Greek document on class boundaries setting and normative definitions for the IC Mediterranean GIG, Rivers (M1, M2 and M4)

Country	Greece
Classification System:	**STAR & MED Intercalibration Common Metric Index (STAR_ICMi, MED_ICMi)**
General Description Part 1.	General approach and introduction In Greece, since the seventies, major Greek rivers are being regularly monitored for their chemical quality by the Ministry of Agriculture, and recently by the Ministry for the Environment Physical Planning and Public Works in collaboration with the General States' Chemical Laboratory. A part of these rivers has been sufficiently studied for their hydrochemical regime [Skoulikidis, 1993; Skoulikidis et al. 1998]. A national classification system for hydrochemical quality is however lacking [Economou & Skoulikidis, 2003]. In addition, as a result of insufficient national environmental research strategy, research related to biological assessment of inland waters was, up to recently, carried out on an occasional and sporadic basis, depended on the research interests of the scientific community and on cash flow. As a result, a national system for the assessment and classification of running waters using biological elements has not been developed [Economou & Skoulikidis, 2003]. Ecological quality assessment using benthic macroinvertebrates has been applied the last years by various Greek research teams. However, sampling methods as well as level of taxonomical identification differed among these studies. With the implementation of the European project AQEM and STAR, ecological quality assessment using benthic invertebrates moved towards standardised and acknowledged methods. However, a national or regional biotic index for ecological quality assessment of Greek rivers and streams has not been implemented. A biotic index named as Greek Biotic Metric (BMG) has been developed by Skoulikidis et al. (2004) in the framework of the AQEM project but needs further improvement by adding more sites. Similarly, a biotic index has also been developed by Artemiadou & Lazaridou (2005) named as Hellenic Evaluation Score and its Interpretation Index (HES) but considers only Northern and Central River catchments. Methodologies concerning benthic diatoms have been recently applied for ecological assessment of running waters, while methodologies for ecological quality assessment as far as fishes are concerned, have not been applied yet. About 40% of streams in Greece are intermittent (RM5), however no data for those streams are available. Biomonitoring has been performed only in few streams with no any standardised methodology. Regarding large rivers, four are interregional (Evros, Axios, Strymon & Nestos) and limited data for those are available.

	Description of the STAR and MED Intercalibration Common Metric Index The STAR and MED intercalibration indices were designed for European IC purposes and they represent one of the indices used in various GIGs for the comparison and harmonization of class boundaries of different MSs. The indices were developed to assess the overall (i.e. general) degradation of a river site, not being aimed at detecting the impact of single stressors on invertebrates (i.e. it is not a stressor-specific system). The STAR and MED ICMi is directly calculated in the form of Ecological Quality Ratio (EQR), in accordance with WFD requirements for classification systems. Three aspects of the used methodology to derive class boundaries have to be considered for intercalibration purposes and to check compliancy with normative definitions: a) the sampling technique b) the calculation formula c) the conversion of STAR and MED ICMi values into quality judgement (i.e. class boundaries setting). a) Macroinvertebrate data for the Intercalibration exercise were collected by using the STAR-AQEM method (AQEM Consortium, 2002) The STAR-AQEM macroinvertebrate sampling methodology is based on a multi-habitat scheme designed for sampling major habitats proportionally according to their presence within a sampling reach. Each sample consisted of 20 "replicates" taken from all microhabitat types at the sampling site with a share of at least 5% coverage, which must be distributed according to the share of microhabitats. Benthic macroinvertebrates were collected with a rectangular hand net of 0.25 m x 0.25 m with a mesh size of 500-ìm nytex screen. A total of 1.25 m^2 was sampled for each sampling site, starting at the downstream end of the reach and proceeding upstream. The samples were preserved with ca. 70% ethanol and the species were collected with soft tweezers and identified with state of the art determination literature as specified in the AQEM manual (AQEM Consortium 2002). Analysis of the macroinvertebrate fauna was conducted at family level to evaluate overall patterns in faunal structure. b) the calculation formula The STAR_ICMi is a multi-metric index and is composed of six metrics; ASPT, Log_{10}(sel_EPTD+1), 1-GOLD, N-taxa, EPT and Shannon-Weiner diversity. The ICMi value is calculated by the sum of all the ICMs, after attributing a weight to each metric. Hereafter, the list and category of each metric is provided (Table 1). After their normalization, the metrics are combined into the ICM index. Metrics are grouped into three groups, providing information on three major response areas: Tolerance, Abundance/Habitat and Richness/Diversity. A different weight is attributed to the metrics within each group, giving greater importance to the metrics based on the whole community (Buffagni et al., 2004). To obtain the final multimetric score, the same weight is attributed to each of the three metric groups (0.333).

The MED_ICMi is a multi-metric index and is composed of four metrics; Iberian ASPT, Number of EPT taxa, Number of taxa and Number of Selected Families of ETD / Total Number of Families. The ICMi value is calculated by the sum of all the ICMs, after attributing a weight to each metric. Hereafter, the list and category of each metric is provided (Table 2). After their normalization, the metrics are combined into the ICM index. Metrics are grouped into three groups, providing information on three major response areas: Tolerance, Abundance/Habitat and Richness/Diversity. A different weight is attributed to the metrics within each group, giving greater importance to the metrics based on the whole community. To obtain the final multimetric score, the same weight is attributed to each of the three metric groups (0.34).

Table 1. Intercalibration Common Metrics (ICMs) used in the STAR ICMi

Information type	Metric type	Metric name	Taxa considered in the metric	Literature reference	weight
Tolerance	Index	ASPT	Whole community (Family level)	e.g. Armitage et al., 1983	0.333
Abundance/ Habitat	Abundance	Log_{10} (Sel_EPTD +1)	Log(sum of Heptageniidae, Ephemeridae, Leptophlebiidae, Brachycentridae, Goeridae, Polycentropodidae, Limnephilidae, Odontoceridae, Dolichopodidae, Stratyomidae, Dixidae, Empididae, Athericidae & Nemouridae)	Buffagni et al., 2004; Buffagni & Erba, 2004	0.266
Richness and Diversity	Abundance	1-GOLD	1 - (relative abundance of Gastropoda, Oligochaeta and Diptera)	Pinto et al., 2004	0.067
	Taxa number	Total number of Families	Sum of all Families present at the site	e.g. Ofenböck et al., 2004	0.167
	Taxa number	number of EPT Families	Sum of Ephemeroptera, Plecoptera and Trichoptera taxa	e.g. Ofenbock et al., 2004; Böhmer et al., 2004.	0.083
	Diversity index	Shannon-Wiener diversity index	$D_{S-W} = -\sum_{i=1}^{s}\left(\frac{n_i}{A}\right)\cdot \ln\left(\frac{n_i}{A}\right)$	e.g. Hering et al., 2004; Böhmer et al., 2004.	0.083

c) Reference values for each individual metric were calculated using the values from the reference sites. The *median* of the values from the reference sites were used as reference values. Each individual metric was normalised by dividing the values by the reference value for that particular metric. The reference value for ICM was determined following the same procedure previously used to determine the reference value of the individual ICM metrics. ICM values were divided by the ICM

reference value and by the national index. All values were thus transformed into EQRs.

Table 2. Intercalibration Common Metrics (ICMs) used in the MED ICMi

Information type	Metric type	Metric name	Taxa considered in the metric	Literature reference	weight
Tolerance	Index	Iberian ASPT	Whole community (Family level)	Alba-Tercedor, J. & A. Sanchez-Ortega, 1988.	0.34
Abundance/ Habitat	Abundance	Number of Selected Families of ETD / Total Number of Families			0.2
Richness and Diversity	Taxa number	Total number of Families	Sum of all Families present at the site	e.g. Ofenböck et al., 2004	0.28
	Taxa number	number of EPT Families	Sum of Ephemeroptera, Plecoptera and Trichoptera taxa	e.g. Ofenbock et al., 2004; Böhmer et al., 2004.	0.18

Selection of Reference sites

Selection of reference sites according to REFCOND Guidance, National Strategy paper ("Criteria for the identification of potential reference sites") and criteria used by AQEM/STAR (AQEM Consortium, 2002).

Boundary setting approach

The High/Good boundary was set as the 25th percentile of the reference values for each river type M. The range from the High/Good boundary to zero was split into 4 equal width classes following the approach in the REFCOND Guidance.

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Criteria for Boundary Setting	High/Good boundary	Good/Moderate boundary
MED ICMi, in general	The REFCOND approach was used to set class boundary (25^{th} percentile value of reference samples)	The REFCOND approach was used to set class boundary (25^{th} percentile value of reference samples) and the gradient from the H/G boundary to the lower value (zero) is divided into 4 equal width classes. This means that M/G boundary = H/G boundary x 0.75
STAR ICMi, in general	The REFCOND approach was used to set class boundary (25^{th} percentile value of reference samples)	The REFCOND approach was used to set class boundary (25^{th} percentile value of reference samples) and the gradient from the H/G boundary to the lower value (zero) is divided into 4 equal width classes. This means that M/G boundary = H/G boundary x 0.75

Type-specific Information

Part 2.

RM1 IC type

Dataset used

Macroinvertebrate data used for RM1 were collected within the framework of the EU co-funded AQEM and STAR projects and cover the full degradation gradient (from bad to reference) observed throughout Greece. In total, 17 sites were included (Table below)

4	Reference	23.53%
5	High	29.41%
2	Good	11.76%
1	Moderate	5.88%
4	Poor	23.53%
1	Bad	5.88%

Class boundary results (According to REFCOND Approach)

RM1	STAR ICMi	Med_ICM7 quant	*MED* ICMi
High/Good boundary(25th percentile)	0.946	0.938	0.950
Good/Moderate	0.709	0.704	0.712
Moderate/Poor	0.473	0.469	0.475
Poor/Bad	0.236	0.235	0.237

RM2 IC type

Dataset used

Macroinvertebrate data used for RM2 were collected within the framework of the EU co-funded AQEM and STAR projects and cover the full degradation gradient (from bad to reference) observed throughout Greece. In total, 15 sites were included (Table below)

2	Reference	13.33%
4	High	26.67%
3	Good	20.00%
5	Moderate	33.33%
1	Poor	6.67%
0	Bad	0.00%
0	Not Classified	0.00%

Class boundary results (according to REFCOND approach)

RM2	STAR ICMi	Med_ICM 7 quant	*MED* ICMi
High/Good boundary(25th percentile)	0.941	0.983	0.969
Good/Moderate	0.706	0.737	0.727
Moderate/Poor	0.471	0.492	0.485
Poor/Bad	0.235	0.246	0.242

RM4 IC type

Dataset used

Macroinvertebrate data used for RM4 were collected within the framework of the EU co-funded AQEM and STAR projects and cover the full degradation gradient (from bad to reference) observed throughout Greece. In total, 12 sites were included (Table below)

3	Reference	25.00%
4	High	33.33%
4	Good	33.33%
0	Moderate	0.00%
0	Poor	0.00%
1	Bad	8.33%

Class boundary results

RM4	STAR ICMi	Med_ICM 7 quant	*MED* ICMi
High/Good boundary(25th percentile)	0.956	0.922	0.891
Good/Moderate	0.717	0.692	0.668
Moderate/Poor	0.478	0.461	0.446
Poor/Bad	0.239	0.231	0.223
