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# Water framework directive intercalibration technical report: Transitional waters Mediterranean geographic intercalibration group

*Benthic invertebrates fauna ecological assessment methods*

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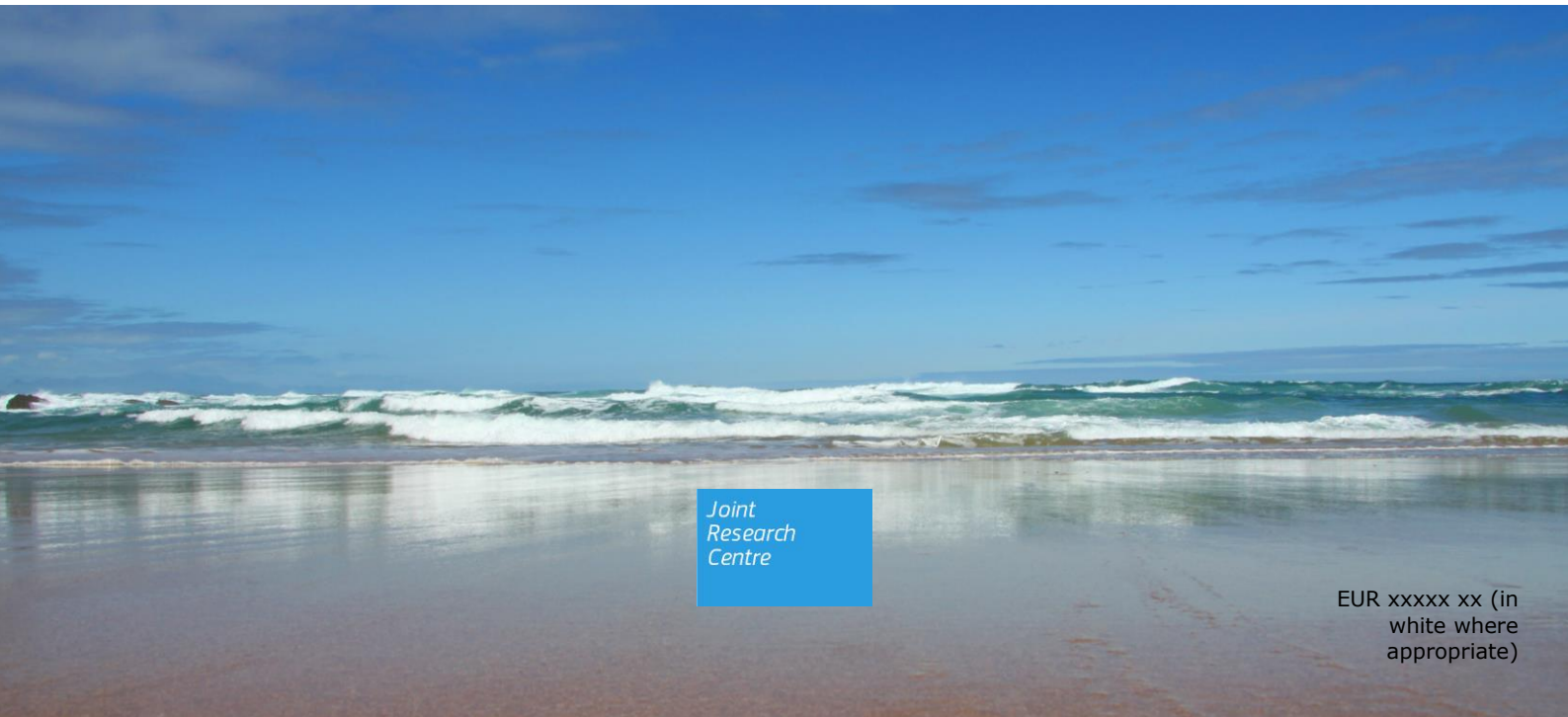
2016

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**JRC Science Hub**
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EUR xxxxx xx

ISBN xxx-xx-xx-xxxxx-x (PDF)
ISBN xxx-xx-xx-xxxxx-x (print)

ISSN xxxx-xxxx (online)
ISSN xxxx-xxxx (print)

doi:xx.xxxx/xxxxx (online)
doi:xx.xxxx/xxxxx (print)



How to cite: Authors; title; EUR; doi

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## Abstract

The European Water Framework Directive (WFD) requires the national classifications of good ecological status to be harmonised through an intercalibration exercise. In this exercise, significant differences in status classification among Member States are harmonized by comparing and, if necessary, adjusting the good status boundaries of the national assessment methods.

Intercalibration is performed for rivers, lakes, coastal and transitional waters, focusing on selected types of water bodies (intercalibration types), anthropogenic pressures and Biological Quality Elements. Intercalibration exercises are carried out in Geographical Intercalibration Groups - larger geographical units including Member States with similar water body types - and followed the procedure described in the WFD Common Implementation Strategy Guidance document on the intercalibration process (European Commission, 2011).

The Technical report on the Water Framework Directive intercalibration describes in detail how the intercalibration exercise has been carried out for the water categories and biological quality elements. The Technical report is organized in volumes according to the water category (rivers, lakes, coastal and transitional waters), Biological Quality Element and Geographical Intercalibration Group. This volume addresses the intercalibration of the Transitional Waters-Mediterranean Sea Benthic Invertebrate Fauna ecological assessment methods.

# 1. Introduction

- Three Member States (Italy, France and Greece) compared and harmonized successfully their national assessment systems for the common type "Mediterranean Coastal lagoon Poly-euhaline restricted and Mesohaline Chocked".
- The national methods address eutrophication pressure.
- An Option 3 was used.
- No enough data (low number of water bodies and/or stations) for the intercalibration of the common types "Coastal lagoons oligohaline, poly-euhaline chocked" and Estuaries.
- Spain has not developed methods for the common types Coastal lagoons mesohaline and Poly-euhaline.

# 2. Description of national assessment methods

*Table 1 Overview of the national assessment methods*

| Member State | Method | Included in this IC exercise |
|---|---|---|
| Italy | M-AMBI | Yes |
| France | M-AMBI | Yes |
| Greece | M-AMBI | Yes |
| Spain (Andalusia region) | BO2A | No* |
| Croatia | M-AMBI | No* |

*Not enough data

## 2.1 Methods and required BQE parameters

*Table 2 Overview of the metrics included in the national assessment methods included in this IC exercise*

| Member State | Full BQE method | Abundance | Disturbance sensitive taxa | Diversity | Combination rule of metrics |
|---|---|---|---|---|---|
| Italy | Yes | Relative abundance | Yes | Yes | Multivariate analysis (Factor Analysis) calculating vectorial distances to reference conditions |
| France | Yes | Relative abundance | Yes | Yes | Multivariate analysis (Factor Analysis) calculating vectorial distances to reference conditions |
| Greece | Yes | Relative abundance | Yes | Yes | Multivariate analysis (Factor Analysis) calculating vectorial distances to reference conditions |

## 2.2 Sampling and data processing

*Table 3 Overview of the sampling and data processing of the national assessment methods included in the IC exercise*

| | |
|---|---|
| Sampling/survey device. | Benthic grab (van Veen grab, Ponar grab, Eckman-Birge grab) for Italy, Greece and France<br>Sieve (mesh size): 1 mm for France, Italy; 0,5 mm for Greece |
| How many sampling/survey occasions (in time) are required to allow for ecological quality classification of sampling/survey site or area? | FR: 1 every 3 years<br>IT: Twice a year<br>GR: 1 every year |

| | |
|---|---|
| Sampling/survey months. | FR: Spring<br>IT: From April to June and from September to October<br>GR: Autumn |
| Which method is used to select the sampling /survey site or area? | FR: Sediments are sampled on soft bottom, on central stations.<br>IT: Stratified sampling/surveying.<br>GR: Sediments are sampled on soft bottom, on central stations. |
| Total sampled area or volume, or total surveyed area, or total sampling duration on which ecological quality classification of sampling/survey site or area is based. | Sample area per station: FR=0.27 m², IT=1 m²,? GR=0.15 m²<br>ES:<br>HR: |
| Short description of field sampling/ survey procedure and processing (sub-sampling). | France: Sampling method requirements of ISO 16665. 1 to 3 central stations are sampled in spring for each lagoon. Each sampling station consists of three sub-stations 100 to 300 meters distant, where four replicates are collected using a Ekman-Birge grab (225 cm²). 0.09 square meters of sediment are taken for each sub-station, so a total of 0.27 square meters per station. An additional grab is sampled for analyzes of organic matter and particle size. The sediments are sieved (mesh size 1 mm). Macrofauna is identified at the species level, following the European Register of Marine Species' nomenclature (ERMS).<br>Italy: In habitats which areas are less than 2.5 $km^2$: 2 sampling points; In habitats witch areas are between 2.5 - 50 $km^2$: as above plus one station each 5 $km^2$ for a maximum of 10 sampling points; In habitats witch areas are > 50 square kilometres, as above plus one station each 25 $km^{2.}$ The sediments are sieved (mesh size 0.5-1 mm). Macrofauna is identified at the species level.<br>Greece: 2 to 4 central stations are sampled in autumn for each lagoon. Three replicates are collected using a Ponar grab (0.05 m²). An additional grab is sampled for sediment analyses (organic carbon and granulometry). Benthic samples are sieved through a 0.5-mm mesh sieve and stained with Rose Bengal. Samples are preserved in 4% formalin. The macrofauna is sorted, identified to a species level where possible, and counted. Temperature, salinity and dissolved oxygen are measured just above the bottom. |

## 2.3 Sampling and data processing

*Table 4 Overview of the methodologies used to derive the reference conditions for the national assessment methods included in the IC exercise*

| Member State | Type and period of reference conditions | Number of reference sites | Location of reference sites | Reference criteria used for selection of reference sites |
|---|---|---|---|---|
| FR (M-AMBI) | RC: spring dataset | 2 for poly-euhaline lagoons | Lagoons of Thau & Leucate | Existing near-natural reference sites. Least disturbed conditions: the best sites are defined like under low influence of human activities. Nutrients and chl-a levels in water column are low (TN~25µM/L, Chl-a~0.6 µg/L, DO2sat~30%). |
| IT | - | 342 sampling point related to 10 coastal lagoons | Adriatic and Tirrenic coastal lagoons | With historical data has been calculated the function of distribution (Johnson's algorithm R software) than was taken into account the 90° percentile of the H' and Richness distribution and was calculated the average of the values of those parameters > of 90° percentile, that was considered the reference condition.<br>For AMBI has been taken into account the 10° percentile, so the average of the values of AMBI<10° was considered a reference condition. |
| GR (M-AMBI) | RC : Autumn dataset | 1 poly-euhaline lagoon | Tsopeli lagoon / Amvrakikos Gulf | Existing near-natural reference sites. Least disturbed conditions: the best sites are defined by low pressures of anthropogenic activities, nutrients and chl-a levels are low (N-$N0_3$ µg-at/l ~12; Chl-a mg/$m^3$~0.5); organic carbon in sediments low (1-2%). |

**POLY-EUHALINE, RESTRICTED**

| | Species richness (S) | Shannon diversity (H) | |
|---|---|---|---|
| **France** | 46 | 4,23 | |
| **Greece** | 50 | 4 | |
| **Italy** | 46 | 4,23 | |
| | | | |
| **AMBI** | **France** | **Greece** | **Italy** |
| **Reference Conditions** | 0,6 | 0,05 | 0,63 |

**POLY-EUHALINE, CHOCKED**

| | Species richness (S) | Shannon diversity (H) | |
|---|---|---|---|
| **France** | 46 | 4,23 | |
| **Greece** | 40 | 4 | |
| **Italy** | 25 | 3,3 | |
| | | | |
| **AMBI** | **France** | **Greece** | **Italy** |
| **Reference Conditions** | 0,6 | 0,05 | 1,85 |

**MESOHALINE, CHOCKED**

| | Species richness (S) | Shannon diversity (H) |
|---|---|---|
| **Greece** | 30 | 3,5 |
| **Italy** | 25 | 3,3 |
| | | |
| **AMBI** | **Greece** | **Italy** |
| **Reference Conditions** | 0,05 | 1,85 |

## 2.4 National boundary setting

*Table 5 Explanations for national boundary setting of the national methods included in the IC exercise*

| Member State | Type of boundary setting: Expert judgment – statistical – ecological discontinuity – or mixed for different boundaries? | Specific approach for H/G boundary | Specific approach for G/M boundary | BSP: method tested against pressure |
|---|---|---|---|---|
| FR | Adapted from Borja *et al*. (2006) and calibrated against pre-classified sampling sites (benefiting from the background of the French lagoon monitoring network, started in 2000: http://rsl.cepralmar.com/). | - | - | Yes |
| IT | The boundaries were derived by the 90°, 60°, 30° and 10° percentile of the distribution functions (Johnson's algorithm R software) of the EQR. | The boundaries were derived by the 90°, 60°, 30° and 10° percentile of the distribution functions (Johnson's algorithm R software) of the EQR. | The boundaries were derived by the 90°, 60°, 30° and 10° percentile of the distribution functions (Johnson's algorithm R software) of the EQR. | Yes |

| Member State | Type of boundary setting: Expert judgment – statistical – ecological discontinuity – or mixed for different boundaries? | Specific approach for H/G boundary | Specific approach for G/M boundary | BSP: method tested against pressure |
|---|---|---|---|---|
| GR | Original boundaries of the metric have been used (Borja *et al*., 2007). | Original boundaries of the metric have been used. | Original boundaries of the metric have been used. | Yes |

## 2.5 Results of WFD compliance checking

*Table 6 List of the WFD compliance criteria and the WFD compliance checking process and results of the national methods included in the IC exercise*

| Compliance criteria | Compliance checking conclusions |
|---|---|
| 1. Ecological status is classified by one of **five classes** (high, good, moderate, poor and bad). | Yes |
| 2. High, good and moderate ecological status are set in line with the WFD's **normative definitions** (**Boundary setting procedure**) | Yes |
| Scope of detected pressures | France : Eutrophication<br>Italy : Pollution by organic matter and eutrophication<br>Greece: Pollution by organic matter and eutrophication |
| Has the pressure-impact relationship of the assessment method been tested? | FR,IT, GR: Yes |
| Setting of ecological status boundaries: methodology and reasoning to derive and set boundaries | FR: Adapted form Borja *et al*. (2006) and calibrated against pre-classified sampling sites<br>IT: The boundaries were derived by the 90°, 60°, 30° and 10° percentile of the distribution functions (Johnson's algorithm R software) of the EQR<br>GR: Original boundaries of the metric from Borja et al. (2007) |
| Boundary setting procedure in relation to the pressure:<br>Which amount of data/pressure indicators have been related to the method and what was the outcome of the relation? | France:<br>N=24<br>Delta_O2% : r(Spearman)=-0.669 (p=0.001)<br>[Chla] : r(Spearman)=-0.538 (p=0.009)<br>[TN] : r(Spearman)=-0.58 (p=0.002)<br>Italy: See pressures addressed section<br>Greece:<br>Parameters tested: % of organic carbon in sediments, oxygen, nutrients and chl-a. No significant correlations due to the limited environmental datasets, but the M_ |

| | | |
|---|---|---|
| | Reference and Good status community description:<br>Is a description of the communities of reference/ high – good – moderate status provided? Not only a formula or an EQR value, but the range of values for the different parameters included in the method that result in high- good- moderate status | Yes |
| 3. | **All relevant parameters** indicative of the biological quality element are covered (see Table 1 in the IC Guidance). A **combination rule** to combine parameter assessment into BQE assessment has to be defined. If parameters are missing, Member States need to demonstrate that the method is sufficiently indicative of the status of the QE as a whole | M-AMBI:<br>The composition in Disturbance sensitive taxa and/or Taxa indicative of pollution is included AMBI (as a component of M-AMBI),<br>Taxonomic composition is reflected in the subdivision of taxa among "sensitivity groups", Community diversityand species richness are included in M-AMBI. Abundance is expressed as proportion among sensitivity classes |
| | Complete list of biological metric(s) used in assessment | Yes |
| | Data basis for metric calculation | Yes |
| | Combination rule for multimetrics | Yes |
| 4. | Assessment is adapted to **intercalibration common types** that are defined in line with the typological requirements of the Annex II WFD and approved by WG ECOSTAT | Yes for all |
| | Is the assessment method applied to water bodies in the whole country? | France: Yes<br>Italy: Yes<br>Greece : Yes |
| | Specify common intercalibration types | France, Greece, Italy: Poly-euhaline, restricted<br>France, Greece, Italy : Poly-euhaline, choked<br>Italy, Greece : Mesohaline, choked |
| | Does the selection of metrics differ between types of water bodies? | No |
| 5. | The water body is assessed against **type-specific near-natural reference conditions** | France: Existing near-natural reference sites<br><br>Italy: With historical data has been calculated the function of distribution (Johnson's algorithm R software)<br><br>Greece: Existing near-natural reference sites |
| | Scope of reference conditions | |
| | Key source(s) to derive reference conditions | |
| | Number of sites, location and geographical coverage of sites used to derive reference conditions | France : 2<br><br>Italy: 10<br>Greece : 1 |

| | |
|---|---|
| 6. Assessment results are expressed as **EQRs:**<br>Are the assessment results expressed as Ecological Quality Ratios (EQR)? | Yes |
| 7. Sampling procedure allows for **representative** information about water body quality/ecological status **in space and time**<br>See info from WISER Questionnaires: | Yes |
| 8. All data relevant for assessing the biological **parameters** specified in the WFD's normative definitions are covered by the **sampling procedure** | Yes |
| 9. Selected taxonomic level achieves adequate **confidence and precision** in classification | Yes |

**General conclusion of the compliance checking:** The intercalibration is feasible in terms of WFD compliance.

# 3. Results IC feasibility checking

## 3.1 Typology

The Intercalibration is feasible in terms of typology?

| Common IC type | Type characteristics | MS sharing IC common type | IC |
|---|---|---|---|
| CL-Oligohaline | Coastal lagoons (Salinity <5 psu) | Spain, France, Italy | Not enough data. The number of water bodies is too low for intercalibration. |
| CL-Mesohaline chocked and restricted | Coastal lagoons (Salinity 5-18 psu) | Spain, France, Italy, Greece | Not data in the case of France. Spain has not developed method. Italy and Greece: Enough data for chocked, but only for the harmonization of G/M boundaries, as no High status samples. |
| CL-Poly-euhaline chocked and restricted | Coastal lagoons (Salinity 18-40 psu) | Spain, France*, Italy, Greece | Yes for France, Italy and Greece. Spain has not developed a method. |
| Hyperhalines (Salinity > 40 psu). | Spain | Not possible, only a MS | Hyperhalines (Salinity > 40 psu). |
| Estuaries | Estuaries (salt wedge type) | Spain, Croatia | Not enough data for intercalibration. Only a water body in the case of Spain (1 station), and 5 stations in the case of Croatia. |

* France does not consider distinction between restricted or choked lagoons.

Yes, the typology and common types data have been agreed by the experts. Despite being out of the intercalibration process, Spain and Croatia will use their national/regional method to assess the ecological status of Mediterranean transitional waters of Andalusia and Croatia. In the same way, France, Italy and Greece will use their method and boundaries to assess the ecological status of Mediterranean costal lagoons poly-euhaline chocked.

## 3.2 Pressures addressed

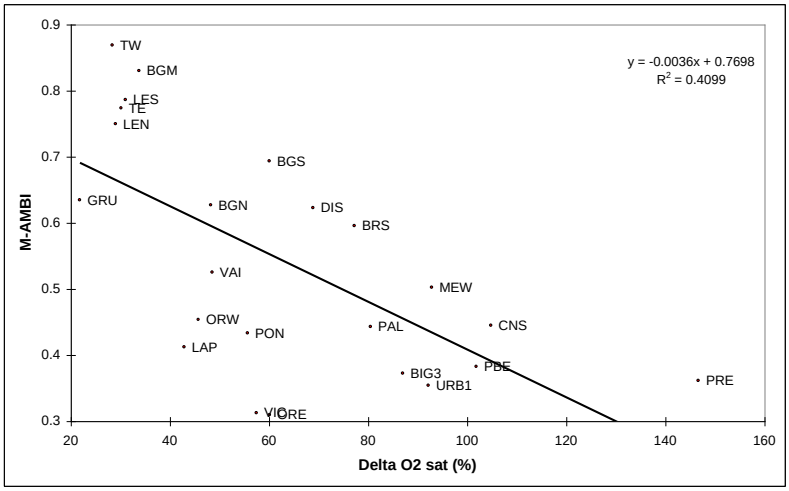
*Table 7 Pressures addressed by the national methods and overview of the relationship between national methods and the pressures*

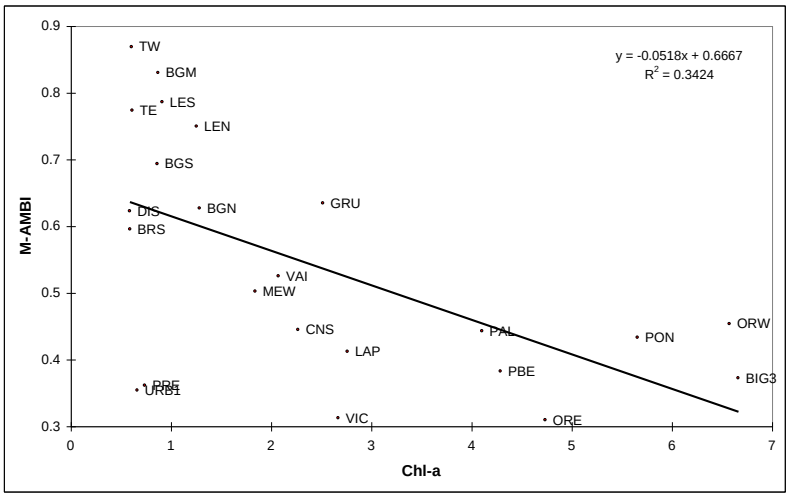
| Member State | Method/ Metrics tested | Pressure | Pressure indicators | Amount of data | Strength of relationship |
|---|---|---|---|---|---|
| France | M-AMBI | Eutrophication | Nutrients and chl-a levels in water column | 24 sites | Delta_O2% : r(Spearman)=-0.669 (p=0.001)<br>[Chla] : r(Spearman)=-0.538 (p=0.009)<br>[TN] : r(Spearman)=-0.58 (p=0.002) |

| Member State | Method/ Metrics tested | Pressure | Pressure indicators | Amount of data | Strength of relationship |
|---|---|---|---|---|---|
| Italy | M-AMBI | Eutrophication; organic enrichment | DIN; TOC; Dilution factor F | 90 | See the Annex |
| Greece | M-AMBI | Eutrophication; organic enrichment | Nutrients, chl-a levels in water column, bottom dissolved oxygen, organic carbon in the sediments | 33 | No strong correlations due to the limited amount of environmental data |

| Method | Pressure |
|---|---|
| M-AMBI (France) | Pollution by eutrophication |
| M-AMBI (Italy) | Pollution by organic matter and eutrophication |
| M-AMBI (Greece) | Pollution by organic matter and eutrophication |
| **Conclusion**:<br>The Intercalibration is feasible in terms of **pressures** addressed? Yes. No strong correlation with pressure indicators for Greece due to the limited amount of environmental data, but it is widely demonstrated in the literature, the existing relationships between M_AMBI and pressure indicators. | |

**France M-AMBI :**



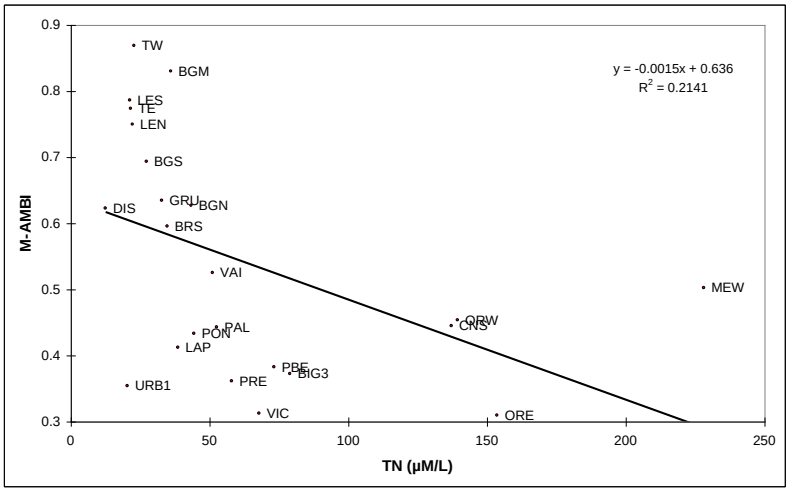




*Figure 1 Correlation graphs of M-AMBI scores and water column parameters for poly-euhaline French lagoons (Chlorophyll-a, Total Nitrogen and difference of O2 % to saturation (summer data)*

**Italy: M-Ambi**

The regression analysis is used to test the existing relationships between a dependent variable (Y), or response variable, and one or more independent variables ($X_1$, $X_2$ ..$X_n$), called explanatory variables, regressors, predictors and so on. A multiple regression analysis, instead of a single regression model, has been used due to the fact that in general the effects of the pressures on an hypothetical index are combined, because of the ecological complexity of a benthic ecosystem. The multiple regression analysis has been applied to the data related to Grado-Marano, Venice, Fogliano and Caprolace lagoons (Poly-Euhaline choked).

The functional relationship may be of any type; however, in practice, we have adopted a function of a linear kind (a linear model or multiple linear regression LM), formulated as follows:

Y = b0 + b 1X1+ b 2X2 + …+b n Xn +e (1)

Where b0 is the known term (the intercept), b 1…b n are the regression coefficients and e represents the error, to say the difference between the sample measurements of Y and the estimated Y values by the model. Together with the error variance (i.e. the variance of the residuals), the intercept and the regression coefficients are therefore the parameters of the model to be evaluated, starting from the sample observations. The results discussed in the following, were obtained using the R Project for Statistical Computing version 2.11.1 (2010).

The choice of the independent variables, i.e. the pressures and status indicators considered in the LM, depend on the results of a Stepwise regression technique previously applied to the whole pressures dataset. The iterative process of the Stepwise Regr. (backward), clearly stops when all the regr. coeff. not significantly different from zero (i.e. not influencing the response-variable), have been eliminated. The LM procedure adopted allows the identification of anomalous sampling stations (outliers) and leave out them from the analysis.

To test M-Ambi and EQR BITS against pressure indicators the adopted linear model was:

*lm(formula = MAMBI/EQR_BITS~F+TOC+DIN,data=15ambi file) (2),*

where the M-AMBI and EQR BITS Indices were tested against: % dilution factor (*F*) that represents the amount of fresh water (correlated with inland pressures) in the WB calculated as $F=(Salinity_{opensea}-Salinity_{measured})/ Salinity_{opensea}$, Total mg/g Organic Carbon in the sediments (*TOC*), Dissolved Inorganic Nitrogen (*DIN*)microg/L.

Diagrams reported in Figure are referred to the goodness of the M-AMBI/EQR BITS linear model, showing the randomness of the residuals and their approximation to normality.

With respect to the initial model, it was not possible to use pressure indicators as Corine Land Cover data because they were too aggregated. Finally, the output provided by the fitted models is shown in the Tables 8-9.

The outputs of the LM presented in

Table 9 show some important results:

- The type of relationships (direct or inverse, depending on the sign of the regr. coeff.)
- The weight of the regressors (i.e. the % value of the regr. coeff. on the total sum)
- The significance and the related Prob.
- The value of the $R^2$, to be meant as the %amount of the variability of the response variable (i.e. the Index M-AMBI) explained by the four chosen regressors in the LM.
- Hypotheses tests applied on the residuals assures us that their distributions are random and consequently there are no other possible sources of variation and/or factors not considered or forgotten.

*Table 8 Mambi LM coefficents*

| **Coefficients:** | | | | | |
|---|---|---|---|---|---|
| | **Estimate** | **Std. Error** | **t value** | **Pr(>\|t\|)** | |
| (Intercept) | 0,9812594 | 0,0537004 | 18,273 | < 2e-16 | *** |
| F | -0,2263182 | 0,1249068 | -1,812 | 0,07835 | . |
| DIN | -0,0004702 | 0,0001661 | -2,831 | 0,00755 | ** |
| TOC | -0,0033889 | 0,001899 | -1,785 | 0,08277 | . |
| --- | | | | | |
| Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 | | | | | |
| | | | | | |
| Residual standard error: 0.08645 on 36 degrees of freedom | | | | | |
| Multiple R-squared: 0.5675, Adjusted R-squared: 0.5315 | | | | | |
| F-statistic: 15.75 on 3 and 36 DF, p-value: 1.051e-06 | | | | | |

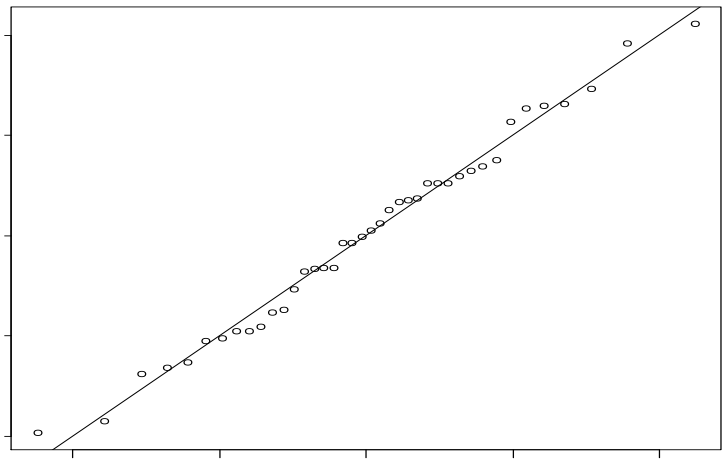


*Figure 2 Linear Model for M-AMBI: diagrams showing the randomness of the residuals and their approximation to normality (Graphical elaborations from R* Stats *Package)*

*Table 9 Tests on residuals for MAMBI LM*

| |
|---|
| One Sample t-test<br>t = 0, df = 39, p-value = 1<br>Alternative hypothesis: true mean is not equal to 0<br>95 percent confidence interval:<br>-0.02656387 - 0.02656387<br>sample estimates:<br>mean of x<br>3,57E-19 |
| Shapiro-Wilk normality test<br>W = 0.9852, p-value = 0.8697<br>Tests on the homogeneity of the residuals variances and absence of autocorrelations |
| Studentized Breusch-Pagan test<br>BP = 1.761, df = 3, p-value = 0.6235 |
| Test di Durbin-Watson<br>DW = 1.7975, p-value = 0.2018<br>alternative hypothesis: true autocorrelation is greater than 0 |

The pressure values corresponding to each value of the EQRs were obtained by solving the inverse of the linear model.

The results are shown in Figure 3 and in Table 10.

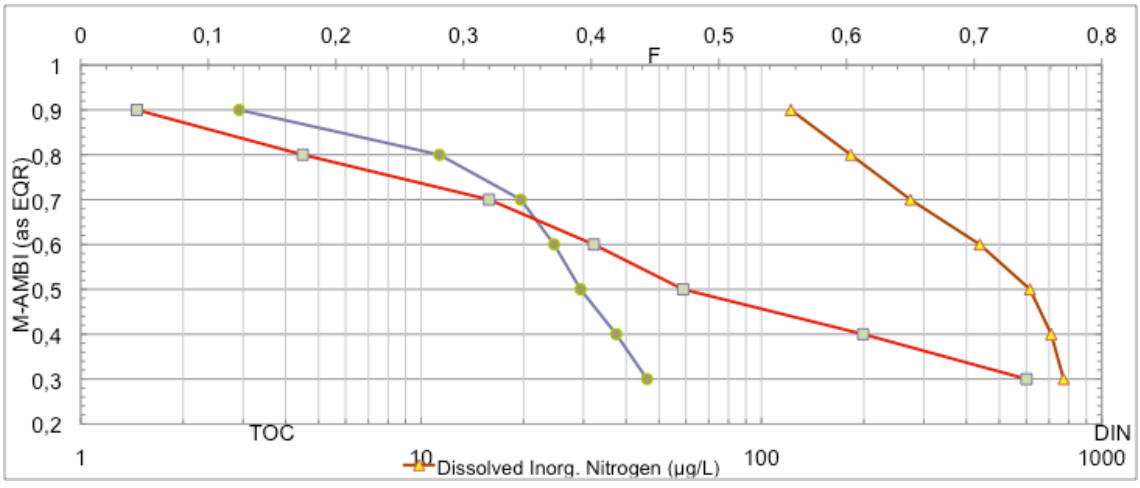



*Figure 3 M-AMBI relationships with significant pressure indicators*

*Table 10 Pressure values corresponding to fixed EQR values*

| | M_AMBI (mediane) | | |
|---|---|---|---|
| **M_AMBI** | **F** | **TOC** | **DIN** |
| 0,9 | 0,044 | 2,92 | 122 |
| 0,8 | 0,174 | 11,32 | 183 |
| 0,7 | 0,32 | 19,64 | 274 |
| 0,6 | 0,402 | 24,6 | 438 |
| 0,5 | 0,472 | 29,41 | 615 |
| 0,4 | 0,613 | 37,44 | 710 |
| 0,3 | 0,741 | 46,12 | 772 |

## 3.3 Assessment concept

| Method | Assessment concept |
|---|---|
| M-AMBI (Italy, Greece, France) | The same method focused on soft bottom macroinvertebrates, based on the abundance of sensitive/tolerant species faced with the increased or decreased disturbance.<br>**FR:** Eckman-Birge grab. 0.27 m²/station, 1 mm mesh<br>**IT:** Van–Veen grab and Box Corer for Venice lagoon; 1 m²/station. Mesh size: 0.5-1 mm<br>**GR:** Ponar grab. 0.15 m²/station. Mesh size: 0.5 mm |

**The Intercalibration is feasible in terms of assessment concept?**

The Member States participating in the current intercalibration exercise apply the same method; therefore, the IC is feasible in terms of assessment concept.

# 4. Collection of IC dataset and benchmarking

## 4.1 Dataset description

*Table 11 Description of the data collection within the GIG*

| | |
|---|---|
| Size of common dataset: total number of sites | FR: 24<br>IT:90<br>GR:33 |
| Number of Member States | 3 |

*Table 12 Overview of the data set*

| Member State | Number of sites or samples or data values | | |
|---|---|---|---|
| | Biological data | Physico- chemical data | Pressure data |
| France | 24 | | |
| Italy | 90 | | |
| Greece | 33 | 15 | 12 |

## 4.2 Data acceptance criteria

*Table 13 List of data acceptance criteria used for the data quality control and describe the data acceptance checking process and results*

| Data acceptance criteria | Data acceptance checking |
|---|---|
| Data requirements (obligatory and optional) | A template for data submission exists with specific requirements towards data format and content. All countries have submitted the obligatory data and all datasets were accepted. |
| The sampling and analytical methodology | No special acceptance checking was done for the sampling and the analytical methodology. All countries follow their national guidelines. |
| Level of taxonomic precision required and taxalists with codes | All countries use species level precision where possible and use the WoRMS database for the taxonomy. |
| The minimum number of sites / samples per intercalibration type | We use all data, we can find anyway. In some cases it may not be possible to meet specific minimum criteria with respect to number of sites. |
| Sufficient covering of all relevant quality classes per type | We use all data, we can find anyway. In some cases it may not be possible to meet specific minimum criteria with respect to sufficient coverage of all classes. |

## 4.3 Common benchmark: IC reference conditions or alternative benchmark

Alternative benchmark sites bases on expert knowledge and distance of pollution sources.

## 4.4 Benchmark standardization

No benchmark standardization as no differences (P>0.05) have been found between the benchmark sites.

# 5. Comparison of methods and boundaries

## 5.1 IC option and common metrics

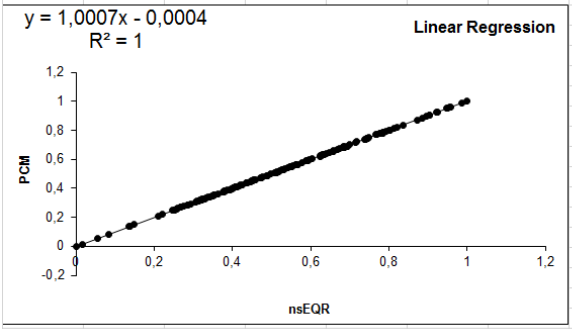
Members States use the same method but with different boundaries: Option 3 for all the common types intercalibrated.

## 5.2 Results of the regression comparison

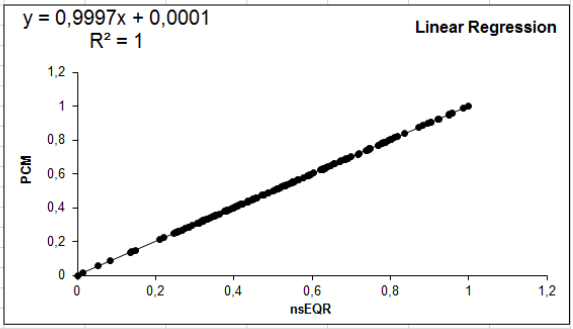
**POLY-EUHALINE, RESTRICTED**

**M-Ambi France, Greece, Italy**

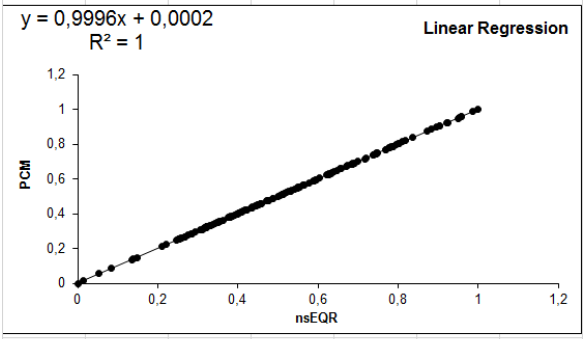
GR




FR

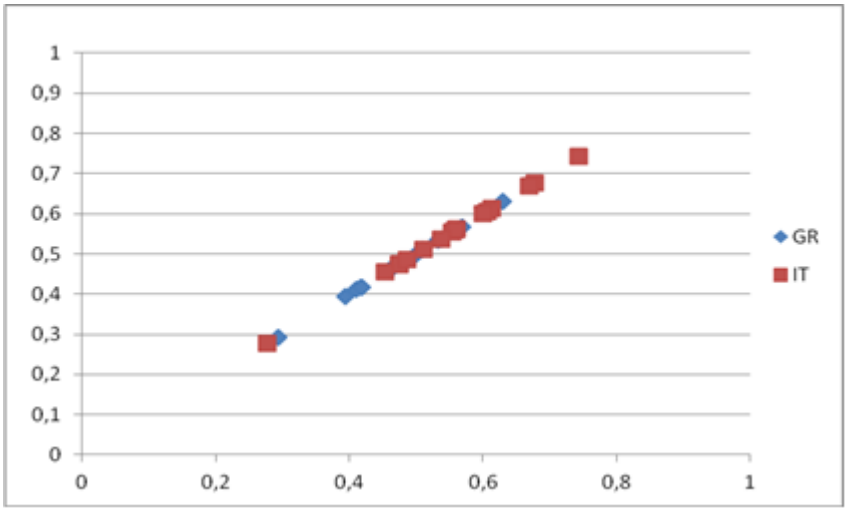



IT



**MESOHALINE, CHOCKED**

**M-Ambi Greece, Italy**




**Pearson correlations**

| | GR | IT |
|---|---|---|
| **GR** | | 0,9906 |
| | | (16) |
| | | 0,0000 |
| **IT** | 0,9906 | |
| | (16) | |
| | 0,0000 | |

In all common types intercalibrated, the relationship between the national methods and the PCM is highly significant ($p < 0.001$). The common metric is adequately representing all methods ($r^2 > 0.5$). The average slope of the regression between lies between 0.5 and 1.5. No free statistical test (like Kendall's tau correlation coefficient) has been applied in addition to the regression analysis.

## 5.3 Comparability criteria

**POLY-EUHALINE, RESTRICTED**

**M-Ambi France, Greece, Italy**

**Assessing level of boundary bias:**

| | GR | FR | IT |
|---|---|---|---|
| **H/G bias_CW** | -0,063 | -0,368 | 0,339 |
| **G/M bias_CW** | -0,078 | -0,182 | 0,068 |
| **N of Bm sites** | 14 | | |

National boundaries exceeding a bias of 0.25 class equivalents should be adjusted to fall inside this permitted level of deviation. The boundary bias analysis showed that H/G boundaries of France should be adjusted. H/G of Italy should be lowered, but Member States are not obliged to lower the boundaries that have been identified as being too stringent, so IT is not obliged to do it. An adjustment from 0.80 to 0.84 shows a bias of <0.25 class equivalents.

| | GR | FR | IT |
|---|---|---|---|
| **H/G bias_CW** | -0,063 | -0,210 | 0,339 |
| **G/M bias_CW** | -0,078 | -0,147 | 0,068 |

**Class Agreement:**

| | GR | FR | IT |
|---|---|---|---|
| **Count** | 304 | 304 | 304 |
| **Absolute Class Difference** | 0,0987 | 0,1151 | 0,1809 |

**MEDO HALINE, CHCKED**

**M-Ambi, Greece, Italy**

**Assessing level of boundary bias:**

As data set is not covering high status classes the harmonization is only made for G/M boundaries.

| | | |
|---|---|---|
| **G/M bias_CW** | 0,025 | -0,079 |

National boundaries exceeding a bias of 0.25 class equivalents should be adjusted to fall inside this permitted level of deviation. The boundary bias analysis showed that no adjustments are necessary.

# 6. Final results to be included in the EC

## 6.1 Table with EQRs

*Table 14 Overview of the IC results for the national methods*

| Biological Quality Element | Macroinvertebrates | | |
|---|---|---|---|
| **Results coastal waters: Ecological quality ratios of national classification systems** | | | |
| **Country** | **National classification systems intercalibrated** | **Ecological Quality Ratios** | |
| | | **High-Good boundary** | **Good-Moderate boundary** |
| **POLY-EUHALINE, RESTRICTED** | | | |
| France | M-AMBI | 0.84 | 0.63 |
| Italy | M-AMBI | 0.96 | 0.71 |
| Greece | M-AMBI | 0.83 | 0.62 |
| **MESOHALINE, CHOCKED** | | | |
| Italy | | - | 0.71 |
| Greece | | - | 0.62 |
| IC of invertebrates MED TW | | | |

## 6.2 Correspondence common types versus national types

The results are directly applicable to the national types that belong to the common type "Mediterranean Coastal lagoons-polyeuhaline restricted and mesohaline chocked".

## 6.3 Gaps of the current intercalibration

- No enough data (low number of water bodies and/or stations) for the intercalibration of the common types "Coastal lagoons oligohaline, poly-euhaline chocked" and Estuaries.
- Spain has not developed methods for the common types Costal lagoons mesohaline and Poly-euhaline.

# 7. Ecological characteristics

## 7.1 Description of reference or alternative benchmark communities

See National reference condition section

## 7.2 Description of reference or alternative benchmark communities

See Boundary setting section

# 8. Conclusions

M-AMBI method has been proposed as assessment method by four Member States (FR, GR, IT, HR). This method meets the WFD compliance criteria, and responds to the general degradation. Spain (common type estuaries) has proposed the BO2A method. Although the BOA2 method, does not meet the compliance criteria, its use is accepted as the non-inclusion of diversity was justified by the Mediterranean benthic experts in the 2nd IC phase.

The intercalibration for the common type "Estuaries" and Coastal lagoons "Oligohaline" has been not possible as there are not enough data (low number of water bodies and stations).

After the comparability analyses, a proposal of class boundaries has been established for the common types Coastal lagoons "polyhaline" and "mesolahine". In the case of mesohaline, the harmonisation has only been possible of the G/M boundaries

The class boundaries will be applied for the establishment of high and good ecological status in the water bodies of the national types included in the common Intercalibration type.

## References

Borja, A., Muxica, I., Franco J. 2003. The application of a Marine Biotic Index to different impact sources affecting soft-bottom benthic communities along European coasts. Marine Pollution Bulletin, 46:835-845.

# List of abbreviations and definitions

## *Key Terms:*

Assessment method: The biological assessment for a specific biological quality element, applied as a classification tool, the results of which can be expressed as EQR.

Biological Quality Element (BQE): Particular characteristic group of animals or plants present in an aquatic ecosystem that is specifically listed in Annex V of the Water Framework Directive for the definition of the ecological status of a water body (for example phytoplankton or benthic invertebrate fauna)

BITS: National assessment method proposed by Italy but not included in the current Intercalibration exercise

Class boundary: The Ecological Quality Ratio value representing the threshold between two quality classes

Common Intercalibration type: A type of surface water differentiated by geographical, geological, morphological factors (according to WFD Annex II) shared by at least two Member States in a GIG

Compliance criteria: List of criteria evaluating whether assessment methods are meeting the requirements of the Water Framework Directive.

Ecological Quality Ratio (EQR): Calculated from the ratio observed value/reference value for a given body of surface water. The ratio shall be represented as a numerical value between zero and one, with high ecological status represented by values close to one and bad ecological status by values close to zero

Geographic Intercalibration Group (GIG): Organizational unit for the intercalibration consisting of a group of Member States sharing a set of common intercalibration types

Intercalibration: An exercise facilitated by the Commission to ensure that the high/good and good/moderate class boundaries are consistent with Annex V Section 1.2 of the Water Framework Directive and comparable between Member States

IC Option: Option to intercalibrate (IC) different national assessment methods

Method Acceptance Criteria: List of criteria evaluating whether assessment methods can be included in the intercalibration exercise

Pressure: Human activities such as organic pollution, nutrient loading or hydromorphological modification that have the potential to have adverse effects on the water environment.

Reference/Benchmark sites: Reference sites meet international screening criteria for undisturbed conditions. Benchmark sites meet a similar (low) level of impairment associated with the least disturbed or best commonly available conditions

Water Framework Directive: Directive 2000/60/EC establishing a framework for Community action in the field of water policy

## *Abbreviations:*

Chl a: Chlorophyll-a

CL: Coastal lagoon

EQR: Ecological Quality Ratio

ES: Spain

DIN: Dissolved Inorganic Nitrogen

FR: France

GR: Greece

HR: Croatia

IT: Italy

GIG: Geographic Intercalibration Group

GIS: Geographical Information System

IC: Intercalibration

MS: Member State

TN: Total Nitrogen

TOC: Total Organic Carbon

TW: Transitional waters

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doi:xx.xxxx/xxxx

ISBN xxx-xx-xx-xxxxx-x