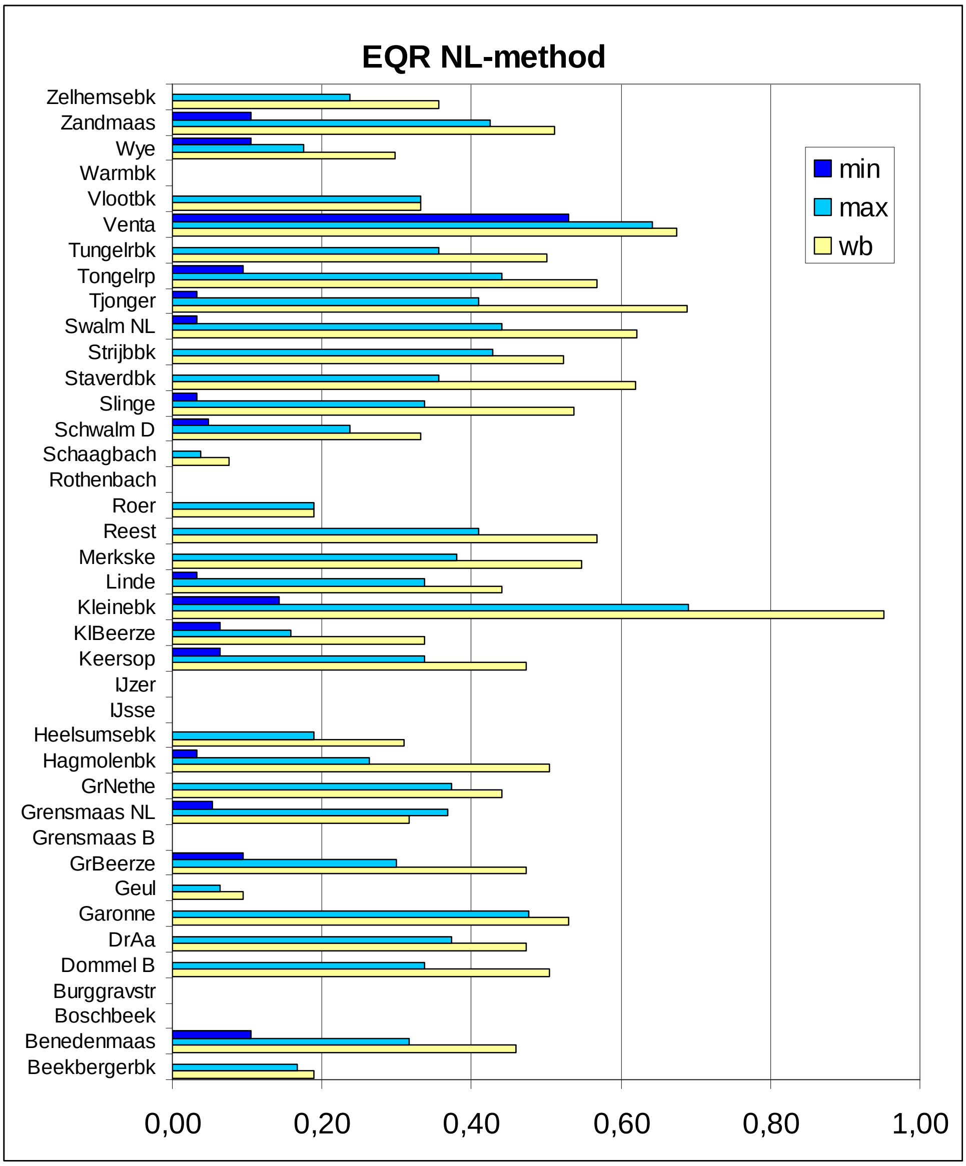
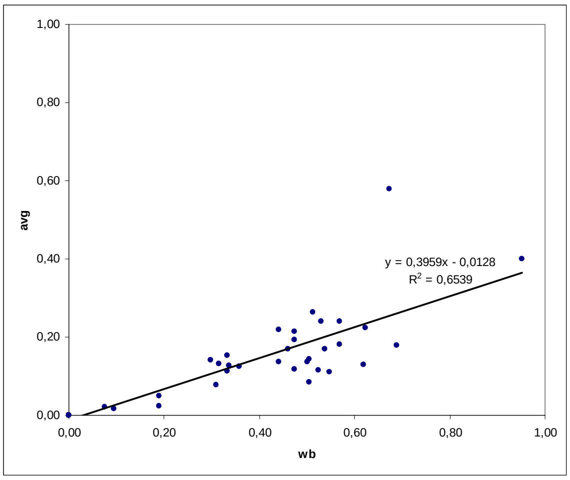
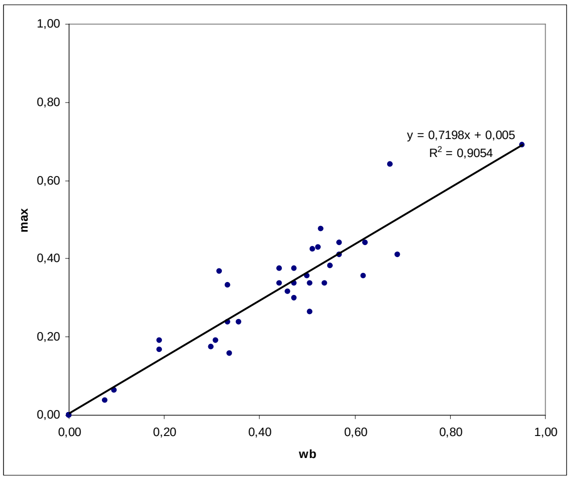


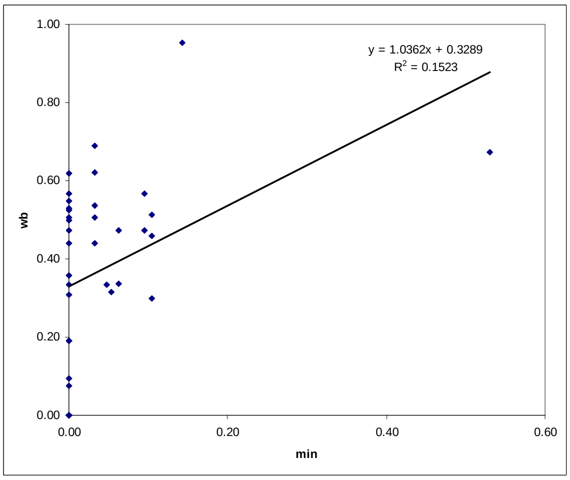
Figure 5: Minimum, maximum and aggregated EQR according to the NL metric.

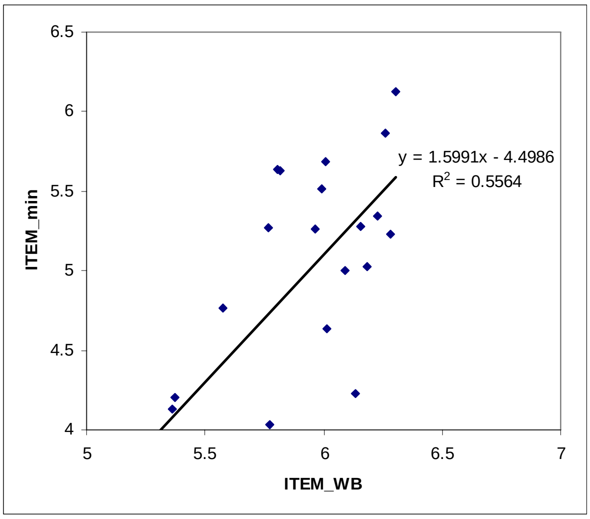
5. Can individual site scores be related to water body score?

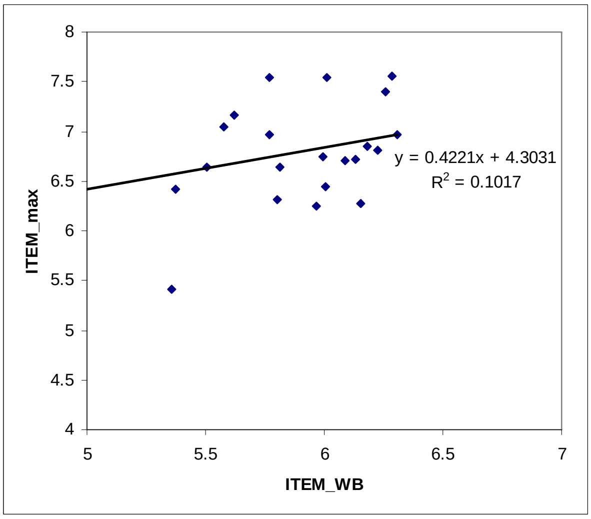
Finally, the ITEM and NL method calculated for sites and water bodies were used to compare how site-based assessment is related to water-body assessment. Therefore, minimum site score (as in Flemish method), average site score, and maximum site score were related to the score derived from all samples in a water body combined (Figure 5). In the NL Method, the maximum site EQR appeared to be highly correlated with water body EQR. However the correlation between maximum site score and water body score was low in the ITEM, and average score yielded the highest correlation.











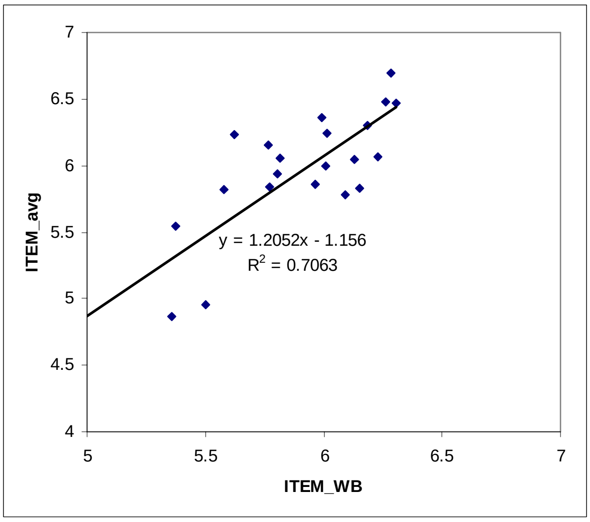


Figure 5

6. Overall conclusions

The relationship between site EQR and waterbody EQR depends on the basic assumptions in the method used for assessment of macrophyte EQR in rivers. The current exercise, based on limited data, suggests that waterbody assessment based on a species richness-based method (the NL method) can be estimated using the maximum site score when a data from a number of sites is known (R^2=0.90), whereas an indicator value-based method (such as ITEM, but also IBMR, MTR) correlates best with average site score (R^2=0.70). This is according to expectation that overall species richness increases when sites are added.

The data presented here suggest that EQR of a water body can be related to EQR of individual sites within that water body. However, one site cannot be representative for a water body. Consequently, intercalibration of site-based assessment methods will not be sufficient to meet the requirements of the WFD.

Appendix

source	Water body (wb)	Country	Number of sites	Common type
NL-1	Beekbergerbk	Netherlands	21	RC1
NL-2	BenedenMaas	Netherlands	5	RC5+
NRW	Boschbeek	Germany	23	RC1
IC	Burggravenstr	Belgium	6	RC1
BE	Dommel	Belgium	17	RC1, RC4
IC	Dordogne	France	32	RC5+
NL-1	DrAa	Netherlands	10	RC1, RC4
IC	Garonne	France	33	RC5+
NL-1	Geul	Netherlands	9	RC4
IC	Grensmaas B	Belgium-Flanders	6	RC5+
NL-2	Grensmaas NL	Netherlands	4	RC5+
NL-1	GrBeerze	Netherlands	5	RC4
BE	Grote Nete	Belgium-Flanders	14	RC4, RC1
NL-1	Hagmolenbk	Netherlands	6	RC1
NL-1	Heelsumsebk	Netherlands	12	RC1
IC	IJsse	Belgium	6	RC1
IC	IJzer	Belgium	6	RC4
NL-1	Keersop	Netherlands	4	RC4
NL-1	KlBeerze	Netherlands	5	RC4
NL-1	Kleinebk	Netherlands	11	RC1
NL-1	Linde	Netherlands	9	RC4
NL-1	Merkske	Netherlands	15	RC1
NL-1	Reest	Netherlands	39	RC4
NL-1	Roer	Netherlands	40	RC4
NRW	Rothenbach	Germany	4	?
NRW	Schaagbach	Germany	20	?
NRW	Schwalm D	Germany	9	RC4
NL-1	Slinge	Netherlands	13	RC1
NL-1	Staverdbk	Netherlands	15	RC1
NL-1	Strijbbk	Netherlands	9	RC1
NL-1	Swalm NL	Netherlands	10	RC4
NL-1	Tjonger	Netherlands	11	RC4
NL-1	Tongelreep	Netherlands	7	RC4
NL-1	Tungelrbk	Netherlands	17	RC1
IC	Venta	Latvia	3	RC5
NL-1	Vlootbk	Netherlands	9	RC1
IC	Warmbeek	Belgium-Flanders	6	RC1
IC	Wye	Great Britain	12	RC5
NL-2	Zandmaas	Netherlands	9	RC5+
NL-1	Zelhemsebk	Netherlands	7	RC1

NL-1 is dataset assembled for CBrivGIG (various small rivers in the Netherlands; data assembled by Roelf Pot); NL-2 is MWTL data (monitoring programme at national level; data of 2004); NRW is data from North Rhine-Westphalia (by Klaus van de Weyer); BE is additional data of Flemish water bodies (by Anik Schneiders).

Annex V: References in macrophyte IC – Summary of current discussions

On the importance of defining a common reference[21]

Because national EQR boundary values (relative deviation from near-natural conditions) are compared in intercalibration, inconsistent reference setting among Member States will impede proper intercalibration (Figure 1).

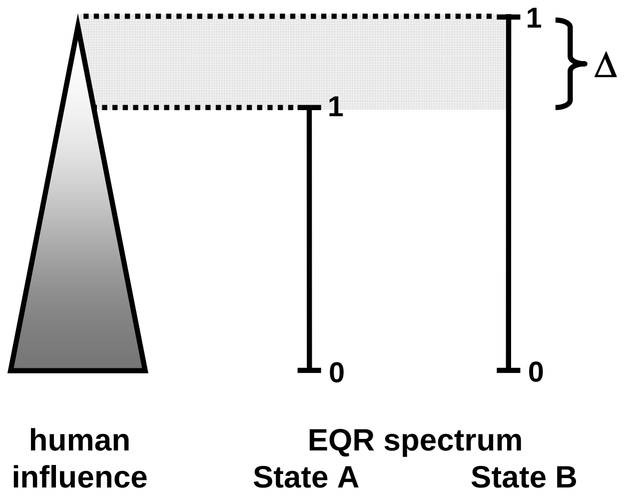


Figure 1: Inconsistent national reference setting. While Member State B is defining its reference as a condition undisturbed by human activity, Member State A allows for some degree of anthropogenic pressure at reference state. By comparing relative EQR boundary values of national methods this difference (Δ) is hidden. Intercalibration must ensure to compare national boundaries on the basis of harmonised reference setting.

Comparability of national EQRs

In the CBrivGIG approach, we are comparing Ecological Quality Ratios that have been derived using river type specific reference values. Thus, reference specification and river type definition are crucial for relevant boundary comparison between Member States' methods.

River type characteristics and therefore reference values may vary between countries within a common intercalibration type (due to the nationally available dataset or natural differences of river types). If we want use common references, we have to carefully define both common reference condition and common types' characteristics.

If we accept to use only national references (implying previously checking by common reference criteria), reference sites and test sites have to belong to the same river type. In other words, the reference can not be the same for all countries, if national datasets hold sites belonging to a national variant of the common intercalibration type.

[21] In this regard "common reference" refers to a harmonised benchmark for intercalibration (using abiotic screening criteria and/or biological community descriptions), i.e. not necessarily near-natural status but a global definition of – for instance – upper or lower good status boundaries.

To obtain an exact matching of common dataset / common reference, we have to impose both common reference and common precise river type. Then we will face a lack of references in certain countries, or a lack of data from the same narrow sub-type.

Reference approach in the CBrivGIG

Within CBrivGIG macro-invertebrate exercise pressure-related screening for type-specific reference sites was done by each country to set a common baseline for boundary comparison. Due to dissimilar data bases (caused by divers sampling techniques, levels of identification etc.), typological and biogeographical differences the actual biological communities and metric values at reference sites of the same IC type were supposed to be incomparable between countries.

This screening approach was adopted by the diatom intercalibration exercise. Here, analyses revealed that the IC typology did not discriminate between references sites, and a strong trophic gradient was discovered within reference sites. This was explained by:

- genuine ecological differences: IC typology generally unsuitable for diatoms and/or typological differences between countries,
- incomplete screening criteria and/or inconsistent application of criteria.

General issues regarding the use of near-natural references in macrophyte IC

I. Lack in existing reference sites

Especially in lowland countries (Denmark, Flanders, Netherlands, Germany) reference sites are scarce or no longer existing[22]. A too general use of the spatial reference site concept (i.e. existing sites without significant pressures) in macrophyte intercalibration would mean to allow for exemptions, which may in turn undermine the general concept: These countries represent a dominant part in macrophyte intercalibration. This was the argument for referring to the national reference definitions only, and the common metric analyses of nutrient-related methods showed that for some types/countries the national reference settings are quite comparable.

Good status definition as alternative reference

It would be possible for some types to agree that the best available sites were in good status (or to set a more relaxed set of screening criteria for identifying only good sites) and to model the reference value using, for example, some of the techniques explored in Vienna[23]. The approach of defining an alternative reference (sites in at least good status) was already carried out in the Eastern Continental GIG macroinvertebrate exercise.

"Borrowing" reference sites from neighbouring countries

It may also be worth to integrate more data from streams that are largely unimpacted from the Baltic countries and Poland. This may help in identifying community richness

[22] In the Netherlands, for instance, chemistry of all rivers is influenced by man. A reconstruction of the reference vegetation exclusively based on historical data is not possible due to lack of reliable data. The actual biological reference communities were constructed referring to "relict sites" (best available) and historical data about endangered species (due to increase of anthropogenic land use) and land use trends.

[23] see Minutes of the 4th CBrivGIG macrophyte meeting in Vienna, May 24th-25th, 2007

and composition in sites that are more close to references than those in western Europe. The community composition can be validated using historical data (despite the fact that they are often qualitative in character). For example: Are there similarities regarding the occurrence of particular species, composition etc.? Denmark is currently doing some analyses using this approach to build up a national database, and the preliminary results are promising.

II. Suitability of existing reference screening criteria for macrophytes

Abiotic screening criteria are needed to identify reference sites and these criteria should be set to meet the scale and impacts that stream macrophytes respond to. For example, the **lateral connectivity** may be crucial for the composition and richness of macrophyte communities in lowland streams. In addition **stream hydromorphological parameters** should also be assessed as habitat quality and availability change dramatically in response to alteration in hydromorphology. As true reference sites are rare, best available sites probably need to be identified from thresholds. Previously used criteria and thresholds (for macroinvertebrates and diatoms) could be considered but these should be supplemented/changed in order to identify potential reference sites for macrophytes.

There is probably no country in Europe that has the perfect understanding of pressure-biota relationships and a sufficiently comprehensive pressure database for all biology sites to be able to say with complete confidence that their reference sites identified by environmental screening alone are truly reference sites. The biology that is generated by the screening has to be considered in the light of the normative definitions and our understanding of historical changes. It would probably be very hard to set a list of thresholds for a large set of variables that all countries could follow. The **land cover** (e.g. CORINE) and **population density** are perhaps the most generally applicable and useful parameters as they should offer a 'catch all' for a range of pressures. The SRP values used in invertebrate screening are a start but it may prove hard to compare data between countries due to methods of analysis, frequency of sampling etc., and the actual values may be too relaxed for macrophytes to represent true reference conditions.

III. Scarcity of suitable data

Reference networks including environmental screening and data collection have not been established by many countries. Abiotic data and linked macrophyte data are scarcely available. However, it may be plausible for countries to screen sites where supporting environmental data are existing, then to check the biology of these sites and then add in other sites with matching biology where less extensive environmental data is available.

Proposal for a practical approach: potential and realised reference sites

Having subjected a set of sites to screening these must be considered a population of ***potential reference sites***. Unless extremely stringent criteria are set (e.g. no agricultural land cover of any sort, <10 people per km^2) and across lots of pressure variables it is impossible to simply assume that the screened reference sites must support reference biology.

Therefore, there is a need to look at the biology that this screening generates. This means to have some image of reference biology based on the existing national sampling network, national distributions of species, or historical datasets. Having reviewed the macrophyte data for a set of sites around the table in Vienna and all coming up with a very similar assessment this 'guiding image' seems to exist[24]. If a threshold of 25% agricultural land use in the catchment is set a proportion of the sites identified will clearly have deviant biology (because they are subject to local pressures not reflected in your screening criteria or because, for example, all 25% of agricultural land is next to the river). Similarly, sites with >25% intensive land use may have biology that corresponds very closely to that of a typical screened site because there are features that mitigate the effect of that land use. Thus there are ***potential reference sites*** and ***realised reference sites*** that support reference biology.

It is possible to generate for each IC type a population of reference sites that countries have screened at the national level and to subject this to biological screening at a GIG level. This is basically what was done in the Northern GIG lake macrophyte exercise although a good set of compatible pressure data was available to help. Sites with outlying biology which could be attributed to outlying chemistry were removed from the common pool of reference sites. Retaining that site as a reference site at a national level would not matter unless all the reference sites of a particular country were outlying (this never came close to happening). If all countries interpret the IC type descriptions rigorously and apply a sensible universally agreed screening criteria, this biological screening is easy to accomplish through ordination. This would also helpfully expose countries whose reference condition sites were simply unrepresentative of the type (e.g. difference in channel size or slope from sites of that type in other countries).

Next steps

- Modification and amendment of the catalogue of CBrivGIG reference criteria with regard to river macrophytes (both near-natural sites and – for instance – sites in at least good status)[25],
- Screening of national datasets to identify sites in reference state (near-natural or sites in at least good status),
- Submission of macrophyte survey data of nationally identified sites,
- Common analysis of national reference sites regarding type-specific macrophyte communities.

[24] The analysis of R-C1 data shown in Vienna also indicates that there is a sensible common view of reference condition for this type when taking the views of all countries into account.

[25] Common variables for screening need to be identified that are widely available in a common format. Establishing suitable reference criteria will be an iterative step to which all countries can contribute.