

## **SUMMARIES OF THE PRESENTATIONS**



## **Identification of reference conditions, and boundaries between high, good and moderate status in lakes and watercourses.**

### **Description of the EU Water Framework Directive project REFCOND.**

Mats Wallin, Swedish University of Agricultural Sciences, Dept. of Env. Assessment, Uppsala, Sweden. Project co-ordinator.

#### **General introduction**

This is a description of the EU Water Framework Directive (WFD) project "Development of a protocol for identification of reference conditions, and boundaries between high, good and moderate status in lakes and watercourses" (acronym: REFCOND). The project is funded by the European Commission (grant agreement: subv/00/259842) and included as a work group in the EU Water Directors "Common Strategy on the Implementation of the WFD".

WFD requires Member States to identify, for each type of body of water, reference conditions for the purpose of identifying a reference biological community in accordance with Annex II, section 1.3. The reference conditions must satisfy certain chemical and hydromorphological criteria set out in Annex V for each category of body of water; rivers, lakes, transitional waters and coastal waters.

The REFCOND project aims at the development of a protocol for identification of reference conditions for inland surface waters and for developing principles for identification of bodies of water corresponding to the boundaries between high, good and moderate ecological status in lakes and watercourses.

#### **Expected outcome**

Techniques validated for application across the Community will be identified and the conditions of their application outlined in the form of a protocol for the identification of reference conditions. Basic assumptions and other conditions will be documented.

Access to a web-site with information on best practices on identification of reference conditions and other findings of relevance for the implementation of the WFD will be established in close co-operation with the Commission to ensure a wider dissemination of the results of the project.

Building on the results of the project, guidance for identification of reference conditions could be elaborated for practical application at the earliest by 2003, provided further financial support can be secured.

#### **Participants**

There are 16 partners participating in the project: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden and UK. Sweden is lead country and the project is co-ordinated by the Swedish Environmental Protection Agency and the Swedish University for Agricultural sciences (SLU).

#### **Links to other activities**

The co-ordinator will establish and maintain contact with the EU Commission and their inter-related projects included in "Common Strategy", especially with the project group developing guidance on inter-calibration where JRC/Environment Institute has the lead.

#### **Timetable**

Duration will be 24 months. The project was initiated on 01 December 2000 and will be finalised 01 December 2002.

## **Project description**

The criteria and other guidance for identification of reference conditions and for classification of water bodies laid down in the WFD imply broadly speaking, the following:

- For hydromorphological parameters and the general physico-chemical parameters (listed in Annex V, section 1.1) that they reflect totally, or nearly totally, undisturbed condition
- For specific synthetic pollutants that concentrations are close to zero or at any rate below the limit of detection of the most advanced analytical techniques in general use
- For specific non-synthetic pollutants that concentrations remain within the range normally associated with background levels

These elements provide the main technical basis for identification of reference conditions. The procedural basis for the identification is Annex II, section 1.3, the main provisions of which are as follows:

- Reference conditions can be either spatially-based (an existing site corresponding to the above conditions) or based on modelling or using a combination of these
- Reference conditions based on modelling can be derived using either predictive models or hindcasting methods, using historical, paleoecological and other available data
- Where it is not possible to establish reliable reference conditions due to high degrees of natural variability in the element, the element can be excluded from the assessment of ecological status

As regards classification and boundaries, Annex V, section 1.2 provides a definition of good status which, for biological elements, is based essentially on a slight departure from the reference biological population identified as above. For hydromorphological elements and general physico-chemical parameters, there are no separate criteria for good status, the condition being that the elements are such as to support a biological community of the requisite standard, and for specific synthetic and non-synthetic pollutants the condition is that waters comply with a quality standard for the relevant substance according to the procedure of Annex V, section 1.2.6. There are similar provisions for moderate status.

## **Working methods**

The study will comprise the following steps:

### **(1) ELABORATION OF WORK PROGRAMME AND ESTABLISHMENT OF WEB-SITE.**

A detailed work programme will be worked out, including the responsibility of different Member States to various programme activities. Common definitions should be agreed on where needed. It is particularly important to develop an operational definition of reference conditions and to agree on the historical period or other circumstances corresponding to reference conditions. A kick-off meeting workshop will be held to provide an opportunity for Member States to present their views on the work programme. The programme will be finalised after the workshop. A web-site will be established, where project plans and results will be made available. The web-site will also provide a virtual forum for discussion and exchange of information. To be completed March 2001. The web-site has the following address: <http://www-nrciws.slu.se/REFCOND/index.html>.

### **(2) REVIEW OF TECHNIQUES FOR IDENTIFICATION OF REFERENCE CONDITIONS (SPATIALLY BASED OR BASED ON PREDICTIVE MODELS OR HINDCASTING MODELS) AND PRINCIPLES FOR THE IDENTIFICATION OF BOUNDARIES BETWEEN QUALITY CLASSES.**

Principles and techniques used in Member States and elsewhere will be reviewed. Each participating Member State is expected to report on their own procedures. Methods used elsewhere will be reviewed by partners who volunteer to do so or as arranged by the leader. The results will be reported and discussed at a workshop, where further analyses and selection of principles and methods to be included in a final protocol will also be discussed. To be completed June 2001 (workshop 14-15 May in Uppsala, Sweden).

(3) EVALUATION OF TECHNIQUES USED FOR IDENTIFICATION OF REFERENCE CONDITIONS AND PRINCIPLES FOR DELINEATION OF QUALITY CLASSES.

Based on the results reported in the previous stage of the project, a comparison and evaluation of techniques and principles will be made, taking into account ecological realism, environmental relevance, need for supporting data, robustness and precision. The possibilities and limitations of different procedures will be highlighted. The evaluation is expected to be made by selected Member States, on a voluntary basis and with tasks distributed among participants according to expertise and interest. The results will be reported and discussed at a workshop, where the outline of a common protocol for the assessment of reference conditions will also be discussed. To be completed in December 2001 (workshop 5-6 Dec in Ispra, Italy).

(4) ELABORATION OF FIRST PROTOCOL DRAFT.

Based on the findings in the previous stage, a first draft outlining a common procedure for identification of reference conditions and for identification of boundaries between high, good and moderate status will be produced and submitted to Member States for comments. The draft will be produced by the leader. To be completed in May 2002.

(5) REVIEW AND VALIDATION OF PROTOCOL.

The draft will be reviewed and commented on by Member States. The protocol will also be applied and evaluated in a number of case studies in different Member States. All Member States are expected to review and comment on the protocol, and those who want may perform one or several case studies. The results will be reported at a workshop, where modification of the draft that might be necessary will be discussed and the final protocol outlined. To be completed in October 2002 (workshop September).

(6) FINALISATION OF PROTOCOL AND TERMINATION OF PROJECT.

Based on the findings in the previous step the protocol will be revised and a final report to the Commission will be written. To be completed in December 2002.



## European research in support of the Water Framework Directive

Andrea Tilche

Unit Head – Water Key Action, DG Research – I/3 – Brussels

### The Water Framework Directive (WFD)

#### Objectives:

The overall objective of the Water Framework Directive is to expand water protection to all waters and thereby stop and reverse water degradation. The Directive aims at achieving "good status" within 15 years. The guiding principle is that water management is on river basins. The Directive encompasses a combined approach, i.e., combined emission limits and water quality standards, plus phasing-out of particularly hazardous substances. Special attention shall be given to water pricing. The Directive emphasizes the need to inform and involve stakeholders and the civil society in the implementation of the Directive. During the implementation process seven old Directives will be repealed.

#### Timetable for implementation of the WFD

Phase 1:	<ul style="list-style-type: none"><li>– Transposition</li><li>– Identification of River Basin districts</li></ul>	Deadline: Dec. 2003
Phase 2:	<ul style="list-style-type: none"><li>– Establishment of reference conditions and reference sites for the inter-calibration network</li><li>– Preparation for specification of values for the ecological status classification system</li><li>– Analyses of the characteristics of the river basin, of pressures and impacts and the economics of water use</li></ul>	Deadline: Dec- 2004
Phase 2a:	<ul style="list-style-type: none"><li>– Establishment of Community criteria for assessing groundwater (Commission Proposals)</li></ul>	Deadline: Dec. 2002
	<ul style="list-style-type: none"><li>– Individual Member State action in absence of adoption criteria</li></ul>	Deadline: Dec. 2005
Phase 3:	Operational monitoring programmes	Deadline: Dec. 2006
Phase 4:	<ul style="list-style-type: none"><li>– Publication of River Basin Management Plans</li></ul>	Deadline: Dec. 2009

#### Problems of implementation of the WFD

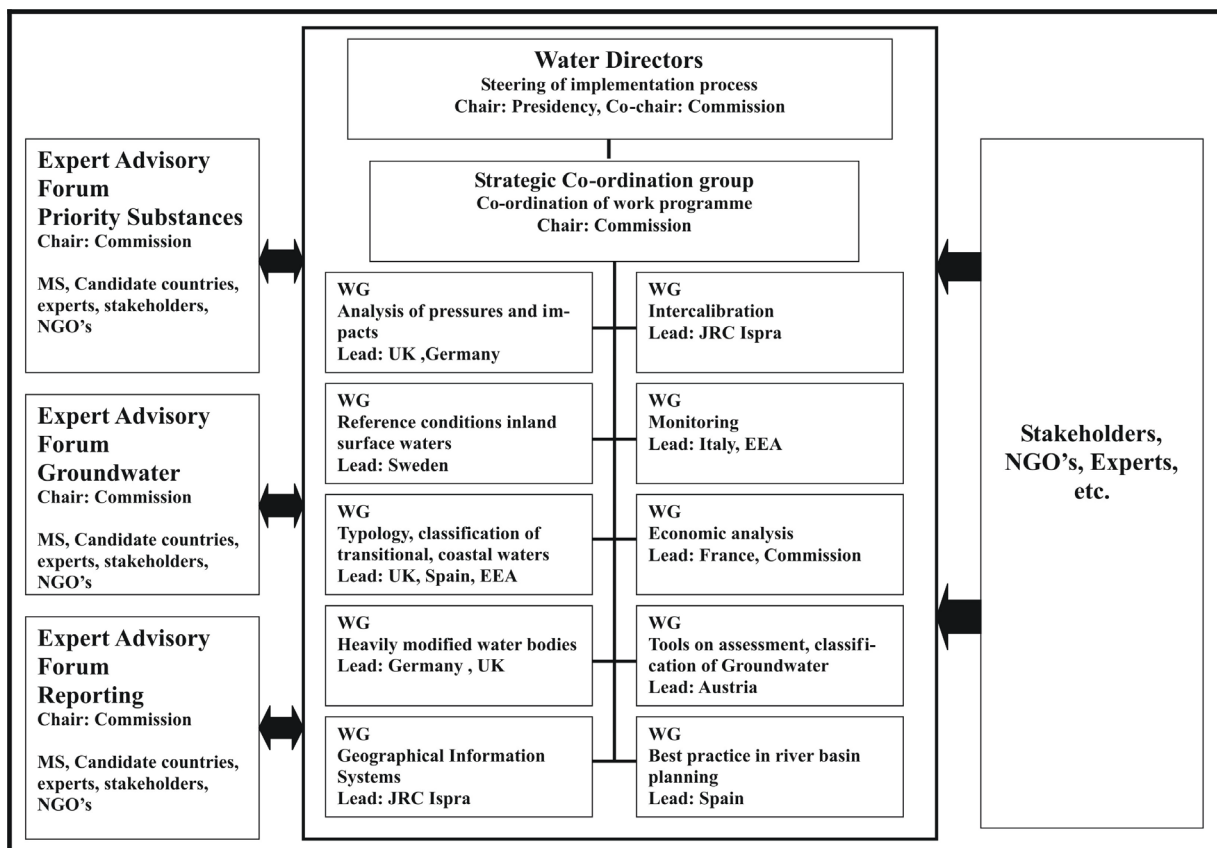
- some countries still need to adopt river basin management
- characterisation and classification of water bodies difficult
- ecological monitoring still primitive
- intercalibration critical
- river basin planning: complexity in prioritising interventions
- public participation missing
- high investment and operational costs (and difficult to estimate)

#### Needs for research

- methodologies for assessment and classification of ecological status
- methodologies for establishing the reference conditions
- heavily modifies water bodies
- modelling tools and decision support systems
- groundwater
- socio-economic aspects
- prioritisation of hazardous substances

## Structure of the implementation strategy

The general objective of the strategy is to establish common understanding on the strategic issues and dead lines and to identify common tasks which are important for achieving the objectives of the WFD. The following structure has been established for the implementation of the strategy.



## Research strategy

- providing support to the working groups for the implementation of the WFD through large projects, clusters and concerted actions
- improving web tools for better dissemination of results
- promoting a specific programme for support to the WFD in the 6<sup>th</sup> FP under priority number 8

## Instruments for the implementation of the Water Framework Directive

Modelling is crucial for the description of catchments, for planning, for testing policies, decision making, for daily management. Many different models exist for the description of the different components of a catchment (hydrology, ecology, river quality (point and non-point sources), lake quality, groundwater/surface water interactions, atmospheric deposition, runoff, impact on coastal waters, socio/economic impacts, etc.). Integrated modelling is a step forward.

## The CATCHMOD initiative

Development of common harmonised modelling tools for the integrated management of water at river basin or sub-basin scales, including the interface to the coastal zone, in order to achieve a selected number of 'European benchmark models' for the various integrated water management requirements at these scales. This should be co-ordinated through a large scale concerted action on catchment/river basin or sub-basin modelling, with related RTD projects on the harmonisation of modelling tools supported by case studies on selected catchments/river basins or sub-basins. Research needs are related to making the model components compatible at different scales, to defining the data need, to optimising definition/complexity and to developing tools with and for the end-users.

## Research activities supporting the implementation of the Water Framework Directive in Finland

Pertti Heinonen  
Finnish Environment Institute,  
P.O.Box 140 (Kesäkatu 6), SF-00251 Helsinki, Finland  
pertti.heinonen@vyh.fi

Finland has participated in the preparations of Water Framework Directive (WFD) in EC from the very first beginning since 1995. The Ministry of the Environment (responsible for environmental questions) is in Finland in charge of the implementation process of the WFD. In this duty it is working in very close co-operation with the Ministry of Agriculture and Forestry (responsible for water reserves and water use). Also the Ministry of Trade and Industry (energy aspects), the Ministry of Social Affairs and Health (responsible for the implementation of Drinking water and Bathing water directives), and the Ministry of Justice are continuously participating in different preparatory committees or working groups.

The implementation of WFD has been guided since December 1998 by a Steering Committee established by the Ministry of the Environment. The Committee includes representatives of several ministries and of environmental administration including regional environment centres. The Finnish Environment Institute has also one member, one secretary and one permanent expert member in this Committee. The Committee is chaired by Director General Pekka Jalkanen from the Ministry of the Environment, who is also the Finnish representative in the meetings of the EU Water Directors.

For preparing the necessary provisions to the Finnish law two committees have been established, one committee for the provisions of the environmental protection legislation and another committee for the provisions of water legislation. Because of the character of WFD a lot of research and developing work is needed. Therefore also several national expert groups with specific issues have been established in a very early phase. Already in March 1999, "The expert group on ecological classification and monitoring" was established. The main objectives of this group have been as follows:

- to develop the national application of the ecological classification system (the main principles of the classification should be ready at the end of 2002),
- to develop the programmes of the surveillance and operational monitoring according to the WFD (should be ready at the end of 2003), and
- to compile and prepare more extensively research projects necessary during the implementation of WFD.

This group is chaired by the Finnish Environment Institute (FEI), and the members are mostly from FEI, but also scientists from Regional Environment Centres are participating, as well as representatives from the Finnish Game and Fisheries Research Institute.

The two other expert groups established by the Ministry of the Environment are "The expert group on ground waters", and "The expert group on coastal waters". The expert group on ground waters is chaired by the Ministry of the Environment, and participants are from FEI, Geological Survey, The Association of Finnish Local and Regional Authorities and Finnish Water and Waste Water Works Association. The main objectives of this group are:

- to prepare a proposal for ground water classification,
- to prepare a proposal for the monitoring programme.

The expert group on coastal waters is chaired by FEI, but there are also several members from the regional environment centres, as well as from some universities and the Finnish Institute of Marine Research. The main objectives of this group are:

- to prepare a proposal for classification of coastal waters,
- to prepare a proposal for the monitoring programme for coastal waters.

Additionally, the Ministry of the Environment has established two "Pilot projects". One pilot is a large river basin, which evidently will be nominated in the future to be one of the Finnish "River basin districts". Some regional environment centres have established also their local pilot projects to prepare the implementation of WFD. Quite a lot of practical tests and exercises have been carried out in the pilot areas.

There are at the moment ten different research areas, which will be carried out in the Finnish Environment Institute as follows:

- Information required for the list of competent authorities (Annex I)
- Characterisation of surface water body types (Annex II: 1.1-1.3) and classification (Annex V: 1.1-1.2, 1.4)
- Monitoring of ecological and chemical status for surface waters (Annex V: 1.3)
- WFD and Coastal Waters (Annex II: 1.1-1.3, Annex V: 1.1-1.4)
- Heavily modified surface water bodies (Annex II, 1.1-1.3, Annex V)
- WFD and Groundwater (Annex II: 2, Annex V:2)
- The planning issues of WFD (Annex VII)
- Priority substances (Annex X)
- The use of models in the implementation of WFD
- Other related research activities

The Finnish Environment Institute is at present participating to the following six international research projects funded by the Commission:

- CHARM: Characterisation of the Baltic Sea Ecosystem: Dynamics and Function of Coastal types (Started in October 2001)
- MOLTEN: Monitoring long-term trends in eutrophication and nutrients in the coastal zone: Creation of guidelines for the evaluation of background conditions, anthropogenic influence and recovery (Started in February 2001)
- EUROLAKES: Integrated Water Resource Management for Important Deep European Lakes and their Catchment Areas (Timo Huttula, Bertel Vehviläinen)
- INCA: Integrated Nitrogen Model for European Catchments (Ahti Lepistö, Katri Rankinen)
- BMW: Benchmark models for the water framework directive (Juha Kämäri, Seppo Rekolainen, Olli Malve) (will be started in December 2001)
- Towards European harmonised procedures for quantification of nutrient losses from diffuse sources (Seppo Rekolainen) (will be started in December 2001).

At present there are in FEI altogether 26 projects which are connected with the implementation of WFD. In 2001 FEI use to these projects personnel costs of 247 person months, that is some 23 person years. The costs are 11.4 million marks (1.9 million euro) altogether, 6.6 million marks (= 57.9 %) consists of permanent funding of FEI, and 4.8 million marks (= 42.1 %) come as project funding from ministries (Ministry of the Environment and Ministry of Agriculture and Forestry) and from EU.

FEI has established June 1, 2001 a WFD-project. The main task of this project is to lead and coordinate the research and development projects of FEI and at the same time to pay regard to the activities of the working groups, committees and corresponding forums founded by the Ministries, where FEI has representatives of its own. The working period of the WFD-project (when the timetables of the WFD is payed regard to) is from June 1, 2001 to December 31, 2003.

One significant increase of different research will take place when the river basin districts will be established and they will start their work in the watershed areas. The very first proposal for river basin districts and the competent authorities has been published by the Steering Committee. The Ministry of the Environment will prepare the decision of the river basin districts in spring 2002.

# Speculations on Biological Quality Indicators, and Ecological Classification of Surface Waters

Hanne Kaas, Flemming Møhlenberg and Jesper Dannisøe  
DHI Water & Environment, Agern Allé 11, DK 2970 Hørsholm; Denmark

## 1 Introduction

The ultimate goal of the Water Framework Directive (WFD) is to obtain High or Good Ecological Status of all our water bodies. To achieve this ambition, we need to convert verbal intentions into operative instruments. The WFD poses a radical adjustment to former standards for assessment of the status of our water bodies. Chemical standards have for many years constituted a central element in the management of surface waters and in particular the control of the sources to pollution. With the adoption of the WFD, the ecological status and thus biological quality criteria has attained a prominent role in the efforts to improve the condition of aquatic environments.

This presents a major challenge to both scientists and managers. Ecological elements (biological as well as physio-chemical) have played a significant role in the assessment of the state of surface waters in many European countries. However this knowledge must now to be converted into specific well-defined indicators which again must be combined in classification systems making it possible to categorise the status on a scale covering the range from High Ecological Status (reference condition) to Bad Ecological Status (*Fig. 1*). The indicators must be founded on robust ecological characteristics, and the classification systems must be universal to ensure that assessments are comparable between water bodies and transboundary.

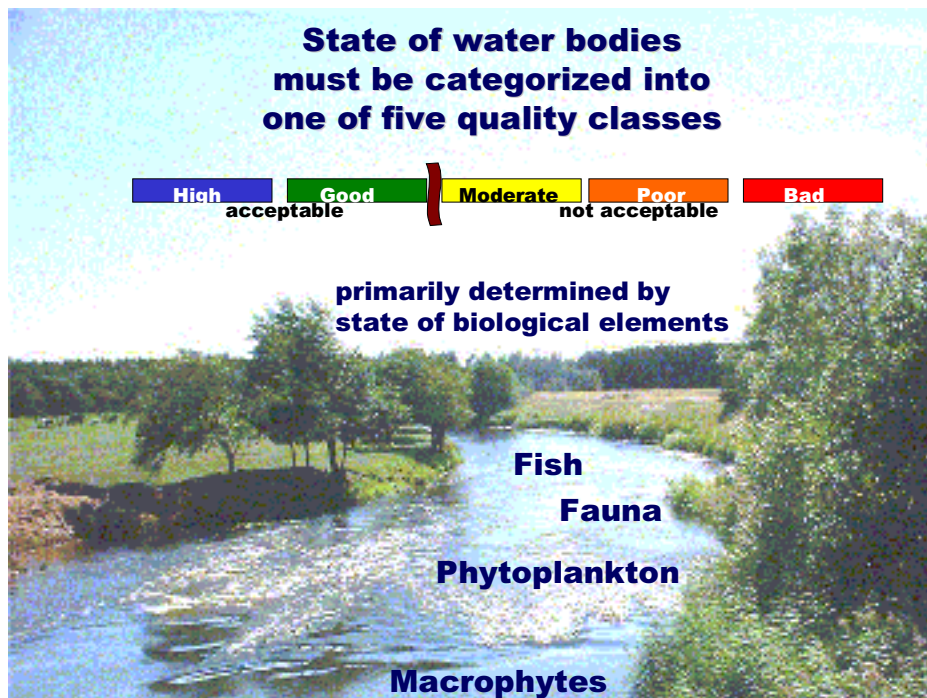


Figure 1

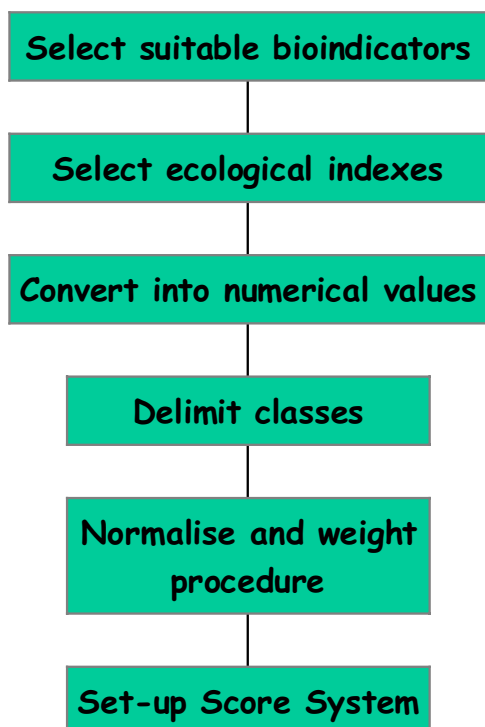
A major goal when establishing indicators and criteria should be to take advantage of the huge amount of data, which has been gathered through monitoring of European water bodies. Extraction of the immense quantity of information embedded in those data is not done over night and some degree of pragmatism must be anticipated considering the time frame given (harmonised and intercalibrated systems should be ready no later than three years after adoption of the Directive). However, it is a must to make benefits of the enormous sums of money already invested in monitoring.

To obtain such systems it is important to describe the overall concepts to be followed and to set up guidelines for the development of indicators and classification systems. It is crucial that concepts and guidelines are ready at a very early stage to ensure that the end-product is cohesive, robust and well-documented. In accordance with this, EU has initiated a number of projects with the objective to work out protocols on implementation of the different ingredients of WFD.

In the following we shall outline some basic considerations to bear in mind when developing indicators, criteria and classifications systems. We introduce a protocol that ensures a consistent and well-documented basis for the assessment of the ecological quality. The reflections are partly based on a pilot study conducted for the Danish EPA (Pedersen et al 2002).

## 2 A Quality Assessment System

To accomplish a consistent assessment of the ecological status it is necessary to set up a quality assessment system that gives firm descriptions and definitions of the legitimate standards and measure. Indicators, indexes, scoring schemes, criteria and quality classes should be described and documented. A practicable way to obtain this is to establish guidelines that points out exactly what kind of information and documentation is needed, and to collect the these data in Documentation Sheets (*Fig. 3*) which form the core of the assessment system.



A suggestion on a procedure for development of quality assessment systems is given to the left (*Fig. 2*).

Each step should comprise a quality assurance to ensure that the selections are carefully prepared and well-documented.

USGS (Intergovernmental Task Force on Monitoring Water Quality 1996) has proposed a three pace procedure for the selection of suitable indicators, which is usable for all subjects:

Identification of potential indicators/indexes -> Testing and validation -> Acceptance (*Fig. 4*).

*Figure 2*

### *Mandatory Sheets with Documentation of Accepted Indicators*



- \* **application (where to use)**
- \* **description**
- \* **ecological relevance**
- \* **characteristica**
- \* **classification**
- \* **presentation**

Figure 3

### 3 Biological Indicators and Indexes

WFD prescribes that the state of the water bodies must be determined on the basis of four biological elements: phytoplankton, macrophytes, benthic invertebrate fauna and fish (*Fig. 1*). It states a number of characters within each element, which should be employed: species composition, abundance, biomass (phytoplankton) and distribution (macrophytes). For all elements the best status is equivalent to the reference condition.

The identification of indicators and indexes should acknowledge that aquatic ecosystems comprise multifaceted relationships. The candidates are thus many-sided and characterise dissimilar scales:

- Individuals: abnormalities, content of toxic substances, size of organisms
- Processes: reduced/increased rates
- Species composition: indicator species, tolerant/intolerant species, alien species, species diversity
- Ecosystems: functional structure, species diversity

### Type of indexes:



- \* **uni-metric**
- \* **multi-metric**
- \* **discriminant models**
- \* **multivariate ordination**

Figure 4

The potential indicators may derive from general knowledge on causal ecological relationships or from existing successful indicators. As a principle development and improvement of indicators should be based on analyses of data from the specific eco-type in the given eco-region (in some cases it may even be necessary to use data from the water body in question).

The selected measures may be simple indicators or more or less complex indexes (Fig. 4). An example of a simple uni-metric indicator is the concentrations of chlorophyll per litre of water (as a measure of phytoplankton biomass). Complex indicators or indexes express aggregated information, e.g. on species composition, key processes and/or functional structures. Production index combining primary production, chlorophyll and temperature is one candidate, which may be useable for large lakes and coastal waters. The most comprehensive experience regards bottom fauna and many studies have dealt with development of indexes and comparisons of indexes to select the most suitable.

Irrespectively of the complexity, the indicators have to fulfil a number of requirements to be suitable (Fig. 5). A key-requirement is that they reflect human-caused changes in the ecosystem. They must be robust, meaning that they cannot be susceptible to stochastic variations, e.g. in meteorology. Furthermore, it is important that the indicators/indexes as a whole reproduce the health of the ecosystem. They must supplement each other (give new knowledge) and not just replicate information. The goal must also be to select simple-to-procure indicators. The risk of getting inaccurate and non-comparable results is large if the measurements are complicated or in other ways strenuous to accomplish. Last but not the least they should be easy to comprehend not only from a technical point of view but also for layman. A vital purpose of indicators/indexes is to facilitate communication to managers, decisions makers, the public etc.

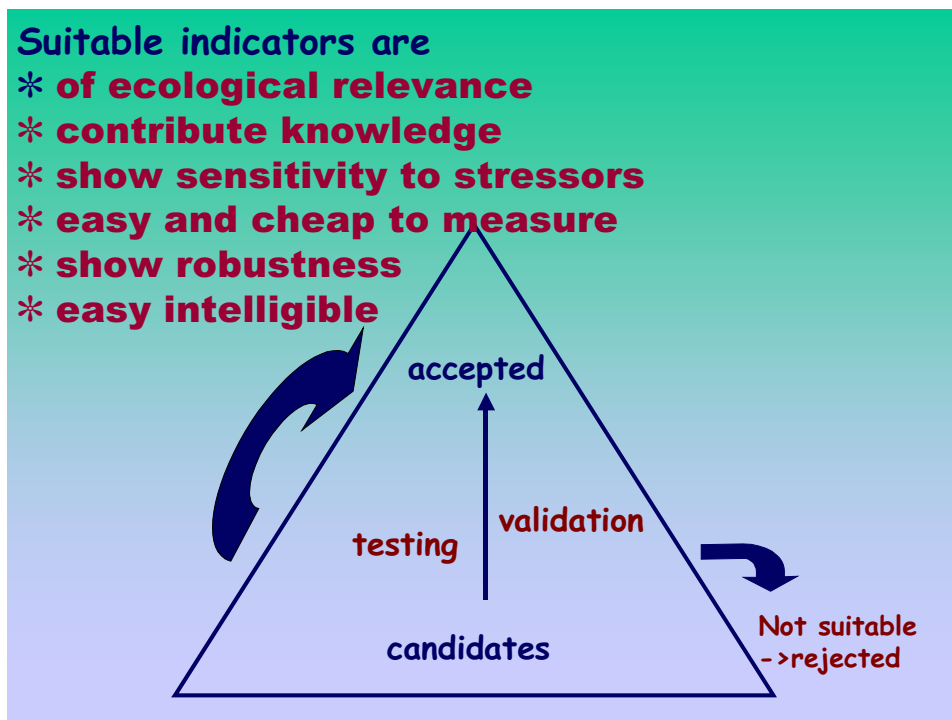
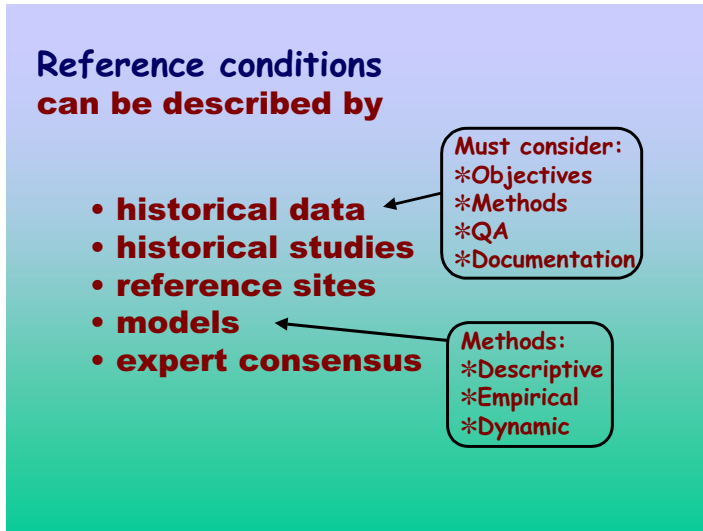


Figure 5

Before an indicator/index is accepted the applicability must be tested and validated, i.e. to test the variation, document the correlation with natural and anthropogenic factors, determine the geographical validity (is it usable for different areas/types) etc. If a number of indicators/indexes comprise identical information, the most suitable should be nominated based on test of their robustness, cost-effectiveness, intelligibility etc.

#### 4 Reference condition

As the objective of WFD is to obtain High or Good ecological status of our water bodies, the definition of the reference condition is a cornerstone in the implementation of the directive. In some parts of Europe it is still possible to find pristine freshwater environments. However, this is far from always the case as dense population leaves few spots unaffected by human activities. In particular, coastal areas are in general impacted by anthropogenic activity.



Thus the understanding of "reference" condition has to be clearly defined. Is it equivalent to year 1900? year 1000? does it refer to the pristine landscape or to early 1900 cultural scenarios?. In order to achieve comparable perceptions, methods to describe reference conditions should be outlined. Candidate methods (Fig. 6) include historical data (museum inventories, palaeo-ecology (Fig. 7), etc.), expert opinion, and empirical modelling and dynamic modelling.

Figure 6

As temporary and spatially variations in the climate affect the reference condition, the environmental background cannot be perceived as a fixed state and it is important to determine the range of the indicators to delimit the environmental background. The EU project REFCOND is presently working on establishing protocols concerning reference conditions.

Another aspect that needs consideration is the temporal variation. Not only must this be integrated into the classification system (the classes must cover ranges for each indicator). It is necessary to set up guidelines on how to treat out-layers e.g. due to extreme climatic conditions. Does compliance with the criteria in only one year justify classification as good status and vice versa? Or should the assessment be based on a five year period.

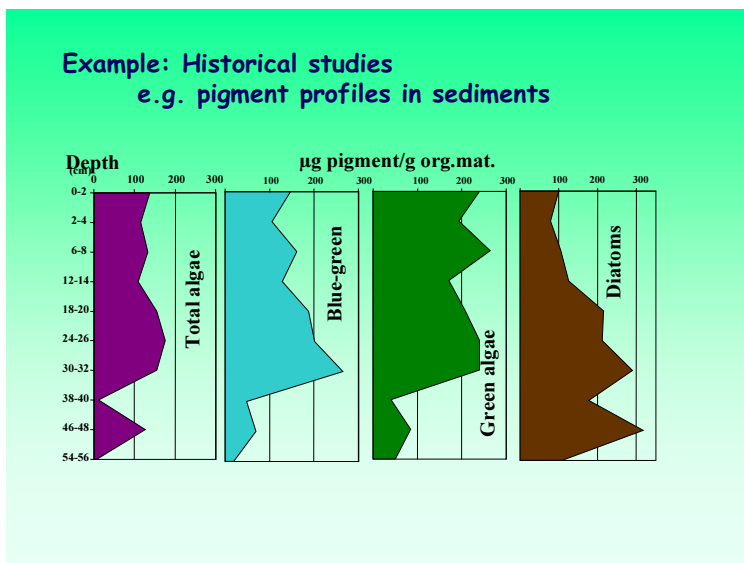


Figure 7 modified after Mortensen et al (2001).

## 6 Quality Status Classes

The definition of ecological quality classes should be based on a suite of elements covering physio-chemical variables and biological indexes encompassing taxonomic and functional descriptors of communities of phytoplankton, submerged plants, benthic fauna and fish.

High ecological status	Good ecological status	Moderate ecological status	Poor ecological status	Bad ecological status
No or very minor alterations of quality elements	Low levels of distortion resulting from human activity	Moderate distortions resulting from human activity	Major distortions resulting from human activity	Extreme distortions resulting from human activity, e.g. without macroscopic life

WFD prescribes that the status of natural water bodies should be categorised into five quality classes (see above) of which only High and Good Ecological Status are considered acceptable classes. However, the WFD does not give explicit guidelines on how these classes should be defined and how they are used in management. In particular the separation between Good (acceptable) and Moderate (not acceptable) Ecological Status is crucial, and it must be clarified when a water body succeeds or fails to attain the designation Good.

The directive does recommend that the status is described in numerical terms using a scale ranging from 0 (=bad condition) to 1 (=reference condition). A very common method is based on cumulative frequency distributions where the 95<sup>th</sup> percentile is taken as the utmost value and the range between the minimum and utmost value is sectioned into classes (*Fig 8*). The utmost value represents either reference or bad conditions – this depends on the type of metric value. The sectioning is frequently made by dividing the range into five equivalent sections (=status classes), but other approaches may be more appropriate. In *Fig. 8* the classes are defined on the basis of assessment of ecological quality based on monitoring data and expert opinion. A vital prerequisite is that the both ends (the bad and the reference) of the spectrum are properly defined.

Finally, to obtain an overall assessment of the quality of any given water body, the classification of the indicators/indexes needs to be aggregated. This may be done using a "score sheet" in which all information is summarised in comparable units. The scoring system has to take into account that the indicators may not have identical weight as descriptors of the health of the ecosystem. Hence it may be more decisive to the quality that toxic algae are present than that the phytoplankton biomass is low. Thus normalisation of data may be necessary. Similarly the weight of the different biological and physio-chemical elements may not be equivalent. The state of invertebrate community may for some water bodies be more decisive than the condition of macrophyte community, because of greater ecological relevance and/or because the relation to human stresses is more sensitive or better documented. The scoring system must also handle situations where indicators and/or elements place the water body in different classes.

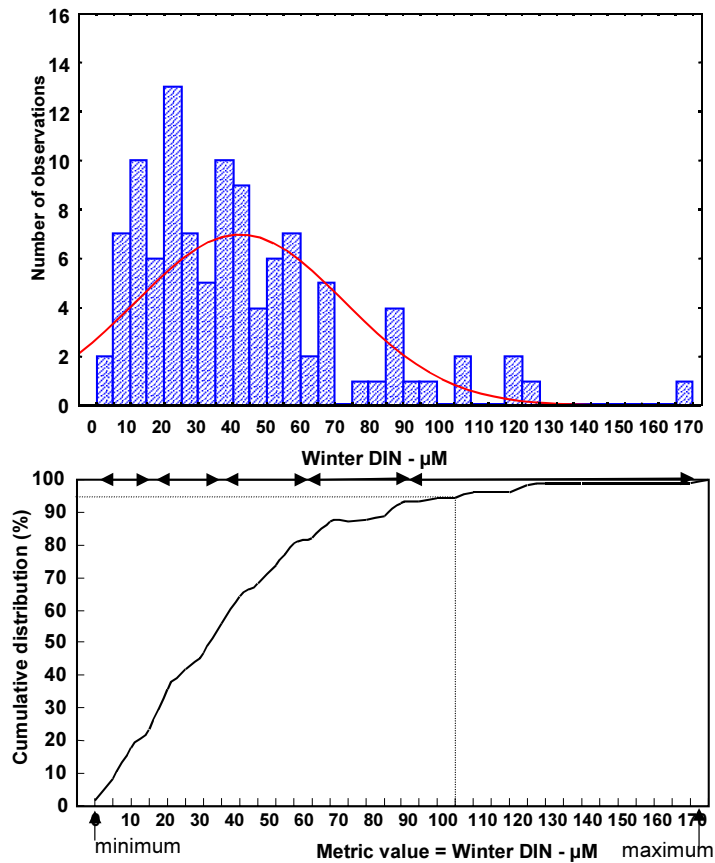


Figure 8

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