# SLOVENSKI STANDARD
# SIST-TP CEN/TR 16151:2011

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**Kakovost vode - Navodilo za načrtovanje multimetrijskih indeksov**

Water quality - Guidance standard on the design of Multimetric Indices

Wasserbeschaffenheit - Anleitung zur Planung und Erstellung Multimetrischer Indices

Qualité de l'eau - Norme de recommandations relatives à la conception des indices multimétriques



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TECHNICAL REPORT

RAPPORT TECHNIQUE

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# CEN/TR 16151

April 2011

ICS 13.060.45

English Version

# Water quality - Guidance on the design of Multimetric Indices

Qualité de l'eau - Lignes directrices pour la conception des indices multimétriques

Wasserbeschaffenheit - Anleitung zur Planung und Erstellung Multimetrischer Indices

This Technical Report was approved by CEN on 27 December 2010. It has been drawn up by the Technical Committee CEN/TC 230.

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## Foreword

This document (CEN/TR 16151:2011) has been prepared by Technical Committee CEN/TC 230 “Water analysis”, the secretariat of which is held by DIN.

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# Introduction

Multimetric Indices are among the commonly used tools for classification of the quality of fresh water and brackish water ecosystems (rivers, lakes, transitional waters, wetlands). A Multimetric Index combines several individual metrics, the results of which are finally combined into a Multimetric result. Thus Multimetric Indices integrate several attributes of a community ("metrics") to describe and assess condition. Different categories of metrics (e.g. taxa richness, share of sensitive and tolerant species, trophic structure) reflecting different environmental conditions are combined into one Multimetric Index.

Multimetric Indices can be applied to different aquatic ecosystems (rivers, lakes, transitional waters, wetlands) and to different Biological Quality Elements (fish, benthic invertebrates, macrophytes, phytoplankton, phytobenthos). They are flexible in terms of the composition of metrics, since different metrics are suited for the assessment of different ecosystems or different stressors.

In recent years, a wide variety of Multimetric Indices has been developed and is now being applied, particularly for the purpose of implementing the Water Framework Directive. It can be expected that many existing Multimetric Indices will be adapted and many new ones will be developed within the next years. To enhance comparability between Multimetric assessment systems the procedure of developing and applying a Multimetric Index is described.

# 1 Scope

This document describes methods for developing and applying Multimetric Indices used for assessing rivers, lakes, transitional waters or wetlands. It is suitable for use with data on fish, benthic invertebrates, macrophytes, phytoplankton, and phytobenthos.

# 2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**2.1**
**Anchors (Upper and Lower Anchors)**
values of a metric, which are empirically set and defined as “1” (Upper anchor) and “0” (Lower anchor), respectively, for transferring a metric’s result into a 0 to 1 score

NOTE The Upper Anchor relates to the reference value (i.e. the metric’s value under reference conditions). The Upper Anchor can be calculated from the median or mean of reference samples or by other appropriate statistical methods as described in 4.3.

The Lower Anchor is related to the lower limit of the metric’s value under the worst ecological quality conditions.

**2.2**
**fresh water or brackish water type (river type, lake type, transitional water type)**
division into an ecologically meaningful entity of sites with limited biotic and abiotic variation and a recognisable discontinuity with other types



NOTE Fresh water or brackish water types serve as “units“, to which an assessment system can be applied.

**2.3**
**metric**
measurable part or process of a biological system empirically shown to change in value along a gradient of human influence [2]



NOTE It reflects specific and predictable responses of the community to human activities, either to a single factor or to the cumulative effects of all events and activities within a watershed.

**2.4**
**metric type**
metrics addressing comparable aspects of a community, regardless of the stressor to which the metrics are responding

NOTE The following metric types can be distinguished (see Annex A):

- composition / abundance metrics: all metrics giving the share of a taxon or taxonomic group in relation to the total number of individuals counted; all metrics giving the abundance of a taxon or taxonomic group; metrics comparing reference and observed taxa (e.g. similarity indices);
- richness / diversity metrics: all metrics giving the number of taxa within a certain taxon (including the total number of taxa), all diversity indices;
- sensitivity / tolerance metrics: all metrics giving the ratio of taxa sensitive and insensitive to stress in general or to a certain stress-type, either using presence/absence or abundance information;
- functional metrics: all metrics addressing the characteristics of taxa other than their taxonomic definition (biological or ecological traits, ecological guilds): feeding types, habitat preferences, ecosystem type preferences, current preferences, life-history parameters, body-size parameters; they can be based on taxa abundance or richness.

**2.5**
**Multimetric Index**
combination of the results of three or more metrics

**2.6**
**stressor**
category of direct or indirect human impact to a fresh water, which potentially influences the composition and / or abundance of stream biota

NOTE The following stressors can be distinguished:

- organic pollution: organic matter input induced by human activities;
- eutrophication: nutrient input induced by human activities;
- acid stress: permanently or temporarily decreased pH value due to human activities;
- temperature stress;
- toxic stress: effects of toxic contaminants released by human activities;
- degradation in stream morphology: bed and bank alteration, habitat degradation, riparian land use, straightening, migration barriers, siltation;
- hydrological stress: alteration of flow regime, e.g. residual flow, pulse releases;
- general degradation: simultaneous and inseparable impacts of more than one stressor.



**2.7**
**stressor gradient**
set of sites of a fresh water ecosystem type with a varying intensity of a stressor



## 3 Principle

Two ways of calculating Multimetric Indices can be distinguished: the “general approach” and the “stressor-specific approach”.

In the “general approach”, various metrics are calculated from a taxa list. The metric results are individually compared to the respective metric values under reference conditions. From this comparison, a score for each metric is determined. These scores are finally combined into a Multimetric Index (Figure 1).

The “stressor-specific” approach sorts a suite of metrics according to their ability to detect a certain stressor. Thus, the scores of the metrics addressing a single stressor are first combined into a value reflecting the intensity of this stressor. The assessment results for all stressors are finally combined into the Multimetric Index (Figure 2).

Both ways of calculating Multimetric Indices may have advantages in certain situations: The “general approach”, carefully applied, provides an overview of a water body’s status and is, thus, mainly suited if the specific effects of individual stressors on the targeted organism group are not known in detail. It can, for example, be applied for the general ecological quality assessment and for intercalibration purposes. The “stressor specific approach” can only be applied if precise information on the effects of different stressors (e.g. acidification, organic pollution) on the targeted organism group are known and it is most suited for investigative monitoring purposes, tailored towards the identification of alteration causes.

The results of a Multimetric Index can be viewed at different levels: at the upper level there is the Ecological Quality Class, at the second level (in case of the stressor specific approach) are the results of the stressor specific modules (quality classes “organic pollution” and “stream morphology degradation” in Figure 2) and at the third level the results of the individual metrics are produced.

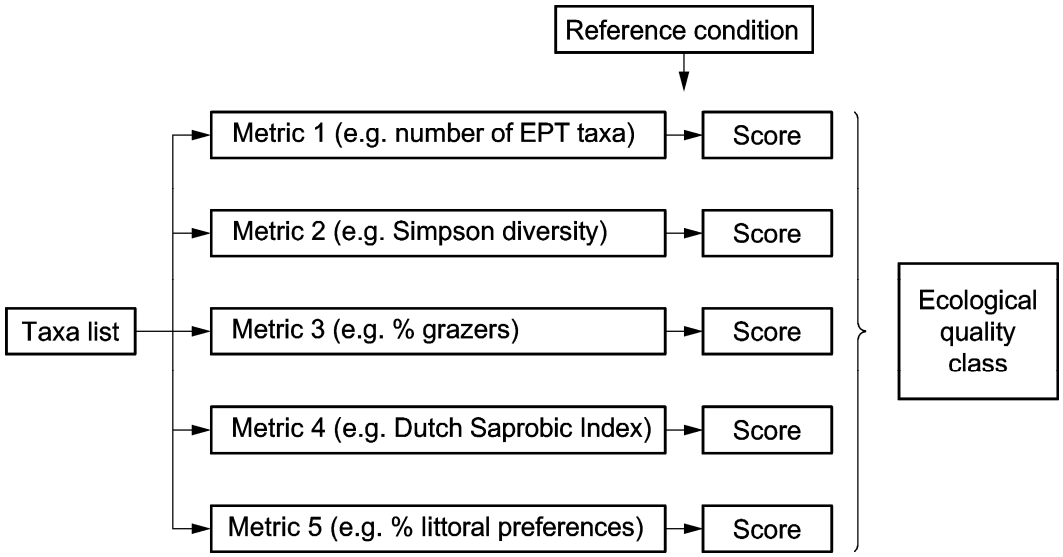


**Figure 1 — The "general approach" of multimetric assessment**

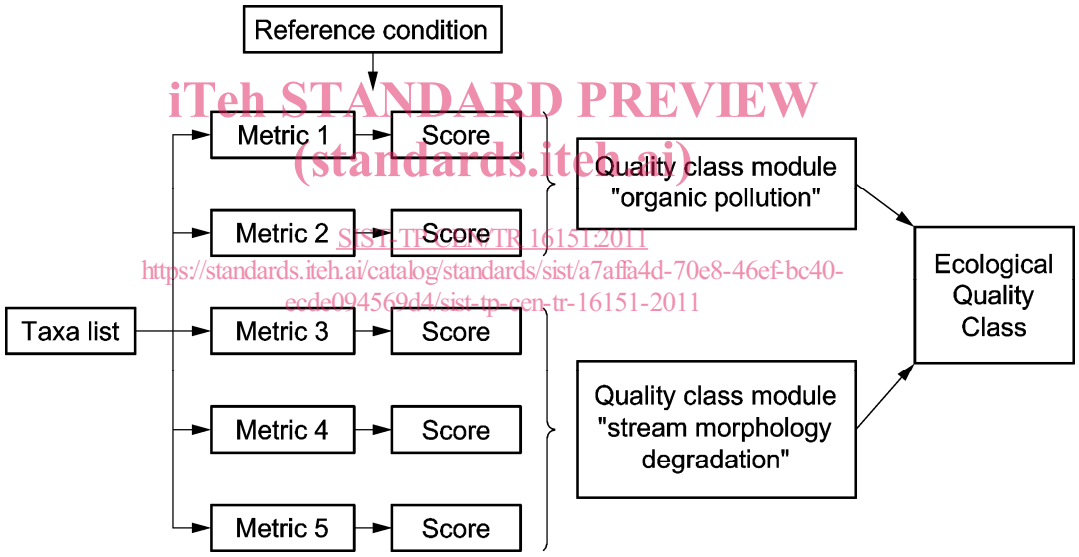




**Figure 2 — "Stressor-specific approach" of multimetric assessment**

## 4 Procedure

### 4.1 General

The procedure of developing a Multimetric Index is composed of the following steps:

— Selection of Candidate Metrics;

— Exclusion of Redundant Metrics;

— Definition of Upper and Lower Anchors;

— Transformation of Core Metrics into a 0 to 1 score;

— Selection of Core Metrics;