THE IMPLEMENTATION OF THE WFD IN THE EASTERN MEDITERRANEAN, STATE OF THE ART ON PHYTOPLANKTON INDICATORS. FURTHER DEVELOPMENT OF INDICATORS RELATED TO EUTROPHICATION IN THE FRAME OF MSFD

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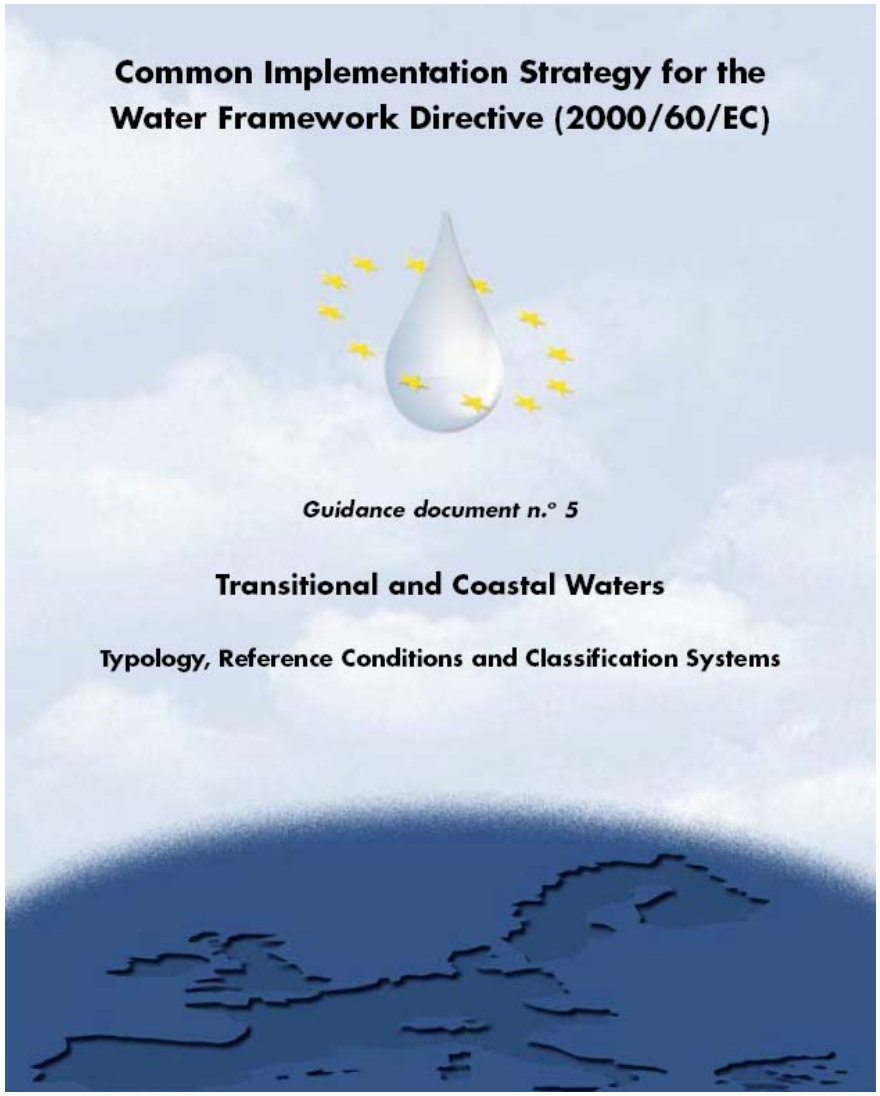
4-8 JUNE 2012, CHIOS ISLAND- GREECE



This guidance document defines coastal and transitional waters and recommends suitable methods for assigning coastal water bodies to river basin districts.

A framework for the identification of reference conditions is developed, guidance on carrying out the initial physical characterisation of water body types and an explanation of biological reference conditions and their use is provided.

The document also introduces the principles of classification and the requirements of classification tools for coastal and transitional waters.

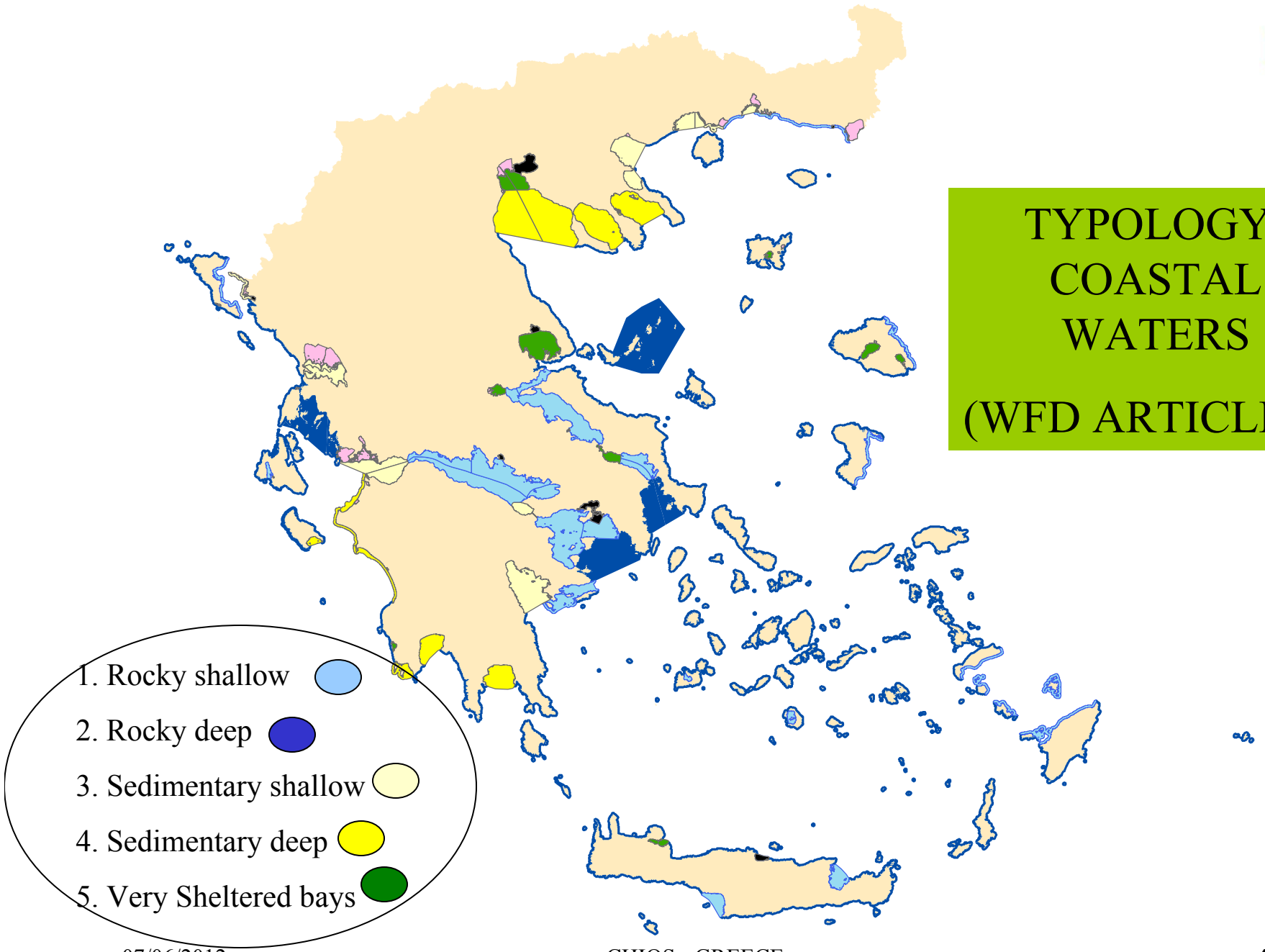
http://www.waterframeworkdirective.wdd.moa.gov.cy/guidance.html

TYPOLOGY SYSTEM B COASTAL & TRANSITIONAL

Salinity	f.w. ≤ 0.5 0.5 ≤ 5-6 5-6 ≤ 18-20 18-20 ≤ 30 > 30 *
Tidal range (m)	< 1 * 1-5 >5
Wave exposure	Exposed Moderately exposed Sheltered
Mixing characteristics	Fully mixed Partially stratified Permanently stratified
Residence time	days weeks month-year
Mean substratum composition (percentages)	Hard (rock, boulders) sand/gravel silt mixed sediment
Depth	shallow< 30 m moderate depth 30 m to 50 (40) m *deep> 50 (40)m- depth limit of Posidonia oceanica*
Current velocity (kn)	<1 * 1-3 >3

TYPOLOGY-COASTAL WATERS

(WFD ARTICLE 5).



1. INITIAL TYPOLOGY FOR MEDITERRANEAN

Different RC for every type

COASTAL WATERS

1. Rocky shallow

2. Rocky deep

3. Sedimentary shallow

4. Sedimentary deep

5. very sheltered bays

**** This typology for CW was abandoned during Phase II of IC***

TRANSITIONAL WATERS

1. coastal lagoons

2. estuaries, deltas

REFERENCE CONDITIONS

TYPES ONLY FOR PHYTOPLANKTON

Biological Quality Element	Phytoplankton

Description of types for coastal waters that have been intercalibrated (applicable for phytoplankton only)

Type	Description	Density (kg/m³)	Annual mean Salinity (psu)
Type I	Highly influenced by freshwater input	<25	<34.5
Type IIA	Moderately influenced by freshwater input (continent influence)	25-27	34.5-37.5
Type IIAdriatic			
Type IIIW	Continental coast, not influenced by freshwater input (Western Basin).	>27	>37.5
Type IIIE	Not influenced by freshwater input (Eastern Basin)	>27	>37.5
Type Island-W			

Countries sharing the types that have been intercalibrated

Type I: France, Italy
Type IIA: France, Spain, Italy
Type IIAdriatic: Italy, Slovenia
Type Island-W: France, Spain, Italy
Type IIIW: France, Spain, Italy
Type IIIE: Greece, Cyprus

THE ECOLOGICAL QUALITY ELEMENTS & INDICATOR PARAMETERS-COASTAL

Biological Quality Elements	**Indicator parameters**
Phytoplankton	**Composition and abundance of phytoplanktonic taxa, phtyplankton biomass, planktonic blooms**
Macroalgae and Angiosperms	disturbance-sensitive macroalgal and angiosperm taxa,the levels of macroalgal cover and angiosperm abundance
Benthic Invertebrate fauna	diversity and abundance of invertebrate taxa, disturbance-sensitive taxa
Fishfauna (only for transitional waters)	Species composition and abundance
Hydromorphological Quality Elements supporting the biological quality elements	Tidal regime (dominant currents, wave exposure and freshwater flow for TW). Depth variation, substrate conditions and both the structure and condition of the intertidal zones
Chemical & Physicochemical elements supporting the biological quality elements	General physicochemical characteristics (physicochemical parameters and nutrient status) and specific pollutants (priority substances and other pollutants)

Biological Quality Elements **A. COASTAL**	**Indices**
Phytoplankton	**Composition and abundance of phytoplanktonic taxa, phytoplankton biomass, planktonic blooms**
Macroalgae and Angiosperms	disturbance-sensitive macroalgal and angiosperm taxa,the levels of macroalgal cover and angiosperm abundance
Benthic Invertebrate fauna	diversity and abundance of invertebrate taxa, disturbance-sensitive taxa
Biological Quality Elements **A. TRANSITIONAL**	**Indices**
Phytoplankton	**Composition and abundance of phytoplanktonic taxa, phytoplankton biomass, planktonic blooms**
Macroalgae	composition of macroalgal taxa, macroalgal cover
Angiosperms	Composition and abunfdance of angiosperm taxa
Benthic Invertebrate fauna	diversity and abundance of invertebrate taxa, disturbance-sensitive taxa
Fishfauna **(only for transitional waters)**	Species composition and abundance

4.4. BIOLOGICAL QUALITY ELEMENTS REQUIRING REFERENCE CONDITIONS

4.4.1. Reference conditions should be described according to the definitions of the biological quality elements at high status in Annex V Table 1.2.3 and Table 1.2.4.

Annex V Table 1.2. General definition for rivers, lakes, transitional waters and coastal waters

High status

"There are no, or only very minor, anthropogenic alterations to the values of the physicochemical and hydromorphological quality elements for the surface water body type from those normally associated with that type under undisturbed conditions.

The values of the biological quality elements for the surface water body reflect those normally associated with that type under undisturbed conditions, and show no, or only very minor, evidence of distortion.

These are the type specific conditions and communities."

METHODS for setting RC

- ✓Historic data
- ✓Expert judgement
- ✓reference areas
- ✓modelling

CLASSIFICATION OF ECOLOGICAL STATUS

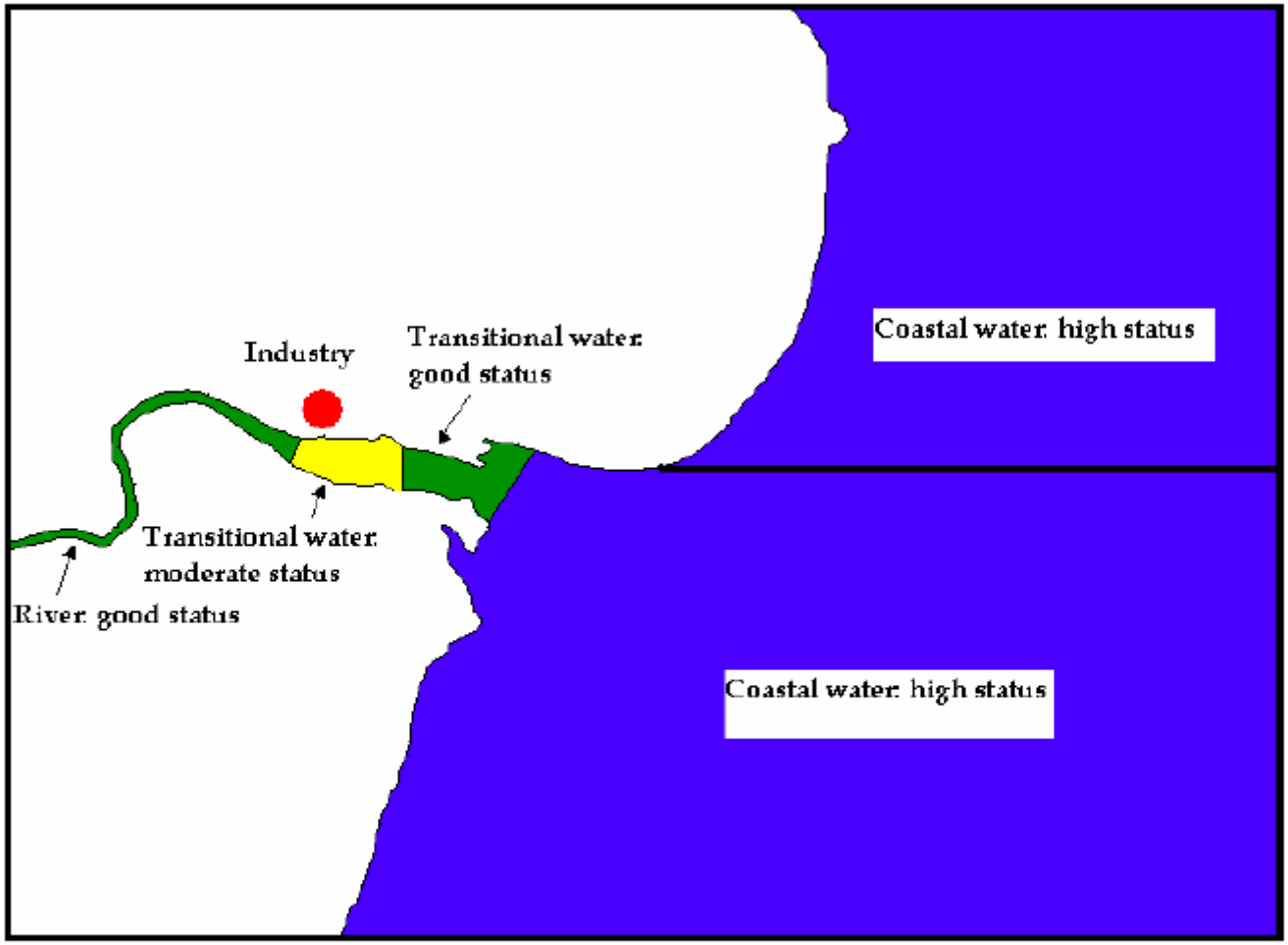
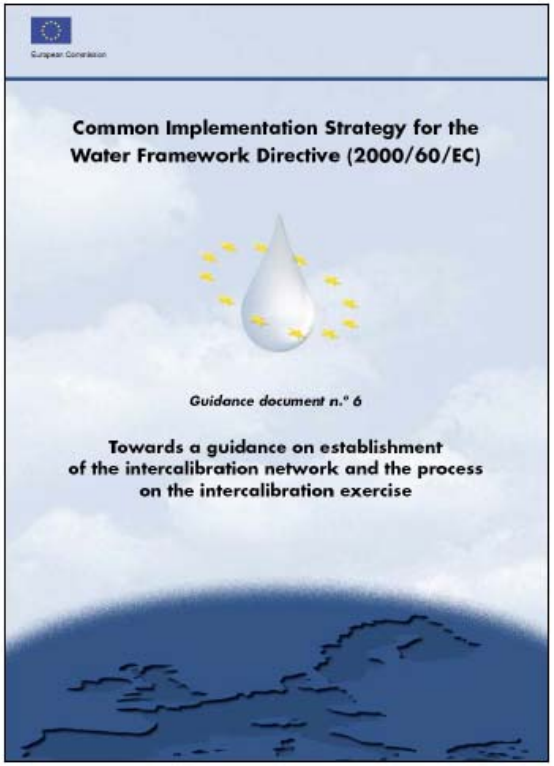


Figure 2.4. Surface water bodies. The colours used relate to those stated in Annex V 1.4.2 for reporting.

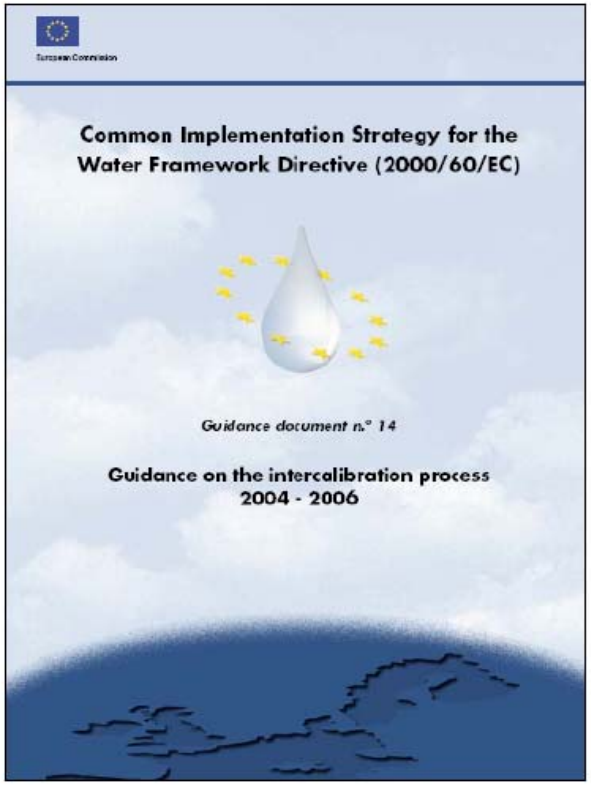
Ecological Status according to Deviation from RC

BIOLOGICAL ELEMENTS	HIGH	GOOD	MODERATE
Phytoplankton Macroalgae Angiosperms Benthic invertebrate fauna	**All parameters are consistent with undisturbed conditions and show no, or only very minor, evidence of distortion.**	**Slight deviation from those normally associated with undisturbed conditions. low levels of distortion resulting from human activity**	**Moderate deviations from those normally associated with undisturbed conditions. In case of phytoplankton and macroalgae these may be such as to result in an undesirable disturbance to the balance of organisms present in the water body.**

Main steps of intercalibration



1. Intercalibration register (2003-2004): 1500 sites selected and published in the Official Journal, 2005



2. Intercalibration process (2004-2006)

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

Ecological objectives

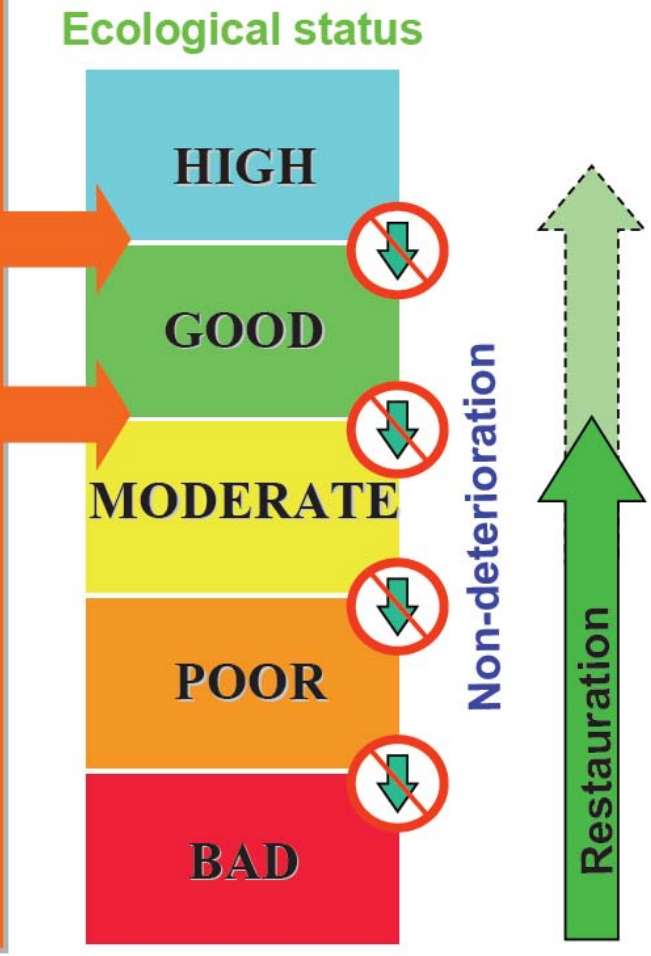
Joint Research Centre

The results of the intercalibration exercise will establish the upper and lower boundaries of

Good ecological status

So that they are

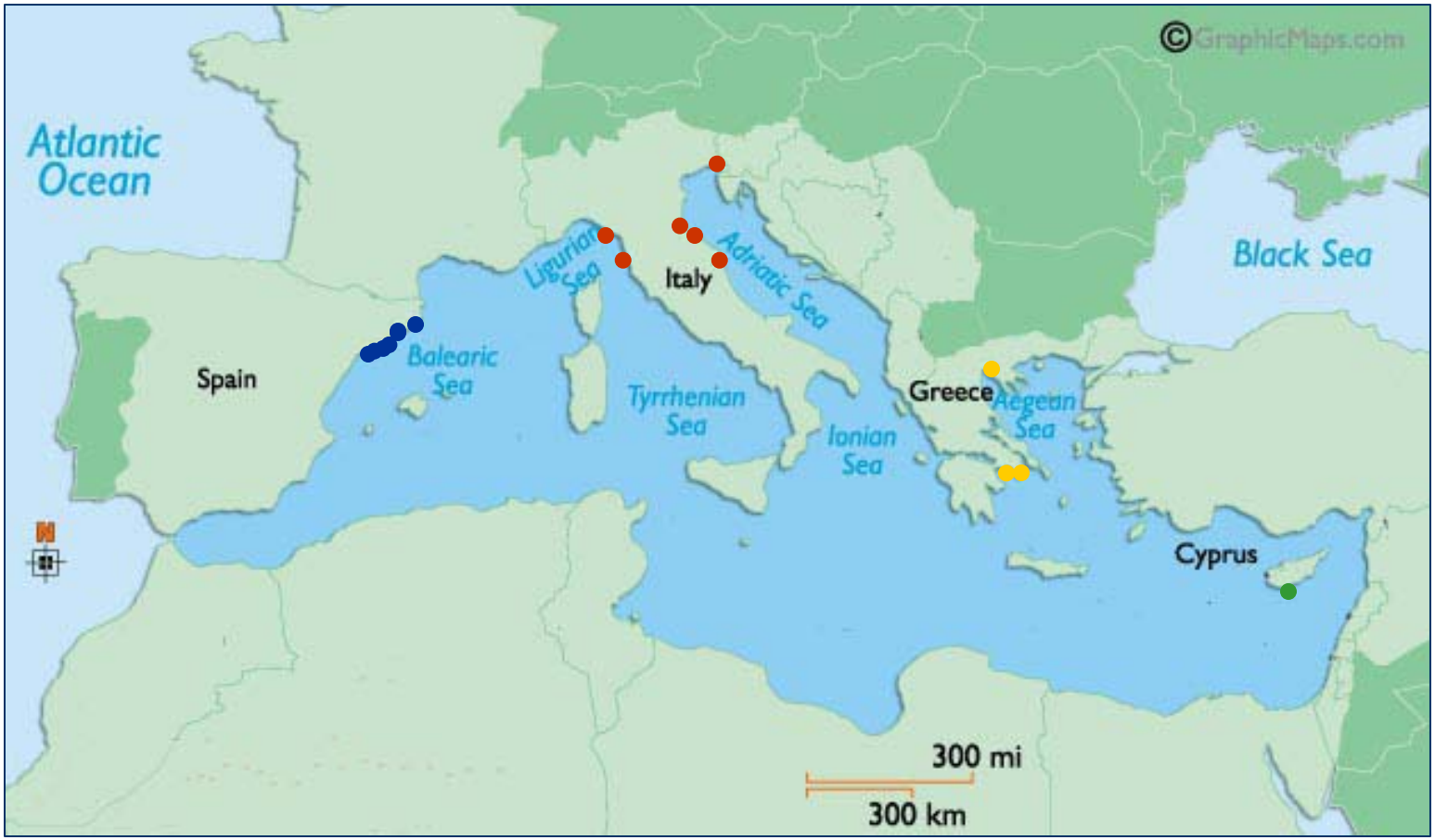
- Consistent with WFD normative definitions and
- Comparable between all Member States;



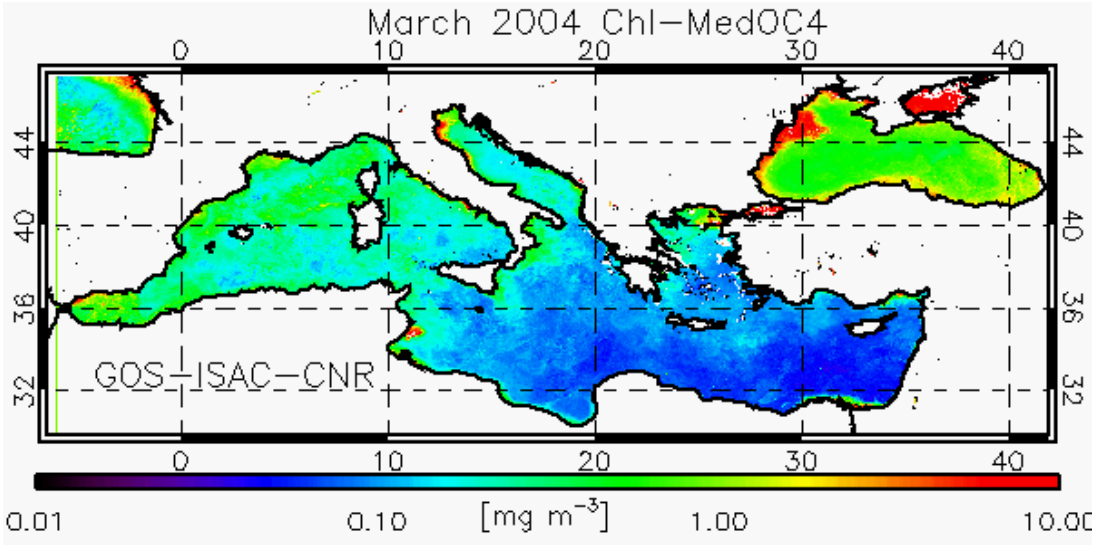
Courtesy Peter Pollard

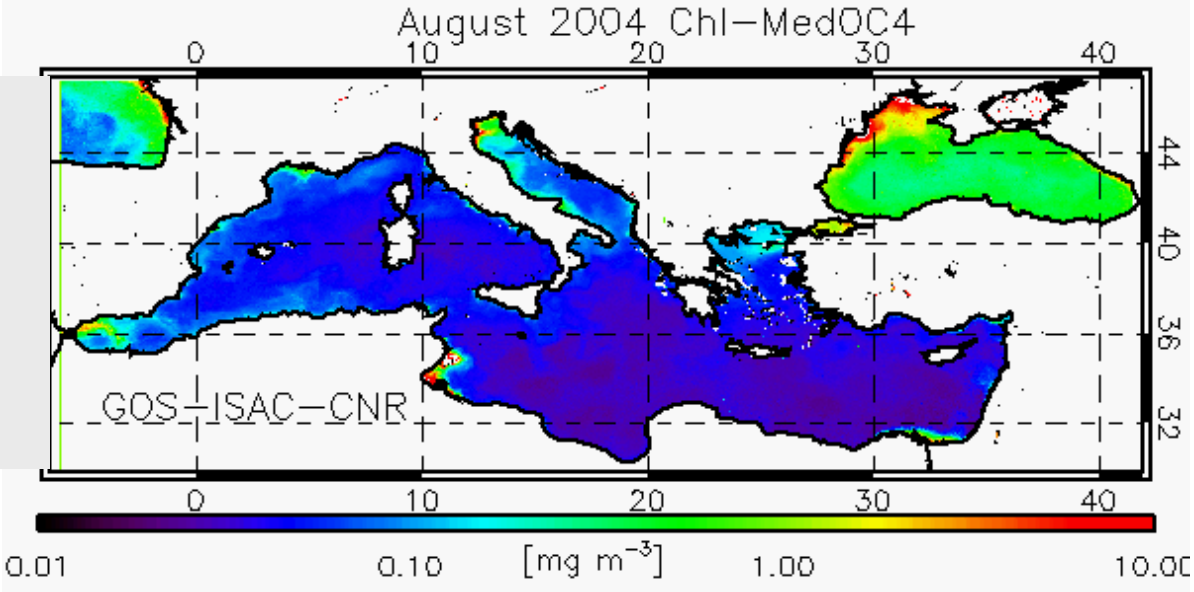
FROM: Heiskanen & Jowett

The intercalibration sites



Six countries participated: Italy, Spain, France, Greece, Cyprus, Slovenia. One MS (Malta was missing).





Mean chlorophyll concentrations in spring and autumn

2004

Phytoplankton experts defined that:

the 4 Mediterranean Coastal IC types, based primarily on the substratum composition and the depth profile,
cannot be applied to the IC for the chlorophyll BQE within the Mediterranean basin:

the classification criterion is based mainly on the morphological features of the bottom and therefore is not so meaningful in a "phytoplankton perspective".

Therefore, in the frame of WFD inter-calibration exercise and especially (**MEDGIG**) phytoplankton experts defined that:

For the chlorophyll as BQE related to phytoplankton and eutrophication,

within the Mediterranean basin a new typology of coastal types has been developed,

mainly focused on hydrological parameters characterizing water bodies' dynamics and circulation.

The typological approach was based on the introduction of the **static stability parameter** (derived from **temperature** and **salinity** values in the water column) having a robust numerical basis, which can describe the dynamic behaviour of a coastal system: **the surface density**

It must be noted here, that common statistical analysis on chlorophyll-α, nutrients and physico-chemical data and some multivariate techniques have been performed, in order to facilitate a wide agreement for the intercalibration process and fulfill the requirement of application of dose-response relationship.

This approach was not successful. However, further intercalibration activity is needed to improve the dose/response analysis correlating nutrients with trophic conditions.

Participation of countries in the Phytoplankton subgroup:

France
Spain
Italy
Slovenia
Croatia (Accession Country)
Greece
Cyprus

Data availability

The examination of the datasets provided by each MedGIG Member States highlighted a huge data heterogeneity, mainly due to different monitoring schemes. In all cases the Chlorophyll *a* indicator of phytoplankton biomass is done in mg/m3. Table 1 summarized the main features of the datasets, highlighting the availability of key features (sites, parameters, vertical profile and population amount of data) needed for the typological identification of water bodies.

The results of the intercalibration exercise apply to the countries sharing the Type IIIE. Parameter values are expressed in μg/l of Chlorophyll-α, as the 90%ile value, calculated over the year in at least five year period (the raw data consisted from, at least, monthly sampling frequency, in the surface layer; MEDGIG Technical Report, June 2007).

Since there was not elaborated a common methodology based on a common data set for the whole Mediterranean, boundaries (on chlorophyll-α concentrations and EQRs) were compared, with those derived from national methods and specifically for Type IIIE the national method was the one described previously (eutrophication scale according to IGNATIADES *et al*., 1992 and KARYDIS, 1999).

MS	N° Sites	N° Records	Period	Freq (d)	Profile	Temp Sal data
France	3	2366		7	not available	available
Spain	117	1109	1991-2006	Variable	available	available
Italy	11	2541	2001-2004	15	available	available
Slovenia	2	332	1997-2004	30	available	available
Croatia	19	1784	2000-2004	120	not available	available
Cyprus	48	158	2005	60	not available	not available

Biological Quality Element	Phytoplankton

Description of types that have been intercalibrated (applicable for phytoplankton only)

Type	Description	Density (kg/m^3)	Annual mean Salinity (psu)
Type I	Highly influenced by freshwater input	<25	<34.5
Type IIA	Moderately influenced by freshwater input (continent influence)	25-27	34.5-37.5
Type IIIW	Continental coast, not influenced by freshwater input (Western Basin).	>27	>37.5
Type IIIE	Not influenced by freshwater input (Eastern Basin)	>27	>37.5

Countries sharing the types that have been intercalibrated

Type I: France, Italy

Type IIA: France, Spain, Italy, Slovenia

Type IIIW: France, Spain, Italy

Type IIIE: Greece, Cyprus

Phytoplankton: parameter indicative of biomass (Chlorophyll a)

PHYTOPLANKTON: Med-GIG

Mediterranean coastal waters New types		Croatia	Cyprus	France	Greece	Italy	Slovenia	Balearic	Catalonia	Valencia
	Description									
Type I	Highly influenced by freshwater input			(?)		X			X	X
Type II	Moderately influenced by freshwater input			X	(?)	X	X	(?)	X	X
Type III WM	Not influenced by freshwater input	X		X		X		X	X	
Type III EM	Not influenced by freshwater input		(?)		X					

Input from REBECCA Deliverable 9

Results: Ecological quality ratios and parameter values

The following results apply to all countries sharing the types. Parameter values are expressed in µg/l of Chlorophyll *a*, for the 90th percentile calculated over the year in at least a five year period. The results relate to geographic areas within the types as described in the technical report..

Type	Ecological Quality Ratios		Values (µg/l, 90%ile)	
	High-Good boundary	*Good-Moderate boundary*	*High-Good boundary*	*Good-Moderate boundary*
Type IIA	0.80	0.53	2.4	3.6
Type IIIW	0.80	0.50	1.1	1.8
Type IIIE	0.80	0.20	0.1	0.4

According to the **MEDGIG report (June 2007)** it is stated that on the basis of surface density values (σt), three major water types have been defined, which in an ecological perspective, can be described as follows:

Type 1: coastal sites highly influenced by freshwater inputs
(σt<25, annual mean salinity <34.5)

Type 2: coastal sites not directly affected by freshwater inputs
(25<σt<27, annual mean salinity 34.5<S<37.5)

Type 3: coastal sites not affected by freshwater inputs
(σt>27, annual mean salinity >37.5)

Type	Ecological Quality Ratios (EQRs)		Values (µg/l, 90%ile)	
	High-Good boundary	*Good-Moderate boundary*	*High-Good boundary*	*Good-Moderate boundary*
Type IIIE	0.80	0.20	0.1	0.4

Eutrophication Guidance

Eutrophication assessment in the context of European water policies

Activity for the **development of the guidance** structured around a group of experts on eutrophication, nominated from MSs & some stakeholders participating in the Common Implementation Strategy (CIS) process

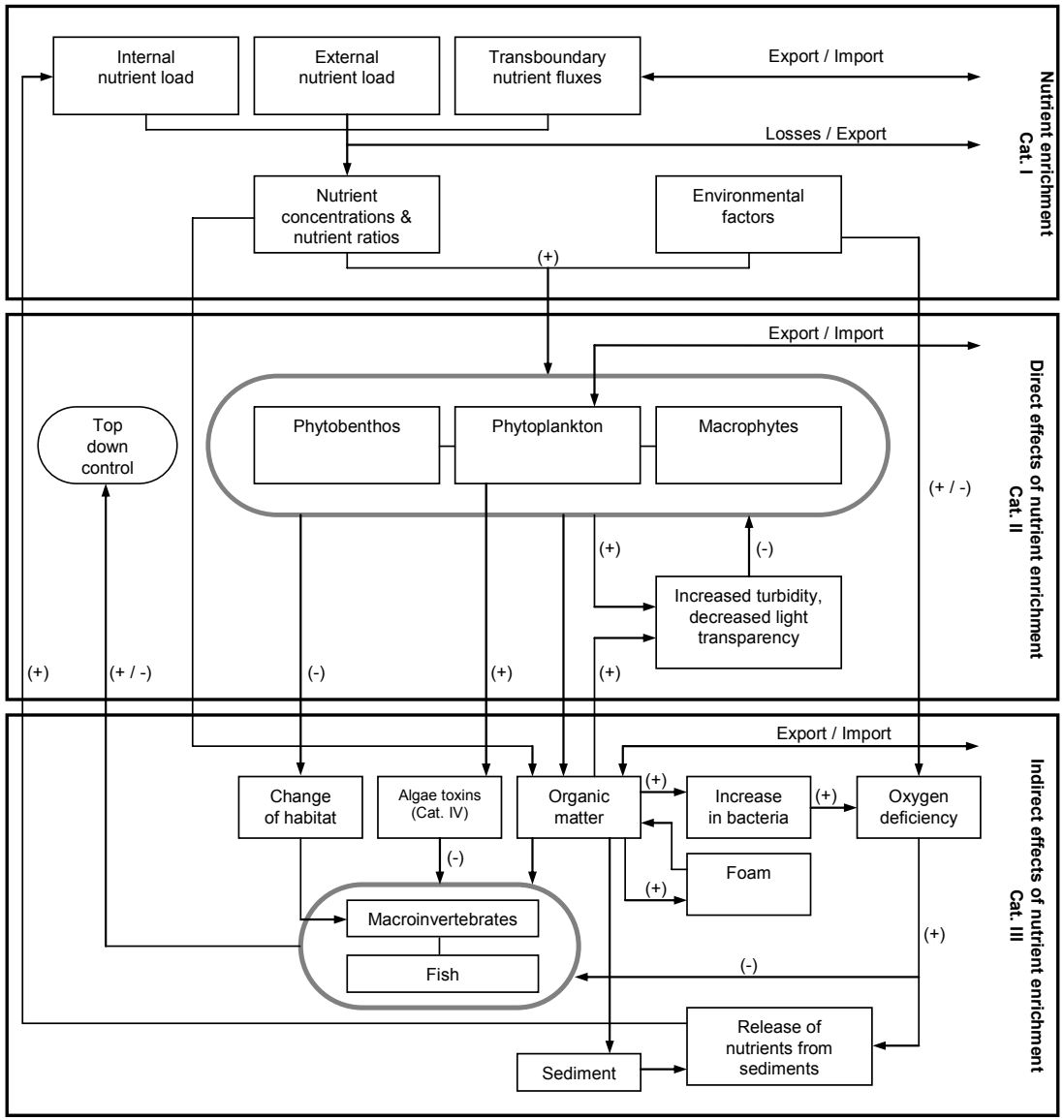
A **Steering Group** chaired by the Commission (EC-DG Environment D2) and including **experts** from DE, UK, NL, FI, EEA & a **Technical Secretariat** has leaded the work.

Objective:

- Produce a paper representing **guidance** on how **to assess eutrophication**
- **Compare** how eutrophication is understood, defined and assessed in EC Directives, policies, guidance and research.
- Propose a **new conceptual framework** for eutrophication assessment across all water categories and policies.

Two Workshops (eutrophication experts) provided major contributions to the document.

1. Ispra (September 2004)
2. Brussels (September 2005)



Pressure and state

Impacts

Impacts

It relates to DPSIR

Round boxes indicate quality elements in WFD.

General overview of WFD requirements regarding eutrophication (Source: EC, 2005)

Directive /Policy	**Requirement to assess eutrophication**	**Minimum monitoring requirements relevant to eutrophication**
WFD	Implicit in classification of Ecological Status where nutrient enrichment affects biological and physico-chemical quality elements. Protected Area's support and upholds requirements of UWWTD and Nitrates Directive.	Phytoplankton (once per 6 months), aquatic flora (once per 3 yrs), macro-invertebrates (once per 3 yrs), fish (once per 3 yrs). Hydromorphological quality elements (Hydrology continuous – once per 1 month; others once per 6 years). Physicochemical quality elements (once per 3 months).

Indicative check-list for general and category-specific features of the impact of eutrophication in rivers, lakes, transitional, coastal and marine waters

General assessment factors for all water categories	Additional River-specific factors	Additional Lake-specific factors	Additional Coastal and marine waters specific factors
a. Causative factors:			
The degree of nutrient enrichment: With regard to inorganic/organic N With regard to inorganic/organic Phosphorus With regard to silicon Taking account of: Sources (differentiating between anthropogenic and natural sources) Increased/upward trends in concentration Elevated concentrations Changed N/P, N/Si, P/Si ratios Changes in nutrient fluxes and nutrient cycles		Riverine, direct and atmospheric inputs internal nutrient loading	Across boundary fluxes, recycling within environmental compartments and riverine, direct and atmospheric inputs)
b.Supporting environmental factors:			
Light availability (irradiance, turbidity, suspended load) Hydrodynamic conditions () Climatic/weather conditions (wind, temperature) Typology factors Other pressures (toxic substances, hydromorphological pressures)	Hydromorphological conditions (current velocity, water flow, substrate type and mobility, water depth, flood frequency,) Typology factors: alkalinity, colour, size of catchment	Stratification, flushing, retention time, Zooplankton grazing (top-down control) (which may be influenced by other anthropogenic activities) Typology factors: alkalinity, colour, size, depth, share of area shallower than the stratification layer	Upwelling, salinity gradients, Typology factors: salinity, wave exposure, others

General assessment factors for all water categories	Additional River-specific factors	Additional Lake-specific factors	Additional Coastal [and marine] waters specific factors
c. Direct effects of nutrient enrichment:			
i. Phytoplankton; Increased biomass (e.g. chlorophyll a, organic carbon and cell numbers) Increased frequency and duration of blooms Increased annual primary production Shifts in species composition to higher proportion of potentially harmful or toxic species ii. Macrophytes including macroalgae (such as Characeans); Increased biomass Shifts in species composition Reduced depth distribution until disappearance of macrophytes iii. Phytobenthos	i. Phytoplankton in parts of rivers with low flow or lake-like structure due to damming iii. Microphytobenthos; Increased biomass and primary production, increased areal cover on substrate Shifts in species composition from diatoms to chlorophytes and cyanobacteria	i. Phytoplankton; from chrysophytes and diatoms to cyanobacteria and chlorophytes ii. Macrophytes In very shallow lakes switches occur from macrophytes dominance and phytoplankton dominance Reduction in depth distribution, consequent shift in balance of species	**i.** Phytoplankton indicator species cells/L (blooms and duration) Shift from diatoms to flagellates **ii.** Macrophytes including macroalgae: shift from long-lived species to short-lived species, some of which are nuisance species (Ulva, Enteromorpha) Coverage of areas

General assessment factors for all water categories	Additional River-specific factors	Additional Lake-specific factors	Additional Coastal [and marine] waters specific factors
d.Indirect effects of nutrient enrichment			
i. organic carbon/organic matter; Increased organic carbon concentrations in water and sediment ii. oxygen; Decreased concentrations and saturation percentage Increased frequency of low oxygen concentrations Increased consumption rate iii. Fish; Changes in abundance Changes in species composition iv. Benthic invertebrates; Changes in abundance and biomass Changes in species composition v. pH vi. Nutrients	ii. oxygen; More extreme diurnal variation iii. Fish; Disruption of migration or movement iv. Benthic heterotrophic organisms: Increased biomass and areal cover of fungi and bacteria	ii. oxygen More extreme diurnal variation in surface waters (oversaturation at day and undersaturation at night) Reduction in hypolimnion during stratification periods Occurrence of anoxic zones at the sediment surface ("black spots") iii. Fish Mortalities resulting from low oxygen concentrations iv. Macrozoobenthos Mortalities resulting from low oxygen concentrations v. pH increase in surface waters vi. Internal loading of phosphorus vii. Increased ammonia concentration in bottom waters viii. Often changed top-down control due to changed predation on zooplankton Often reduced top-down control due to loss of habitat structure provided by macrophytes leading to heavy fish Release of soluble Fe, Mn from sediments	i. Organic carbon/organic matter; Occurrence of foam and/or slime ii. oxygen; Occurrence of anoxic zones at the sediment surface ("black spots") iii. Fish Mortalities resulting from low oxygen concentrations iv. Macrozoobenthos Mortalities resulting from low oxygen concentrations vi. Release of nutrients and sulphide from sediment Occurrence of algal toxins

General assessment factors for all water categories	Additional River-specific factors	Additional Lake-specific factors	Additional Coastal [and marine] waters specific factors
e. Other possible effects of nutrient enrichment			
•Amenity values compromised: •bad smell, turbid waters,	Clogging of pipes and filters, build up of iron deposits due to low DO	Incidence of toxic algal blooms increases Loss visual amenity due to colour in water	

Overview and common understanding of eutrophication in EC and international policies

Directive /Policy	Requirement to assess eutrophication	Minimum monitoring requirements relevant to eutrophication
WFD	Implicit in classification of Ecological Status where nutrient enrichment affects biological and physico-chemical quality elements. Protected Area's support and upholds requirements of UWWTD and Nitrates Directive.	Phytoplankton (6 months), aq. flora (3 yrs), macro-invertebrates (3 yrs), fish (3 yrs). Hydromorphological quality elements (Hydrology continuous - 1 month; others 6 years). Physicochemical quality elements (3 months).
UWWT Directive	In order to identify Sensitive Areas under Annex IIA(a) criteria (i.e. water bodies that are eutrophic or may become eutrophic in the near future).	Review of the existing Sensitive Areas and designation of new ones at least every 4 years (Article 5(6)).
Nitrates Directive	In order to identify polluted waters and designate their catchment area as Nitrate Vulnerable Zones.	Review the eutrophic state of surface water at least every 4 years.

Directive /Policy	Requirement to assess eutrophication	Minimum monitoring requirements relevant to eutrophication
OSPAR Eutrophication Strategy	**Explicit requirements for assessing the eutrophication status of waters in OSPAR maritime area using the OSPAR Common Procedure (in particular its Comprehensive procedure).**	**Monitoring of selected parameters for nutrient enrichment, direct effects, indirect effects and other possible effects according to the mandatory Eutrophication Monitoring ¨Programme (OSPAR 2005-4).**
HELCOM	**Explicit in quantifying and assessing emissions/discharges/losses and inputs to as well as concentrations and effects in the Baltic Sea [HELCOM Periodic Assessments of the Status of the Baltic Sea and PLCs (Air and Water)]**	**MONAS: Pollution Load Compilation (PLC Air and Water) Monitoring Programme (TN, NO_3, NH_4, PO_4 & TP) and COMBINE (including TN, TP, DIN, DIP, Si, phytoplankton and zoobenthos species composition, abundance and biomass, Chl a, dissolved oxygen and Secchi depth).**
Barcelona Convention-Strategic Action Programme (SAP) to address LBS	**The SAP states Eutrophication as the result of input of nutrients from rivers and sewage into inshore waters such as lagoons, harbours, estuaries and coastal area which are adjacent to river mouths, so actions should be taken to reduce inputs of nutrients from Land Based Sources (LBS).**	**MED POL Eutrophication monitoring strategy (2003) – DIN, DIP, TP, Si, Chl A, Phytoplankton (total abundance, abundance of major groups, bloom dominance), Transparency, DO, T, S, pH**

Comparison of assessment results under various policies

ASSESSMENT OF CURRENT STATUS				
Status	**WFD**	**UWWT Directive**	**Nitrate Directive**	**OSPAR**
High	Nearly undisturbed conditions	Non Eutrophic, designation of sensitive area not required	Not Polluted Water, NVZ is not required	Non-problem Area
Good	Slight change in composition, biomass	Non Eutrophic, designation of sensitive area not required	Not a Polluted Water, NVZ is not required	Non-Problem Area
Moderate	Moderate change in composition, biomass	Eutrophic, designation of sensitive area is required	Polluted water, designation of NVZ is required	Problem Area
Poor	Major change in biol.communities	Eutrophic, designation of sensitive area is required	Polluted water, designation of NVZ is required	Problem Area
Bad	Severe change in biol. communities.	Eutrophic, designation of sensitive area is required	Polluted water, designation of NVZ is required	Problem Area

Trophic scale	Trophic status	Description
< 4	High	Low trophic level Good water transparency Absence of anomalous water colour Absence of subsaturation of dissolved oxygen in bottom waters
4-5	Good	Average trophic level Occasional clouding of water Occasional anomalous water colour Occasional hypoxias in bottom waters
5-6	Poor	High trophic level Low water transparency Anomalous water colour Hypoxias and occasional anoxias in bottom waters States of suffering at the benthic ecosystem level
> 6	Bad	Very high trophic level High water turbidity Widespread and persistent anomalies in water colouring Widespread and persistent hypoxias/anoxias in bottom waters Dying off of benthic organisms Alteration of benthic communities

MED POL TRIX Classification of trophic status

GREEK NATIONAL ASSESSMENT

EYTROPHICATION SCALE
developed according to
THE CHARACTERISTICS OF THE GREEK SEAS
(Karydis, 1999)

PARAMETERS:
- phosphates
- nitrates
- ammonium
- chlorophyll-α
- phytoplankton cells

DATA:
- mean annual values of the integrals over depth
- outliers excluded according to "Box and Whisker" plot

Eutrophication Scale

Parameter	Oligotrophic	Low mesotrophic	High mesotrophic	Eutrophic
PO_4 (μM)	<0.07	0.07-0.14	0.14-0.68	>0.68
NO_3 (μM)	<0.62	0.62-0.65	0.65-1.19	>1.19
NH_4 (μM)	<0.55	0.55-1.05	1.05-2.20	>2.20
Phyto (cells/l)	$<6X10^3$	$6X10^3$-$1.5X10^5$	$1.5X10^5$-$9.6X10^5$	$>9.6X10^5$
Chl-α (μg/l)	<0.10	0.10-0.60	0.60-2.21	>2.21

The coastal waters of Cyprus and most of Greece are classified as Type III (no freshwater input – density greater of 27), due to their hydrographical features and the prevailed physicochemical characteristics. Among MSs, only Greece and Cyprus belong to the Eastern Mediterranean basin (Type III E) and ıntercalibration was performed between these 2 countries for this water type.

The results of the intercalibration exercise apply to the countries sharing the Type IIIE. Parameter values are expressed in μg/l of Chlorophyll-α, as the 90%ile value, calculated over the year in at least five year period (the raw data consisted from, at least, monthly sampling frequency, in the surface layer; MEDGIG Technical Report, June 2007)

Since there was not elaborated a common methodology based on a common data set for the whole Mediterranean, boundaries (on chlorophyll-α concentrations and EQRs) were compared, with those derived from national methods and specifically for Type IIIE the national method was the one described previously (eutrophication scale according to IGNATIADES *et al*., 1992 and KARYDIS, 1999).

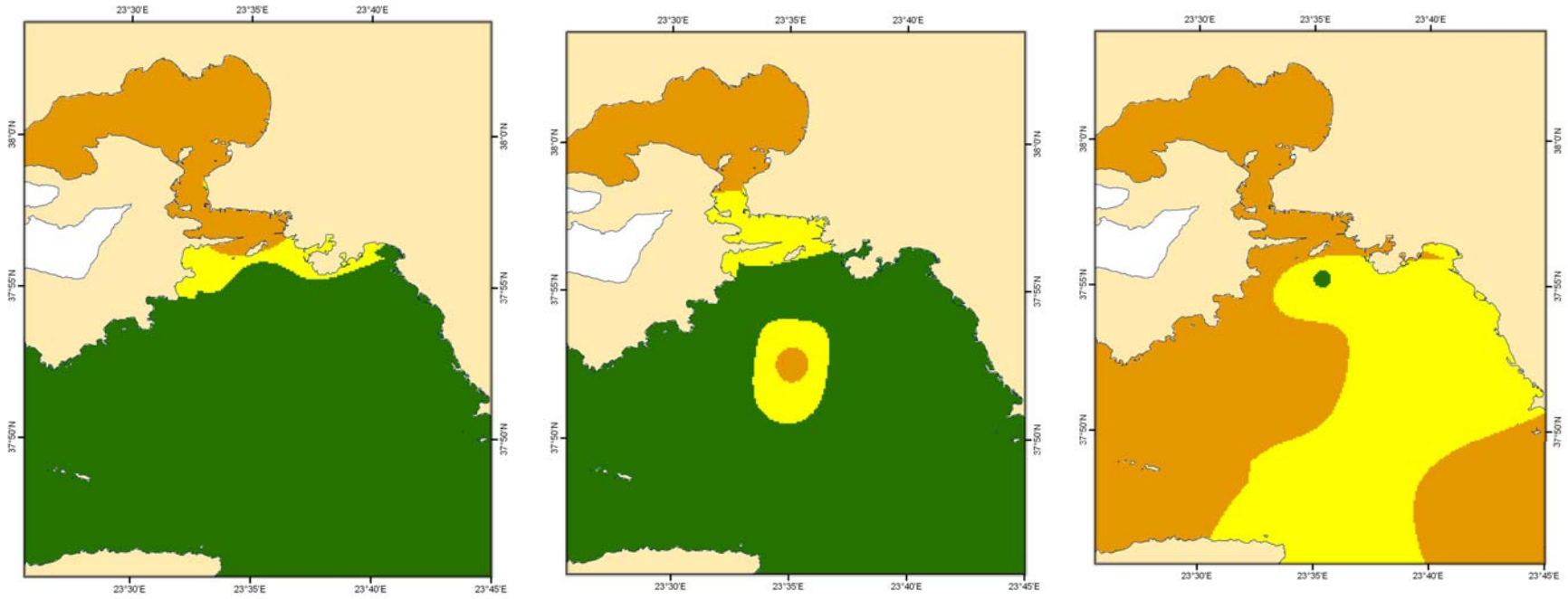
Eutrophication scale based on chlorophyll-a concentration (after Karydis, 1999; modified)

eutrophication scale	Chlorophyll-a μg/l	Ecological Quality Status
reference conditions	< 0,1	High
oligotrophic	0,1-0,4	Good
lower mesotrophic	0,4-0,6	Moderate
higher mesotrophic	0,6-2,21	Poor
eutrophic	>2,21	Bad

Sept 2005-Sept 2006

Jan 2007-Dec 2007

Sept 2008-Sept 2009



Chlorophyll-α (μg l-1) - Eutrophication Scale - Ecological Status (WFD)

< 0.1	Oligotrophic	High
0.1 - 0.4	Lower Mesotrophic 1	Good
0.4 - 0.6	Lower Mesotrophic 2	Moderate
0.6 - 2.21	Upper mesotrophic	Poor
2.21 <	Eutrophic	Bad

Phytoplankton abundance

There is not much work on eutrophication scaling based on phytoplankton cell numbers.
However, in published work on spatial analysis it was found that cell number was an efficient
variable in studying spatial trends (Kitsiou and Karydis, 2001; Kitsiou and Karydis, 2002).

The following scale was proposed:
(a) up to $6x10^3$ cells L-1 for oligotrophic waters
(b) a range from $6x10^3$ to $1.5x10^5$ cells L-1 for mesotrophic waters and
(c) more than $1.5x10^5$ cells L-1 for eutrophic waters

Menhinick's Index (DMn)

This is also a well known index (Washington, 1984) expressing species richness.
It was
assumed that this index showed smaller variation compared to Margalef's Index implying less overlapping between different samples:

$D = S/\sqrt{N}$

Where N=total number of individuals collected and S=the number of species

Menhinick's index was found efficient in evaluating trophic levels (Karydis and Tsirtsis, 1996),

although this index does not seem to be in common use in aquatic systems.

Tsirtsis, G. and S. Spatharis, 2010. Development of coastal water quality criteria for WFD2000/60 using phytoplankton ecological indices. Ecological Indicators, 10(4), 840-847.

Structural changes of phytoplankton communities, often expressed through ecological indices, constitute one of the metrics for the implementation of the European Water Framework Directive (WFD).

… a thorough analysis of the efficiency of 22 ecological indices was performed and a small number was selected for the development of five-level water quality scales (High, Good, Moderate, Poor, and Bad).

The analysis was performed on simulated communities free of the noise of field communities due to uncontrolled factors or stochastic processes.

Two criteria were set for the sensitivity of indices, namely their **monotonicity** and **linearity** across the studied eutrophication spectrum.

The whole procedure was based on the development of a five-level quality assessment scheme based on phytoplankton abundance.

Among the indices tested, **the Menhinick diversity** index and three indices of evenness were the most efficient, showing consistency (monotonic behavior) and linearity and were therefore used for the development of quality scales for the WFD.

An Integrated Phytoplankton Index (IPI) based on three phytoplankton metrics, chlorophyll a, abundance, and diversity is also proposed.

The efficiency of these indices was evaluated for a number of sites in the Aegean, already classified in the past by various methods based on nutrient concentrations or phytoplankton data. The results indicate that the various phytoplankton metrics (chlorophyll a, abundance, and diversity) assessed or proposed in the current study, carry their own information showing differences in the final classification of areas. Therefore the establishment of synthetic indices as the IPI seems to be advantageous for the integrated assessment of coastal water quality in the framework of European policies as the WFD

TRANSITIONAL WATERS

MS	EU_CD,C,24	CODE	Name	Poly_Euhaline / Restricted type	Oligo-Mesohaline / Restricted.
Greece	GR000500020003N	GR	Tsopeli	X	
Greece	GR000200020003N	GR	Papas	X	
Greece	GR000500020002N	GR	Logarou	X	
Greece	GR000500020001N	GR	Tsoukalio	X	
Greece	GR000500020001N	GR	Rodia	X	
Greece	GR001200020003N	GR	Agiasma	X	
Greece	GR000200020001N	GR	Kotychi		**X**
			Prokopos (to be added)	**X (?)**	

TW phytoplankton (17-18 January, Rome)

Coastal Lagoons (France, Italy and Spain)

1) Only Italy has got a subtipology, chocked and restricted, and France no. Neither Italy or France have taking into account salinity for typology.

2) There are two **methods** (France and Italy).

France: biomass (chla) and abundance (nano and pico density)

Italy: biomass (chla), Hulburt index, blooms and Menhinick index (cell counts)

France and Italy should send the methods about chla, and they will be probe for Spain

Spain hasn't developed methods but has chla data

3) **Pressures** (to do before the next meeting, February)

LUSI method could be applied on all coastal lagoons by all member states. It can be refined by member states. For coastal lagoons, the spatial scale should be the water basin instead of the 1.5 km distance used for coastal waters.

Only France has got a method to evaluate pressures. They will send it and propose it to Italy and Spain. So, the three countries should agree a common metrics for pressures.

Pressures relationship with phytoplankton EQR has to be tested by each member state for their coastal lagoons.

It is very important that every MS provides information about the approach of pressures taken into account by others BQE experts.

To justify typology, the relation pressures-impact must be tested for the different types proposed by Italy (restricted/choked).

4) **Intercalibration**

At the moment, Option 2 will be used for Italy and France ➔ a common metric needs to be defined. This metric should be related to a pressure index

Italy and France must establish the common boundary setting protocol for phytoplankton EQR for all data.

Italy and France will circulate their methods, metrics, etc… and Spain will test both methods, and choose one of them if it works. Then Spain will participate in the intercalibration.

Other MedGIG countries should participate to intercalibration if local data of chla, etc are available.

Estuaries (Croatia, France and Spain)

No methods for Spain and Croatia. A method for France (chla, blooms). Maybe this method would be tested and applied by Croatia and Spain. At the moment no intercalibration is possible for estuaries.

Saltworks

All WB are HMWB, for this, the experts decided not to include in this intercalibration phase.

PRESSURES & LUSI INDEX

For the application of the pressure Index LUSI (Flo et al., 2008) the following categories and scores were followed according to the assessment methodology applied for Catalonia in 1,5km inland. River pressures were not taken into account as in the areas of IC sites there are not any significant rivers.

Urban	Agricultural	Industrial	Score
	<10%	<10%	0
<33%	10-40%	>10%	1
33-66%	>40%		2
>66%			3

Confinement	Correction number
Concave	1.25
Convex	0.75
Straight	1.00

LUSI index calculation details for coastal water bodies IC sites-Greece

WATER BODY NAME	Urban %	Urban score	Agricultural %	Agr. score	Industrial %	Ind. score	Total	Confinement	Corno	LUCI
Gulf of Thessaloniki	24	1	39	1	13	1	3	Concave	1.25	3.75
Inner Saronikos-Psittalia	36	2	11	1	18	1	4	Concave	1.25	5.00
Petalioi gulf coasts-Rafina	22	1	41	2	4	0	3	Straight	1	3.00
Inner (Central Saronikos)	40	2	25	1	8	0	3	Straight	1	3.00
S. Evvoikos-Markopoulo	4	1	57	2	4	0	3	Concave	1	3.00
Bay of Nicopolis	4	1	80	2	2	0	3	Convex	0.75	2.25
Bay of Methoni	0	1	39	1	1	0	2	Convex	0.75	1.50
Outer Saronikos gulf*	23	1	28	1	1	0	2	Convex	1	2.00
Sea of Lavrion-Makronissos	13	1	20	1	6	0	2	Convex	0.75	1.50
Coasts of Petalioi-Styra	0	1	26	1	6	0	2	Straight	1.25	2.50

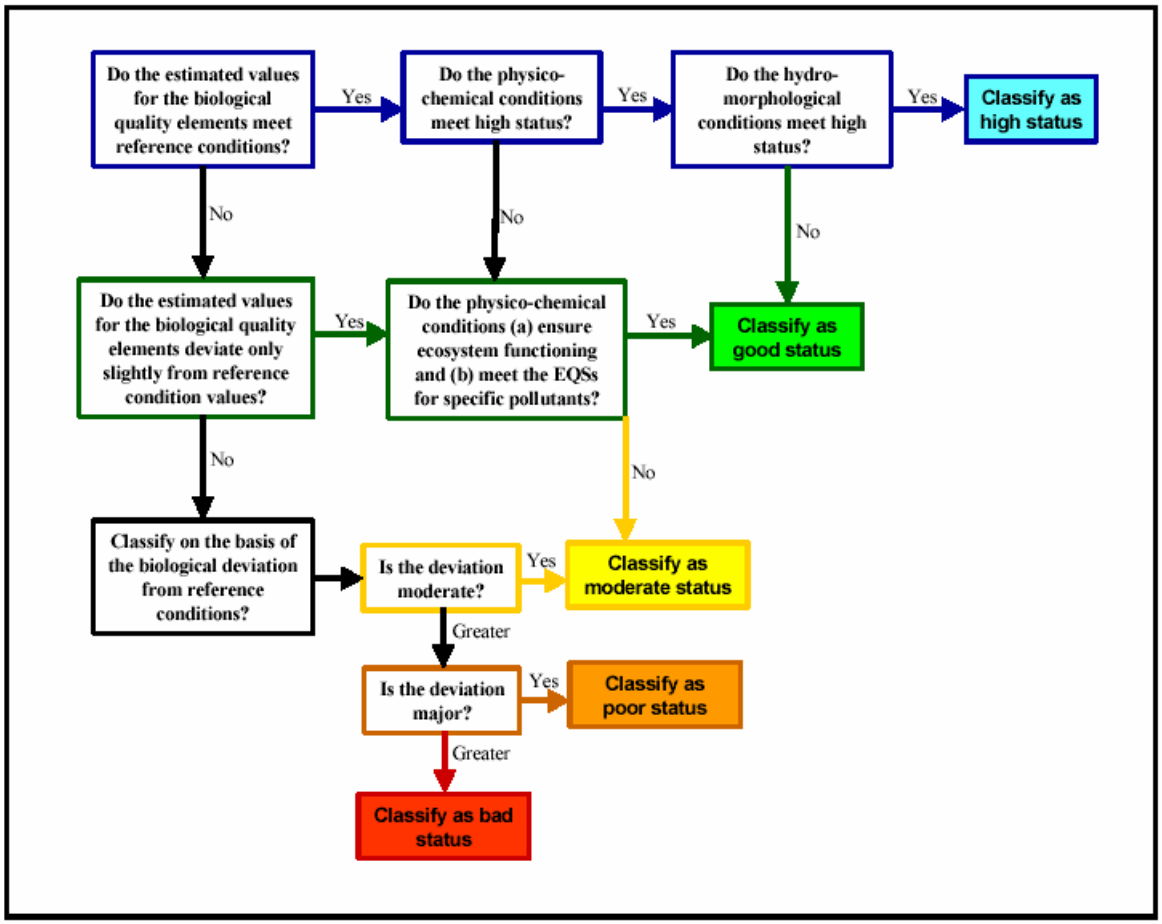
As agricultural use we took into account all the CLC codes of agricultural use (21-24).

· Flo, E.; Garcés, E.; Manzanera, M. y Camp, J. 2011. *Mediterranean coastal inshore waters: an important but ignored sea area. Estuarine, Coastal and Shelf Science*

SYNTHESIS OF RESULTS

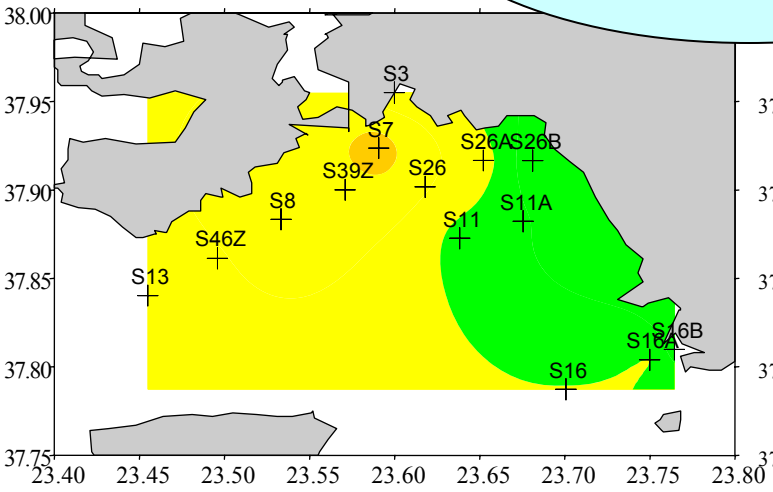
a) Decision tree

b) One out all out Principle

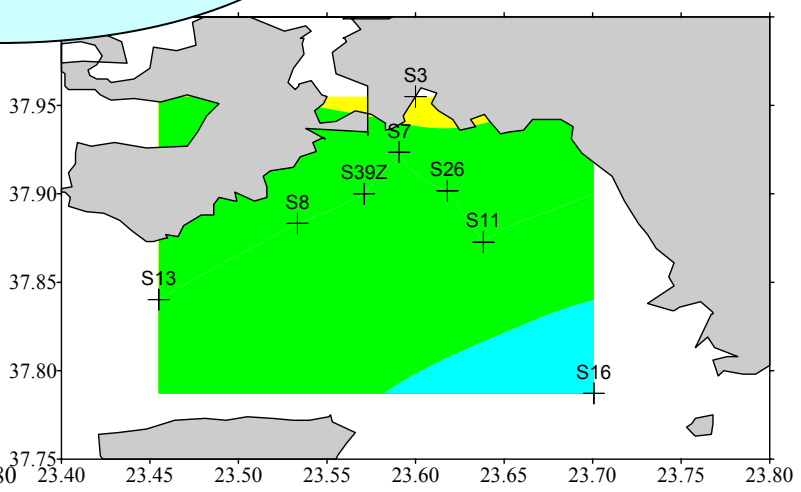

Do the estimated values for the biological quality elements meet reference conditions?
Yes
Do the physico-chemical conditions meet high status?
Yes
Do the hydro-morphological conditions meet high status?
Yes
Classify as high status
No
No
No
Do the estimated values for the biological quality elements deviate only slightly from reference condition values?
Yes
Do the physico-chemical conditions (a) ensure ecosystem functioning and (b) meet the EQSs for specific pollutants?
Yes
Classify as good status
No
No
Classify on the basis of the biological deviation from reference conditions?
Is the deviation moderate?
Yes
Classify as moderate status
Greater
Is the deviation major?
Yes
Classify as poor status
Greater
Classify as bad status

one-out all-out principle

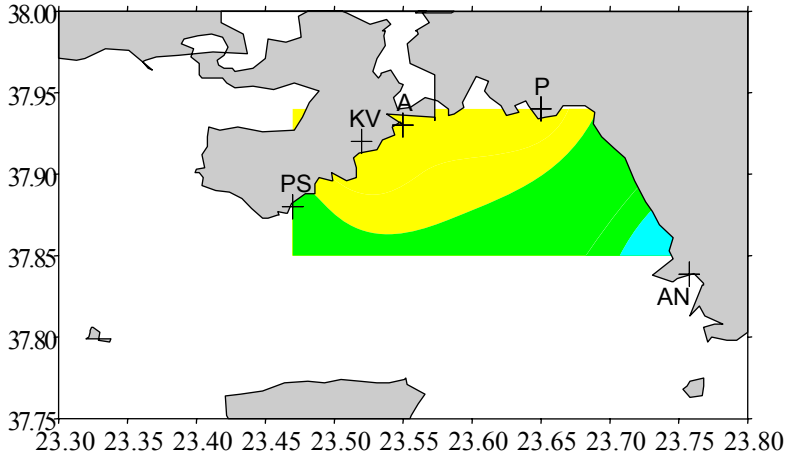
ZOOBENTHOS



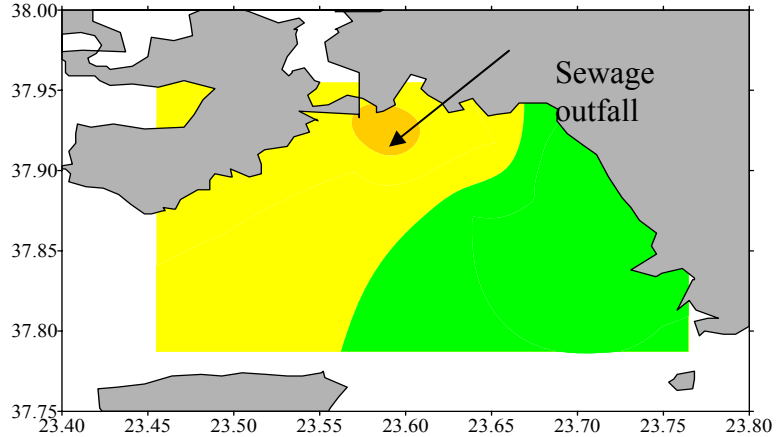
PHYTOPLANKTON



PHYTOBENTHOS



ALL QUALITY ELEMENTS



Criteria for the selection of the monitoring sites

✓One site per water body is mainly selected in within the known or predicted zone of impact.

✓In areas where a number of site source pressures or diffuse source pressures exist more than one site may be selected per water body.

✓Types of Monitoring: Operational (stations at risk, visited every year)

✓Surveillance: Stations non at risk visited every 3 years or twice per river basin management plan period (6 years)

Monitoring frequencies (coastal) for both types of monitoring

✓Twice a year (2/y) for phytoplankton

✓Once every 3 years (3y) for phytobenthos and macroinvertebrates

✓Once every 6 years (6y) for hydromorphological elements

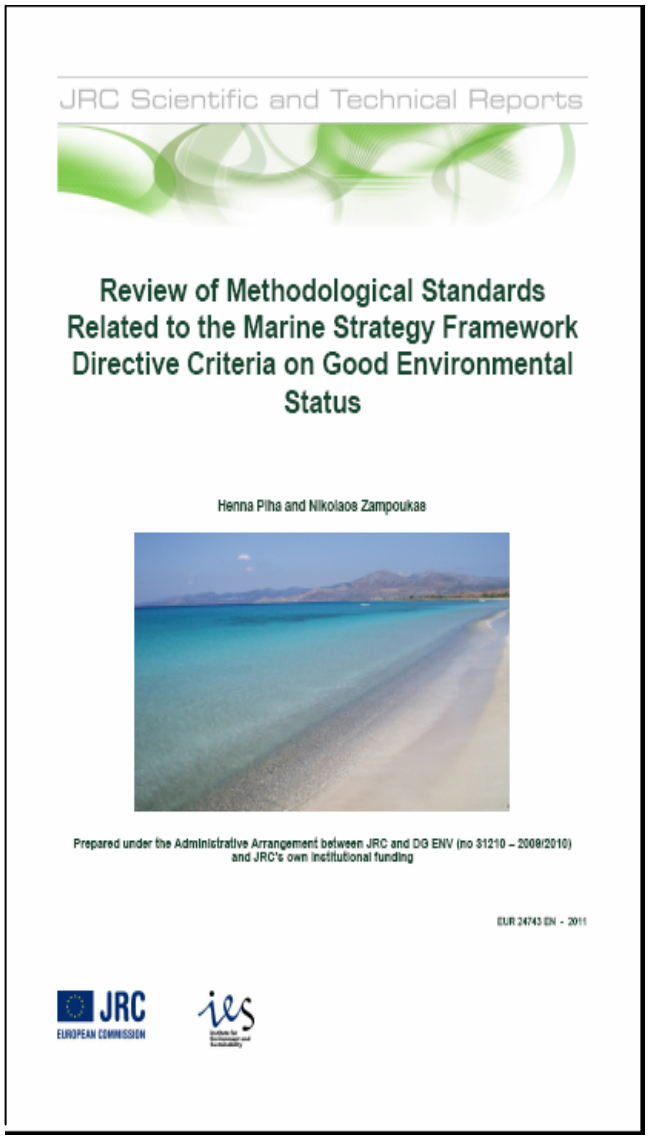
✓4 times per year (4/y) for general physicochemical elements

✓4 times per year (4/y) for priority substances and other pollutants with the possibility of future reconsideration of these frequencies depending on the results of this initial monitoring.

TOWARDS MSFD

MSFD Descriptors
(Commission Decision 2010/477/EU, Annex I, part B)

Descriptors	Criteria
D1 Biodiversity	Species distribution, population size, population condition, habitat distribution, habitat extent, habitat condition, ecosystem structure
D2 Non-indigenous species	Abundance and state characterisation of non-indigenous species, in particular invasive species, environmental impact of invasive non-indigenous species and impacts of non-indigenous invasive species at the level of species, habitats and ecosystem, where feasible
D3 Fisheries	Level of pressure of the fishing activity, reproductive capacity of the stock and population age and size distribution
D4 Food webs	Productivity of key species or trophic groups, proportion of selected species at the top of food webs and abundance/distribution of key trophic groups/species
D5 Eutrophication	Nutrients levels, direct effects of nutrient enrichment and indirect effects of nutrient enrichment
D6 Sea-floor integrity	Physical damage, having regard to substrate characteristics and the condition of the benthic community
D7 Hydrographical conditions	Spatial characterisation of permanent alterations and impact of permanent hydrographical changes
D8 Concentrations of contaminants	Concentration of contaminants and effects of contaminants
D9 Contaminants in fish and other seafood	Levels, number and frequency of limit level exceedance for contaminants
D10 Marine litter	Characteristics of litter in the marine and coastal environment and impacts of litter on marine life
D11 Underwater noise	Distribution in time and place of loud, low and mid-frequency impulsive sounds and continuous low frequency sound



Methodological standards *per se* are not defined in the MSFD or in the COM Dec, nor are methodological standards clearly specified for any of the descriptors in the COM Dec. The aim of the requirement for the use of methodological standards is however related to the need for comparability of approaches in determining GES and environmental goals within and among marine regions.

In this report, methodological standards are reviewed for the following points:

I. the assessment of the status of the marine environment and the determination of GES
II. environmental targets
III. monitoring.

Methodological standards are defined in general terms as all methods developed and agreed in the framework of European or international conventions.

An environmental target, within this report, is interpreted as a value set on the basis of an environment indicator or index at or beyond which good environmental status has been achieved, or which guides progress towards achieving GES.

The screening of available methodological standards is restricted to

a. WFD (2000/60/EC)
b. EQS Directive (2008/105/EC)
c. Habitats Directive (92/43/EEC)
d. Birds Directive (2009/147/EC)
e. Common Fisheries Policy (CFP)
f. Regional Sea Conventions covering European seas (OSPAR, HELCOM, UNEP MAP, Black Sea Commission).

Table 1. The availability of methodological standards by MSFD GES Descriptor. X indicates the existence of at least one standard being this related to assessment, environmental targets or monitoring.

	WFD	EQS Directive	Habitats Directive	Birds Directive	CFP	Regional Sea Conventions	Other Sources
D1 Biological diversity	X		X		X	X	
D2 Non-indigenous species						X	
D3 Commercial fish					X		X
D4 Food webs	X					X	X
D5 Eutrophication	X					X	X
D6 Sea floor	X		X			X	X
D7 Alteration of hydrographical conditions	X						
D8 Contaminants and pollution effects	X	X				X	
D9 Contaminants in fish and other seafood							X
D10 Litter						X	X
D11 Energy/Noise							X

Descriptor 5: Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters

In the Mediterranean Sea the TRIX (Vollenweider, 1998) is proposed for assessment and monitoring of eutrophication in the Mediterranean Sea (UNEP, 2007).

Many WFD methods submitted for intercalibration, particularly for phytoplankton and macrophytes, include metrics that assess the eutrophication related indicators.

Criterion 5.1 Nutrients levels

Indicator 5.1.1 Nutrients concentration in the water column

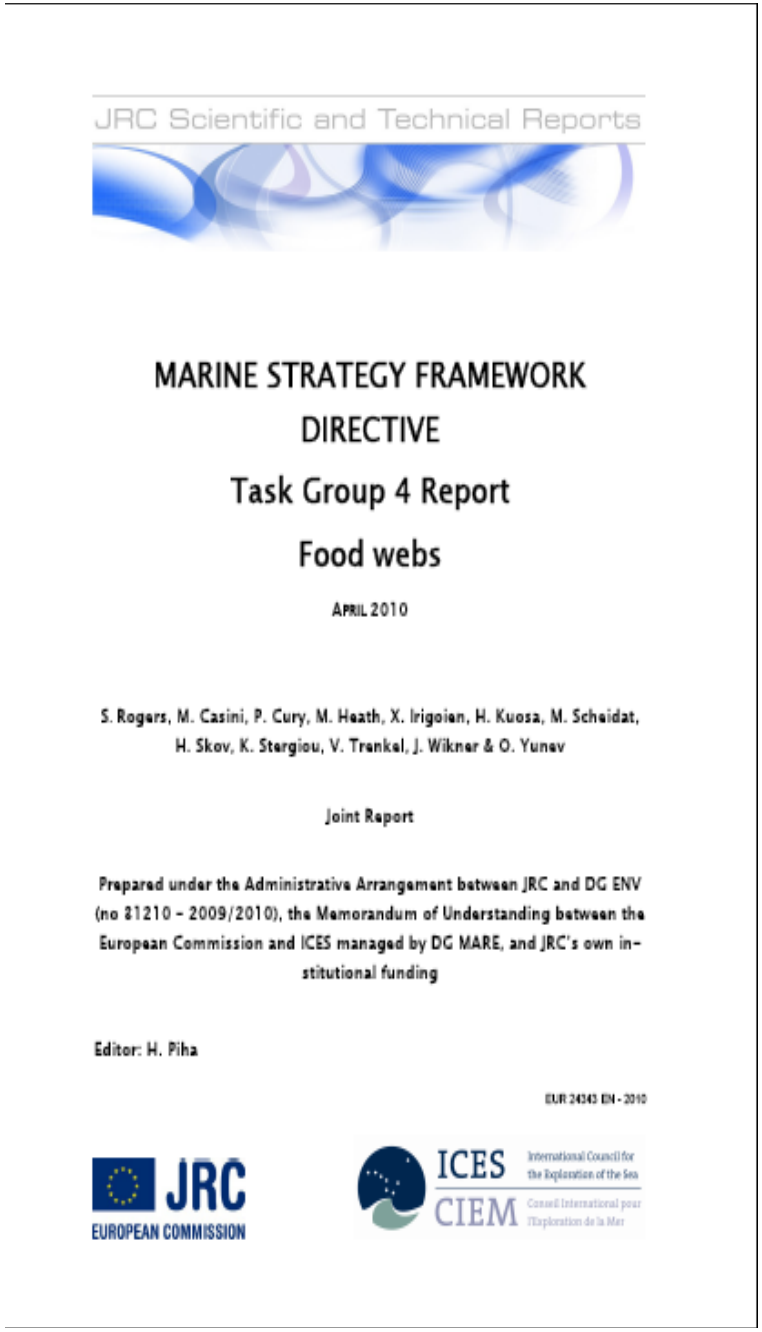
The eutrophication assessment guidance (EC, 2009) provides some guideline to derive nutrient standards in line with WFD requirements.

Criterion 5.2 Direct effects of nutrient enrichment

Indicator 5.2.1 Chlorophyll concentration in the water column

ISO 10260 (1992) on spectrometric determination of the chlorophyll-a concentration provides a standard method for quantification of chlorophyll-a.

WFD phytoplankton methods that are listed and described in the on-line database complied within the WISER project (Birk et al., 2010) include metrics on Chlorophyll a in the water column. Their compliance with the WFD is not yet fully checked and their application out of the coastal waters needs to be evaluated or/and developed. A description of the methods that were included in the Commission Decision 2008/915/EC can be found in the technical report of the 1st intercalibration phase (Carletti & Heiskanen, 2009).



The Task Group 4 'Food Webs' descriptor reads: *All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.*

This report defines the terms used in this descriptor (section 2), describes the scientific understanding (section 3) and the relevant spatial and temporal scales (section 4). A framework to describe attributes of GES for food webs is provided in section 5.

Good Environmental Status of Food Webs will therefore be achieved when the indicators describing the various attributes of the descriptor reach the thresholds set for them. These should ensure that populations of selected food web components occur at levels that are within acceptable ranges that will secure their long-term viability. Components must be selected carefully to avoid use of large numbers of species for which abundance / biomass trends are required (i.e. avoid use of general terms such as 'predators' or 'prey'). Assessment of food webs will need to include;

(i) biological groups with fast turnover rates (e.g. phytoplankton, zooplankton, bacteria) that will respond quickly to system change;

(ii) groups that are targeted by fisheries;

(iii) habitat-defining groups; and

(iv) charismatic or sensitive groups often found at the top of the food web.

1. Recommendations for Quality Descriptor TG5: Eutrophication

Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.

TG5 arrived at the following definition as the basis for interpreting the MSFD descriptor:

Eutrophication is a process driven by enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, leading to: increased growth, primary production and biomass of algae; changes in the balance of organisms; and water quality degradation. The consequences of eutrophication are undesirable if they appreciably degrade ecosystem health and/or the sustainable provision of goods and services.

3. What is "Good Environmental Status" of the descriptor?

GES with regard to eutrophication has been achieved when the biological community remains well-balanced and retains all necessary functions in the absence of undesirable disturbance associated with eutrophication (e.g. excessive algal blooms, low dissolved oxygen, declines in seagrasses, kills of benthic organisms and/or fish) and/or where there are no nutrient-related impacts on sustainable use of ecosystem goods and services.

5. Key Attributes of the Descriptor

a. Description of attribute and why it is important

Attribute	Why it is important
Water clarity	Related to phytoplankton biomass and important for growth of benthic plants
Primary production	Associated with the loading of nutrients to marine waters
Organic decomposition	Registers fate of ungrazed production and potential for oxygen consumption. Potentially leads to oxygen depletion (hypoxia/anoxia)
Algal community structure	Reflects the ecological balance of primary producers. Undesirable shifts in balance can include the appearance of harmful algal blooms (HAB)

b. Criteria: characteristics of the attribute with respect to GES and degradation gradient(s)

- ❑ Compliant with GES target conditions (all)
- ❑ Decreased water clarity
- ❑ Increased primary production
- ❑ Increased organic decomposition
- ❑ Undesirable changes in algal community structure

c. What are the pressures that act upon the attribute

Nutrient loads, especially nitrogen and phosphorus. Physical processes (i.e. climate, upwelling, ocean circulation and currents, water column stratification) may act to modify the response to nutrients.

Nutrient sources and loads should be included so that loads can be associated with impairment and successful management measures can be developed.

d. What are the indicators or classes of indicators that cover the properties of the attribute and linkages to the pressures?

Indicator class	Indicator[1]	Linkage to pressure increase
Physico-chemical	Nutrient load	Increase
	Nutrient concentration	Increase
	Nutrient ratios (Si:N:P)	Deviate from normal proportions (e.g. Si is r relation to other nutrients)
	Water transparency	Decrease due to increase in suspended alga
	Dissolved oxygen	Decrease due to increased organic decompo
Biological	Chlorophyll	Increase due to increased nutrient availabili
	Opportunistic macroalgae	Increase (e.g. can form blankets over the na and suffocate benthic animals)
	Floristic composition	Species shifts (e.g. diatom: flagellate ratio, pelagic shifts, indicator species, HAB)
	Perennial seaweeds and seagrasses	Decrease (e.g. fucoids and wracks, eel Neptune grass, that are adversely imp decreases in water transparency

[1] *Not all indicators in this list may be relevant in particular systems/regions.*

6. How are the indicators aggregated to assess GES for the descript

The question of aggregation was discussed at two levels: (i) the integration of indicators into attributes for the descriptor; and (ii) A range of tools was reviewed. N method (i.e. tool) is recommended to be used for GES, but those used must b integrated, sufficiently sensitive, comparable, and with recognized scientific merit.

7. Emergent messages about monitoring and research and final Synthesis

Monitoring

Member States must determine to what extent data needs are covered by national monitoring programmes, and what aspects of the descriptor are not or are poorly covered. The framework for a monitoring program should also be guided by existing programs, such as the OSPAR Comprehensive Procedure. On this basis it will be possible to optimize existing monitoring information, and identify where improvements may be made through targeted and focused additional monitoring.

On an EU level, the importance of infrastructure improvements is highlighted, in order to provide long-term datasets and information to help avoid misdiagnosis of new events/changes, improve interpretation of trends, and facilitate development of management measures.

Quality Assurance guidelines for the descriptor are an essential requirement for successful monitoring, allowing for appropriate intercalibration and comparative assessment.

Research

Coupled atmosphere-river-coastal sea models need to be developed at the regional scale for the estimate of critical nutrient loads from terrestrial sources, in relation to transitional/ coastal retention, and chemical and biological target indicators (Cat. I); natural background nutrient enrichment (e.g. import by upwelling; import from pristine/ good status rivers) for determination of unimpacted state and separation of naturally productive status from anthropogenically eutrophic status; climate change impacts on availability and transformation of nutrients and organic matter from land to the sea.

Nutrient regulation for algal biomass production; selection of dominant species, functional groups, and community structure, nutrient competition and needs (nutrient stoichiometry);

Impact of top-down (e.g. shellfish filtration, zooplankton grazing) control, grazing-resistant species, and other food-web interactions (viral infections, parasitism…) on fate/ sinks of algal biomass and transmitted/ amplified effects; regulation of harmful algal blooms (HABs); the link to land-based inputs is not always well established: blooms may be linked to upwelling relaxation events, cyst formation etc; research is needed to categorize to what extent events are manageable; Setting the GES targets (with safety margins) for algal production/ biomass ensuring none or minor undesired secondary effects on zoobenthic or fish communities;

Research on factors that govern the occurrence and extension of hypoxic/ anoxic sediment surface: there is a need to distinguish between natural range and increase of spatial extension of anoxic sediments due to anthropogenic organic loading; ecoregion and/ or habitat-specific relationships between the indicators/ parameters and proxies for nutrient loading pressures; identification of critical nutrient loading thresholds beyond which the whole system is changing into an alternative steady state; recovery pathways and the outcome of the restoration.

Development of phytoplankton assessment tools that account for shifts in species composition and frequency of blooms in the scoring; Development of monitoring tools that account for rapid changes in algal communities, allowing detection of bloom peaks (continuous measurements, ships-of-opportunity, remote sensing tools, algorithm development, real-time monitoring, etc.).

DESCRIPTOR 5: EUTROPHICATION

Table 11. Availability of monitoring parameters for the indicators (COM DEC 2010/477/EU) of eutrophication.

MSFD indicators	WFD[1]	HD	BD	CFP	EQS	RSCs
5.1.1 *Nutrients concentration in the water column*	X					OSPAR, HELCOM, Mediterranean
5.1.2 *Nutrient ratios (silica, nitrogen and phosphorus), where appropriate*	X					OSPAR, HELCOM, Mediterranean
5.2.1 *Chlorophyll concentration in the water column*	X					OSPAR, HELCOM, Mediterranean
5.2.2 *Water transparency related to increase in suspended algae, where relevant*	X					OSPAR, HELCOM
5.2.3 *Abundance of opportunistic macroalgae*	X					OSPAR
5.2.4 *Species shift in floristic composition such as diatom to flagellate ratio, benthic to pelagic shifts, as well as bloom events of nuisance/toxic algal blooms (e.g. cyanobacterial) caused by human activities*	X					OSPAR, HELCOM
5.3.1 *Abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency*	X					OSPAR, HELCOM
5.3.2 *Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned*	X					OSPAR, HELCOM, Mediterranean

1: only for coastal waters

Frequency of monitoring:

In the MSFD there are no specifications for monitoring frequency. Since the cycle of assessment, determination of GES, target setting, monitoring and establishment of measures should be reviewed and updated every six years the provided data should allow representative assessments at that timescale. While for some indicators therefore the minimum monitoring frequency should not be less than every 6 years, others are based on trend assessments and monitoring of change, requiring therefore higher data acquisition frequencies.

The WFD provides some guidelines for the minimum operational (for water bodies at risk) monitoring frequency in coastal waters as shown below:

QUALITY ELEMENT	FREQUENCY
Phytoplankton	6 months
Other aquatic flora	3 years
Macro invertebrates	3 years
Morphology	6 years
Thermal conditions	3 months
Oxygenation	3 months
Nutrient status	3 months
Other pollutants	3 months
Priority substances	1 months

Surveillance monitoring (for water bodies not at risk) can be done once every six years or even once every 18 years in the cases of water bodies that reached good status in the previous surveillance monitoring exercise and when the relevant review provides no evidence of new pressures.

In the EQS Directive, the long-term trend analysis of concentrations of those priority substances that tend to accumulate in sediment and/or biota is advised to be based on data collected in monitoring occurring every three years, unless technical knowledge and expert judgment justify another interval.

Conclusively, all the relevant *aquis* requires monitoring ranging from every 1 months to every 6 years and thus with intervals not longer than the 6 years cycle of MSFD implementation. The choice of MSFD monitoring frequency should be parameter and indicator specific e.g. more frequent for particularly dynamic biota such as phytoplankton and less for long lived species such as mammals and reptiles.

Guidance on the frequency of monitoring are also set as part of monitoring programmes related to the RSCs, such as the OSPAR Joint Assessment and Monitoring Programme, the Programme for the Assessment and Control of Marine Pollution in the Mediterranean region (MED POL), the Black Sea Integrated Monitoring and Assessment Programme (BSIMAP) and the HELCOM monitoring programme.

With the enormous amount of monitoring undertaken in the previous decades and the addition of further requirements through the MSFD, it is important to investigate the possibility for synergies between monitoring for different purposes. Also different MSFD Descriptors require the same or similar data, thus allowing a considerable reduction in effort through integration.

For the purpose of this report we considered integrated monitoring as the one providing data:

a) for the calculation of different indicators and the assessment of different descriptors
b) fulfilling the monitoring requirements of different pieces of legislation
c) covering the monitoring needs of more then one Member State
d) collected in comparable way between MSs

9.1 Integration across descriptors and indicators

The commonalities and possible synergies between indicators of different descriptors is obvious and also reflected in the fact that the MSFD Common Implementation Strategy Working Group on GES is currently discussing GES definition and target setting by grouping descriptors into themes and subthemes as below:

Ref. number	Themes	Subtheme	Descriptors
I	Nutrients enrichment and contaminants		5, 8 & 9
I A		Nutrients enrichment	5
I B		Contaminants	8 & 9
II	Disturbance		10 & 11
III	Biodiversity		1, 2, 3, 4, 6, 7
III A		Species	1(partly), 2, 3 & 4
III B		Habitats	1 (partly), 6 & 7

Marine Strategy Framework Directive (MSFD)
Common Implementation Strategy

Guidance for 2012 reporting under the Marine Strategy Framework Directive

Draft: 16 April 2012

Marine Strategy Framework Directive reporting

A user guide for electronic reporting 2012

Marine Strategy Framework Directive reporting

Access Reporting Database Content

Version 1.0 draft2
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Document History

JOB NUMBER: 1011112-1			DOCUMENT REF: MSFD Database overview v1.0			
1.0	1st draft	Wisletup	Maidens		Maidens	30.03.2012
1.1	2nd draft	Wisletup	Maidens		Maidens	02.04.2012
1.2						
Revision	Purpose Description	Originated	Checked	Reviewed	Authorised	Date

Reporting sheet (RS)

GEOGRAPHICAL BOUNDARIES AND REGIONAL COOPERATION (GB)

Database tables covering above reporting sheet(s)

Notes

- The MarineUnitID is unique and is referring to the level to which a specific reporting sheet is reported. The Member State (MS) can choose to report at several levels of detail (Region, Subregion, Assessment area) and the MarineUnitID will reflect this level of detail
- All main tables in the database are linked to a MarineUnitID except for the Targets and Indicators (Art 10) and GES (Art 9) which only can be reported at Region level
- GB_RegionalCooperation tables covers the Regional cooperation reporting sheet where column C in the RS is covered in table GB_RegionalCooperationMS

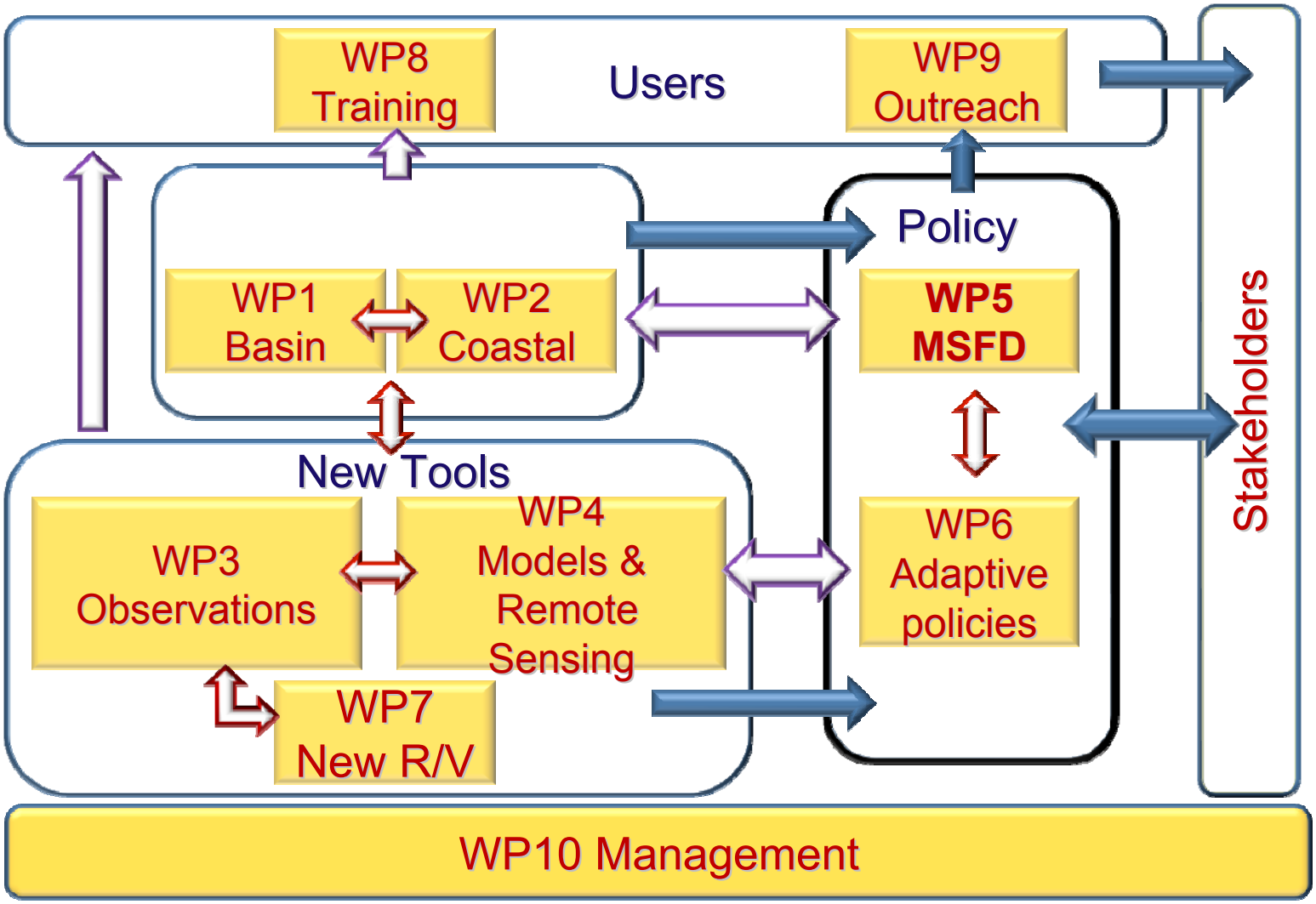
Besides the adaptation and specification of indicators

entirely new indicators may have to be developed

(HCMR is working through PERSEUS, EEA, national program)

Reporting on the characteristics of GES (Art. 9) and the setting of targets and associated indicators (Art. 10) include questions relating to threshold values, reference points.

WP5, together with WP6, are the PERSEUS policy WPs aiming to provide decision makers with a scientific basis needed to set common environmental targets for the SES ecosystems.



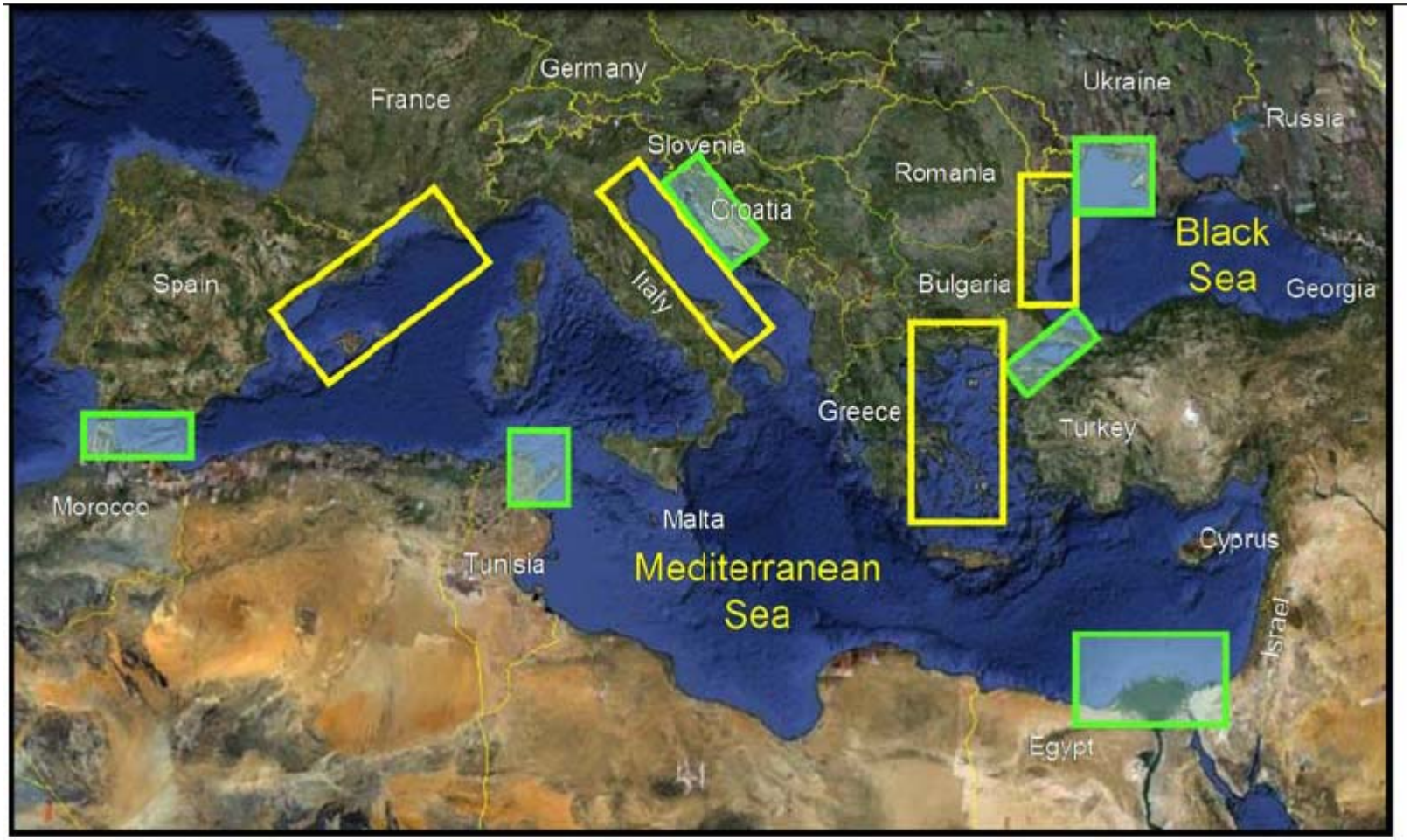
PERSEUS WP 5 - MAIN OBJECTIVES

- **Identify, develop and promote tools and methods to assess environmental status** across the Mediterranean and the Black Sea basins with emphasis on non-EU countries, in accordance with the principles and objectives of the MSFD;
- **Provide an opportunity for scientific cooperation** and networking between scientists from EU Member States and non-EU countries;
- **Create a platform for strengthening human capacity building** in interdisciplinary science and science-based management;
- **Improve marine research and monitoring infrastructure** in the region;

Overall responsibility:

WP 5 leader *Vassiliki Vassilopoulou (HCMR) - Greece*

Co-leader *Gheorghe Oaie (GeoEcoMar) - Romania*



Areas for demonstration of the MSFD principles in PERSEUS

European Topic Centre
Inland, coastal, marine waters

CENIA, Czech Environmental
Information Agency
European Topic Centre on Water

1.5.2.a: Update and development of Marine and Maritime Indicators, also in support of MSFD implementation

Update: ***ocean color, salinity, aquaculture, fish stocks, oil discharges, socio economic indicators (coastal and offshore renewable energy, maritime transport – shipping, maritime transport – ports, coastal tourism) (no country review)***

Milestone 2: New indicators linked to MSFD descriptors and criteria

Deliver new EEA marine and maritime indicators linked to the MSFD descritpors and criteria and support development of a concept for further indicators.
This task should for each indicator include exploring relevant activities being developed in the context of the different regional sea conventions or other relevant fora (e.g. EU research projects), and a prioritised list to EEA of where efforts should be focused. Indicators could include:

i.Eutrophication (incl. replacement for CSI21 and 23) (Deltares) (1st draft: 30 Nov)
ii.Fisheries (based on D3+ process outcomes and incl. replacement for CSI32 and 34) (ICES) (1st draft: 30 Nov)
iii.Marine litter (based on TSG Marine Litter outcomes in 2011 and 2012 possible activities, and incl. update on marine beach litter indicator, if relevant). This activity also includes participation in MSFD TSG on marine litter. (IWRS) (1st draft: 31 March; final draft: 30 june)
iv.Biodiversity (incl. update indicators based on HD Art.17 and N2000 reporting - Conservation status of marine and coastal habitats; Anthropogenic pressures in Marine and Coastal N2000; Sea grass) (DHI) (1st draft: 31 March; final draft: 30 june)
v.Seafloor integrity (incl. the development of a spatial indicator on fishing effort within specific MSFD sub-regions) (ICES) (1st draft: 30 Nov)
vi.Marine invasive species (incl. the update of the Trends in Marine Aliens indicator, and further exploring trends in pathways of invasion and links to impacts on the ecosystem) (HCMR) (1st draft: 31 March; final draft: 30 june)
vii. Noise (based on TSG Noise outcomes in 2011 and 2012 possible activities)(DHI[s1])

National Program

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ

ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ,
ΔΙΑ ΒΙΟΥ ΜΑΘΗΣΗΣ ΚΑΙ ΘΡΗΣΚΕΥΜΑΤΩΝ

ΓΕΝΙΚΗ ΓΡΑΜΜΑΤΕΙΑ ΕΡΕΥΝΑΣ
ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ

ΕΛΛΗΝΙΚΟ ΚΕΝΤΡΟ ΘΑΛΑΣΣΙΩΝ ΕΡΕΥΝΩΝ

46,7 ΧΑΜ ΛΕΩΦ. ΑΘΗΝΩΝ ΣΟΥΝΙΟΥ
Τ.Θ. 712, Τ.Κ. 19013 ΑΝΑΒΥΣΣΟΣ

Ανάβυσσος: 16.03.2012
Αρ. Πρωτ.: 2001 1/1600

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Τηλέφωνο: 2291076371
Φαξ: 2291076347

Προς: Πίνακα Αποδεκτών

Κοιν: Δρ. Δ. Γεωργόπουλο
Αναπληρωτή Διευθυντή Ι.Ω.

Δρ. Κ. Παπακωνσταντίνου
Διευθυντή Ι.ΘΑΒΙ.Π.

Θέμα: Δράσεις για τον ορισμό του Ελληνικού Κέντρου Θαλασσίων Ερευνών (ΕΛ.ΚΕ.Θ.Ε.) ως τελικού δικαιούχου στην ΕΠΕΡΑΑ/ΕΣΠΑ για τη Θαλάσσια Στρατηγική

Το Ελληνικό Κέντρο Θαλασσίων Ερευνών (ΕΛ.ΚΕ.Θ.Ε.) ευρίσκεται σε συνεννόηση με το ΥΠΕΚΑ για να χαρακτηριστεί τελικός δικαιούχος στο ΕΠΕΡΑΑ/ΕΣΠΑ για την εφαρμογή της Οδηγίας Πλαίσιο για την Θαλάσσια Στρατηγική (2208/56/ΕΚ). Σύμφωνα με το Νόμο 3983/2011 «Εθνική Στρατηγική για την προστασία και διαχείριση του θαλάσσιου περιβάλλοντος – εναρμόνιση με την οδηγία 2008/56/ΕΚ» άρθρο 19, παράγραφο 1, εδάφιο στ.ββ, με απόφαση του ΥΠΕΚΑ και του κατά περίπτωση συναρμόδιου Υπουργείου, στην περίπτωση του ΕΛ.ΚΕ.Θ.Ε. το Υπουργείο Παιδείας, Δια βίου Μάθησης και Θρησκευμάτων, ορίζονται οι αρμόδιοι φορείς και οι υποχρεώσεις τους για την παρακολούθηση της ποιότητας των θαλάσσιων υδάτων.

Στο πλαίσιο της παραπάνω απόφασης ορίζεται επιτροπή ερευνητών του ΕΛ.ΚΕ.Θ.Ε. (πίνακας αποδεκτών) που θα υποστηρίξει τη διαδικασία εφαρμογής των επιμέρους δράσεων, οι οποίες αναφέρονται στο δίκτυο των σταθμών, στις παράμετρες, στη συχνότητα των μετρήσεων καθώς και στο προϋπολογιζόμενο κόστος τους.

Στο συνημμένο πίνακα αναφέρονται τα θέματα περιγραφής που καλύπτει η οδηγία και τους υπεύθυνους ερευνητές, οι οποίοι στο έργο τους θα συνεπικουρούνται από άλλους επιστήμονες του ΕΛ.ΚΕ.Θ.Ε., οι οποίοι μπορούν να συμβάλλουν στην καλύτερη υλοποίηση του προγράμματος. Συντονιστής ορίζεται ο Δρ. Π. Παναγιωτίδης.

Συν 1: Πίνακας Αποδεκτών
Συν 2: Πίνακας Marine Strategy FD Descriptors

Ο Πρόεδρος και Διευθυντής του ΕΛ.ΚΕ.Θ.Ε.

Καθηγητής Κώστας Συνολάκης

ΓΙΑ ΠΙΣΤΟ ΑΠΟΓΡΑΦΟ
Εκ της Γραμματείας

Πίνακας: Marine Strategy FD Descriptors	Προτεινόμενη ομάδα
Descriptor 1: "Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions"	Pancucci-Παπαδοπούλου Αρβανιτίδης
Descriptor 2: "Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems"	Ζενέτου
Descriptor 3: "Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock"	Βασιλοπούλου
Descriptor 4: "All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity"	Μαχιάς
Descriptor 5: "Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters."	Πάγκου
Descriptor 6: "Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected	Σύμπουρα
Descriptor 7: "Permanent alteration of hydrographical conditions does not adversely affect marine ecosystem"	Παπαδόπουλος Β.
Descriptor 8: "Concentrations of contaminants are at levels not giving rise to pollution effects"	Χατζηανέστης
Descriptor 9: "Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards."	Κατσίκη
Descriptor 10: "Properties and quantities of marine litter do not cause harm to the coastal and marine environment	Σαλωμίδη
Descriptor11:" Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment"	Προσπαθόπουλος
Coordinator	Παναγιωτίδης

ΟΔΗΓΙΕΣ

ΟΔΗΓΙΑ 2008/56/ΕΚ ΤΟΥ ΕΥΡΩΠΑΪΚΟΥ ΚΟΙΝΟΒΟΥΛΙΟΥ ΚΑΙ ΤΟΥ ΣΥΜΒΟΥΛΙΟΥ

της 17ης Ιουνίου 2008

περί πλαισίου κοινοτικής δράσης στο πεδίο της πολιτικής για το θαλάσσιο περιβάλλον (οδηγία-πλαίσιο για τη θαλάσσια στρατηγική)

(Κείμενο που παρουσιάζει ενδιαφέρον για τον ΕΟΧ)

ΤΟ ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΟΒΟΥΛΙΟ ΚΑΙ ΤΟ ΣΥΜΒΟΥΛΙΟ ΤΗΣ ΕΥΡΩΠΑΪΚΗΣ ΕΝΩΣΗΣ,

Έχοντας υπόψη:

τη συνθήκη για την ίδρυση της Ευρωπαϊκής Κοινότητας, και ιδίως το άρθρο 175 παράγραφος 1,

την πρόταση της Επιτροπής,

τη γνώμη της Ευρωπαϊκής Οικονομικής και Κοινωνικής Επιτροπής [1],

τη γνώμη της Επιτροπής των Περιφερειών [2],

Αποφασίζοντας σύμφωνα με τη διαδικασία του άρθρου 251 της συνθήκης [3],

Εκτιμώντας τα ακόλουθα:

(1) Τα θαλάσσια ύδατα υπό την κυριαρχία ή δικαιοδοσία των κρατών μελών της Ευρωπαϊκής Ένωσης περιλαμβάνουν τη Μεσόγειο, τη Βαλτική, τον Εύξεινο Πόντο και τον Βορειοατλαντικό Ατλαντικό, περιλαμβανομένων και των υδάτων που περιβάλλουν τις Αζόρες, τη Μαδέρα και τα Κανάρια νησιά.

(2) Είναι προφανές ότι τόσο οι πιέσεις που ασκούνται στους φυσικούς ενάλιους πόρους όσο και η ζήτηση για θαλάσσιες οικολογικές υπηρεσίες είναι συχνά πολύ μεγάλες και ότι η Κοινότητα θα πρέπει να μειώσει τις επιπτώσεις τους στα θαλάσσια ύδατα, ανεξάρτητα από τον τόπο όπου εκδηλώνονται οι συνέπειές τους.

(3) Το θαλάσσιο περιβάλλον αποτελεί πολύτιμη κληρονομιά που πρέπει να προστατεύεται, να διαφυλάσσεται και, εφόσον είναι εφικτό, να αποκαθίσταται ώστε τελικά να διατηρείται η βιοποικιλότητα και να εξασφαλίζεται η πολυμορφία και η δυναμική των ωκεανών και θαλασσών, που θα είναι καθαρές, υγιείς και παραγωγικές. Η παρούσα οδηγία αναμένεται, μεταξύ άλλων, να προωθήσει την ενσωμάτωση περιβαλλοντικών προβληματισμών σε όλους τους σχετικούς τομείς πολιτικής και να αποτελέσει τον περιβαλλοντικό πυλώνα της μελλοντικής Θαλάσσιας Πολιτικής της Ένωσης.

(4) Σύμφωνα με την απόφαση αριθ. 1600/2002/ΕΚ του Ευρωπαϊκού Κοινοβουλίου και του Συμβουλίου, της 22ας Ιουλίου 2002, για τη θέσπιση του Έκτου Κοινοτικού Προγράμματος Δράσης για το Περιβάλλον [4], εκπονήθηκε θεματική στρατηγική για την προστασία και τη διατήρηση του θαλάσσιου περιβάλλοντος, με γενικούς στόχους την προαγωγή της αειφόρου χρήσης των θαλασσών και τη διατήρηση των θαλάσσιων οικοσυστημάτων.

(5) Η εκπόνηση και η εφαρμογή της θεματικής στρατηγικής θα πρέπει να αποσκοπούν στη διατήρηση των θαλάσσιων οικοσυστημάτων. Η προσέγγιση αυτή θα πρέπει να περιλαμβάνει προστατευόμενες περιοχές καλύπτοντας όλες τις ανθρώπινες δραστηριότητες που επηρεάζουν το θαλάσσιο περιβάλλον.

(6) Η θέσπιση προστατευόμενων θαλάσσιων περιοχών, περιλαμβανομένων εκείνων που έχουν ήδη οριοθετεί, ή πρόκειται να οριοθούν στην οδηγία 92/43/ΕΟΚ του Συμβουλίου, της 21ης Μαΐου 1992, για τη διατήρηση των φυσικών οικοτόπων καθώς και της άγριας πανίδας και χλωρίδας [5] («οδηγία για τους οικοτόπους»), την οδηγία 79/409/ΕΟΚ του Συμβουλίου, της 2ας Απριλίου 1979, περί της διατηρήσεως των αγρίων πτηνών [6] («οδηγία για τα πτηνά»), καθώς και σε διεθνείς ή περιφερειακές συμφωνίες, των οποίων αποτελούν μέρη η Ευρωπαϊκή Κοινότητα ή τα ενδιαφερόμενα κράτη μέλη, συνιστά σημαντική συμβολή στην επίτευξη της καλής περιβαλλοντικής κατάστασης στο πλαίσιο της παρούσας οδηγίας.

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[1] ΕΕ C 185 της 18.8.2006, σ. 20.

[2] ΕΕ C 206 της 29.8.2006, σ. 5.

[3] Γνώμη του Ευρωπαϊκού Κοινοβουλίου της 14ης Νοεμβρίου 2006 (ΕΕ C 314 Ε της 21.12.2006, σ. 86), κοινή θέση του Συμβουλίου της 23ης Ιουλίου 2007 (ΕΕ C 242 Ε της 16.10.2007, σ. 11) και θέση του Ευρωπαϊκού Κοινοβουλίου της 11ης Δεκεμβρίου 2007 (δεν έχει ακόμα δημοσιευθεί στην Επίσημη Εφημερίδα). Απόφαση του Συμβουλίου της 14ης Μαΐου 2008.

[4] ΕΕ L 242 της 10.9.2002, σ. 1.

[5] ΕΕ L 206 της 22.7.1992, σ. 7. Οδηγία όπως τροποποιήθηκε τελευταία με την οδηγία 2006/105/ΕΚ (ΕΕ L 363 της 20.12.2006, σ. 368).

[6] ΕΕ L 103 της 25.4.1979, σ. 1. Οδηγία όπως τροποποιήθηκε τελευταία με την οδηγία 2006/105/ΕΚ.


THANK YOU
ΕΥΧΑΡΙΣΤΩ

More about TRIX…

3.2. Approach and criteria for a practical trophic index

In developing the above general framework in terms of an explicit trophic index, the following principles have been observed: Component parameters of the index should (a) be meaningful in terms of both, production and production dynamics, (b) encompass major causal factors, (c) be a routine measurement in most marine surveys.

After careful considerations of this sort, the following set of parameters, listed under three headings, were selected as useable components of a trophic index:

(a) Factors that are direct expressions of productivity:
Chlorophyll 'a': [Ch: mg/m^3]
Oxygen as absolute [%] deviation from saturation: [abs | 100−%0 | = aD%0]

(b) Nutritional factors:
(i) Totals
Total nitrogen: [NT: mg/m^3]
Total phosphorus: [PT: mg/m^3]
(ii) Available
Dissolved inorganic nitrogen as N-(NO3 + NO2 + NH3): [DIN = mN: mg/m^3]
Dissolved inorganic phosphorus as P-PO4: [DIP = PO4: mg/m^3]

(c) Supplementary water quality factor:
Transparency: [Secchi depth: m]

The components selected for the proposed index are those listed under (a) and (b) above, whereby among the nutritional factors, respectively, two (nitrogen and phosphorus) are selected according to availability of data. The desirable combination are: NT and PT(1), mN and PT(2), mN and PO4(3), in this order; the least desirable, NT and PO4, instead is of little interest. Transparency is used for a supplementary index.

2) *Trophic Index TRIX.*

TRIX Index formulation is the following:

$$TRIX = (Log_{10}\,[ChA \cdot aD\%O \cdot DIN \cdot PT]+k)/m$$

Each of the four components represents a trophic state variable, to say:

a) **factors that are direct expression of productivity :**
   - ***ChA*** = chlorophyll *a* concentration, as *µg/L;*
   - ***aD%O*** = Oxygen as *absolute % deviation from saturation;*

b) **nutritional factors:**
   - ***DIN*** =mineral nitrogen: *dissolved inorganic nitrogen* = $N\text{-}(NO_3+NO_2+NH_4)$, as *µg/L;*
   - ***PT*** = total phosphorus, as *µg/L.*

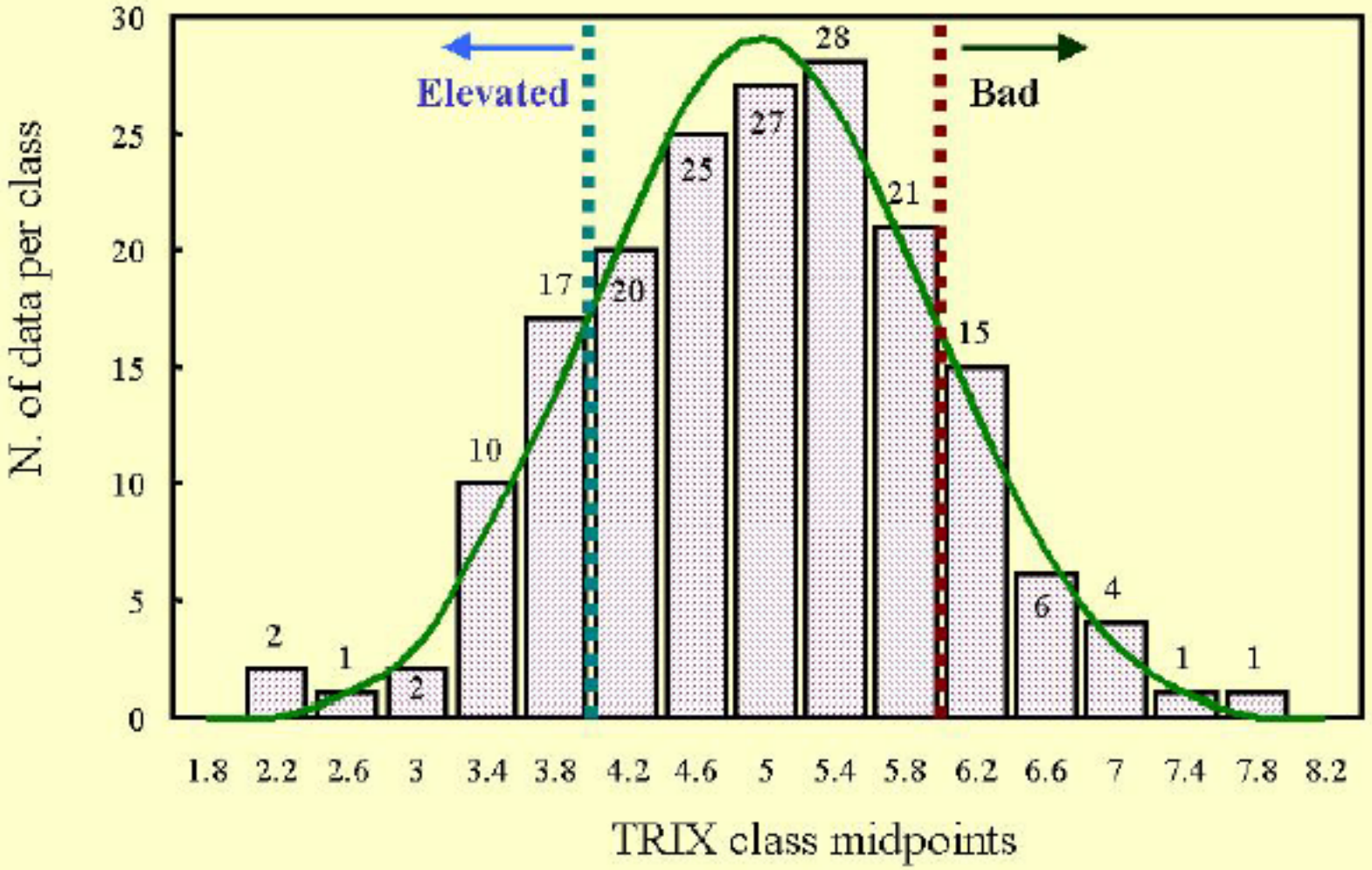
The parameters ***k=1.5*** and ***m=1.2***, are scale coefficients, introduced to fix the lower limit value of the Index and the extension of the related Trophic Scale, from 0 to 10 TRIX units.

Because of the log-transformation of the four original variables, annual distributions of TRIX data over homogeneous coastal zones, are very close to normal kind and show a quite stable variance, with **STD around 0.9.**

Reference values for TRIX means, corresponding trophic state and related coastal water quality conditions.

TRIX annual means	Trophic Status	Water quality Conditions
<4	Elevated	• Scarcely productive waters. • Good water transparency. • Absence of anomalous water colours. • Absence of Oxygen undersaturation in the bottom waters.
4-5	Good	• Moderately productive waters. • Occasionally water turbidity. • Occasionally anomalous water colors. • Occasionally bottom waters ipoxia episodes.
5-6	Mediocre	• Very productive waters. • Low water transparency. • Frequently anomalous waters colours. • Ipoxia and occasionally anoxia episodes in the bottom layers. • Suffering of the benthic communities.
>6	Bad	• Strongly productive waters. • High water turbidity. • Diffuse and persistent anomaly in the water colours. • Diffuse and persistent ipoxia/anoxia episodes in the bottom waters. • High mortality rate of benthic organisms. • Alteration of the benthic communities and strong decrease of the biodiversity

Adriatic coastal waters: frequency class distribution for TRIX data.
Sampling stations 500 and 3000 m off-shore, from Rimini to Cattolica
(TRIX mean = 4.965; STD = 0.982; N=180).



Classification of trophic status

Trophic scale	Trophic status	Description
< 4	High	Low trophic level Good water transparency Absence of anomalous water colour Absence of subsaturation of dissolved oxygen in bottom waters
4-5	Good	Average trophic level Occasional clouding of water Occasional anomalous water colour Occasional hypoxias in bottom waters
5-6	Poor	High trophic level Low water transparency Anomalous water colour Hypoxias and occasional anoxias in bottom waters States of suffering at the benthic ecosystem level
> 6	Bad	Very high trophic level High water turbidity Widespread and persistent anomalies in water colouring Widespread and persistent hypoxias/anoxias in bottom waters Dying off of benthic organisms Alteration of benthic communities

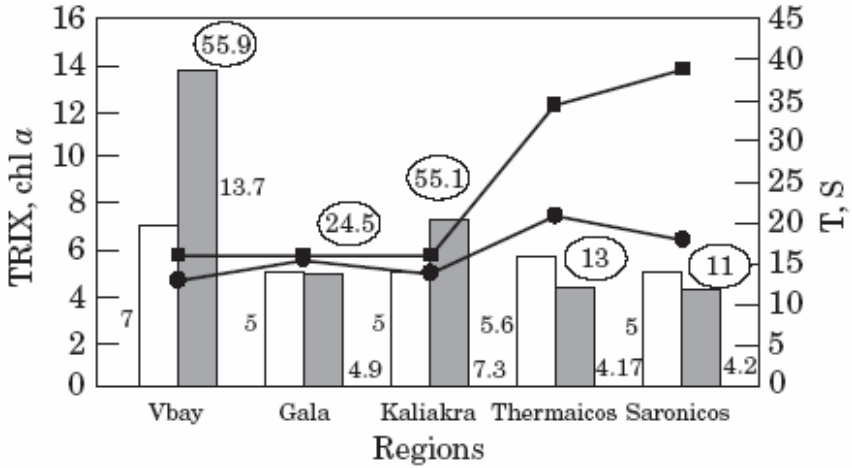


FIGURE 6. Average annual values of TRIX, chlorophyll temperature and salinity, by sites. (Maximum chlorophyll values are shown in the circles) ● T, ■ S.

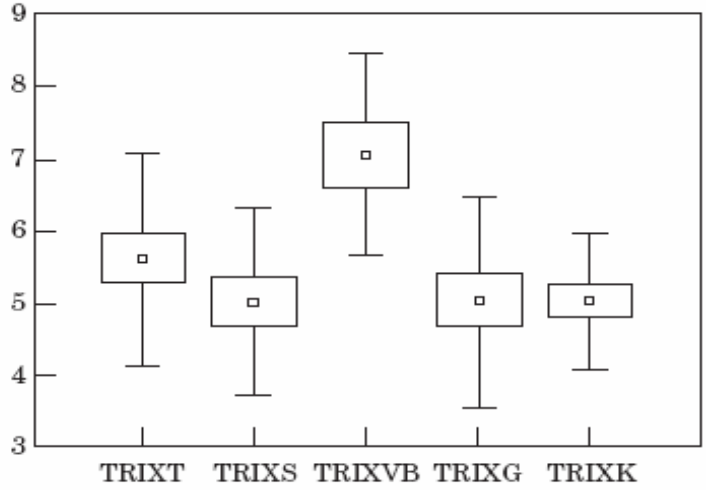
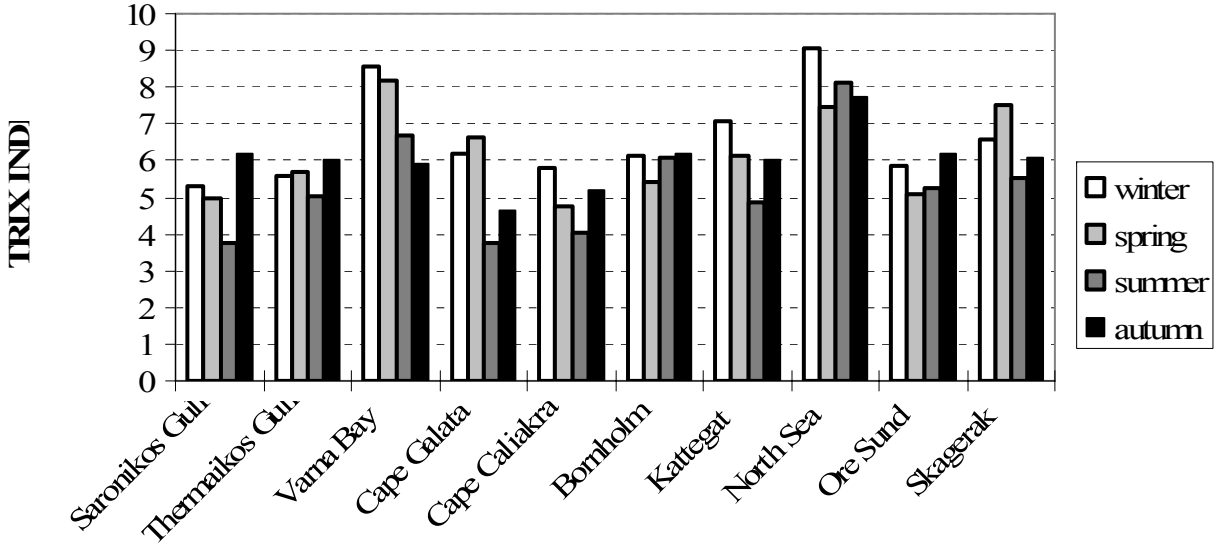


FIGURE 7. Box-Whisker Plot for TRIX by sites. TRIX=Trophic State Index (Vollenweider *et al.*, 1998). (T-Thermaikos Gulf, S-Saronikos Gulf, VB-Varna Bay, G-Cape Galata, K-Cape Kaliakra)



Environ., Suppl. 1992: 83-100.

Vollenweider, R.A., F. Giovanardi, G. Montanari & A. Rinaldi. 1998. Characterization of the trophic conditions of marine coastal waters, with special reference to the NW Adriatic Sea: proposal for a trophic scale, turbidity and generalized water quality index. *Environmetrics*, 9: 329-357.