

Development of Marine & Maritime indicators in support of MSFD implementation

Dr. Claudette Spiteri

European Environment Agency



European Topic Centre
Inland, coastal, marine waters



Deltares
Enabling Delta Life



1. General context
 - Indicators
 - MSFD & indicators
2. Indicator development
 - Process
 - Pan European
 - Regional Seas
 - National
 - Content
 - Descriptors
 - Criteria
 - **Indicators**
 - Monitoring parameters
 - Environmental Targets
 - Maritime Indicators
3. Shortcomings
4. Way forward



What is an indicator?

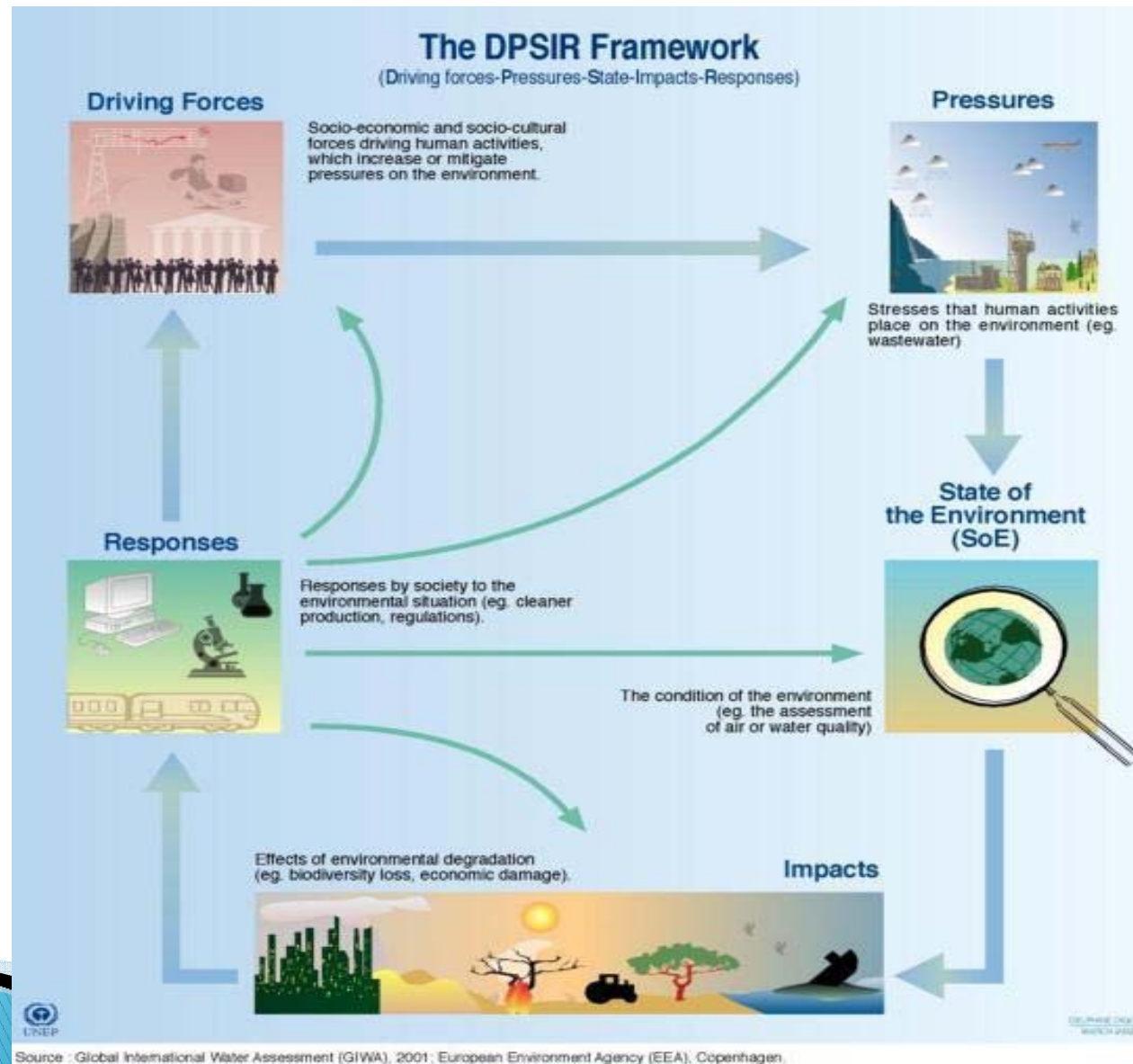
...is a measure, generally quantitative, that can be used to illustrate and communicate complex environmental phenomena in a simple manner, including trends and progress over time..

EEA Guide Core Set of Indicators, 2005

Criteria for indicators

- ▶ Address clearly the policy question
- ▶ Measurement
 - Accurate
 - Simple to measure
 - Existing data
 - Available at reasonable cost/benefit ratio
- ▶ Responsive to changes in environment and anthropogenic activities
 - Tightly linked in time & space
 - cause–effect
 - Sensitive
 - detection vs background
 - Responsive
 - early–warning
 - Specific
 - response primarily to human pressure

DSPIR and Indicators



► Marine Strategy Framework Directive (MSFD)

- adopted in July 2008
- EU's legal instrument for the protection of our seas
- development of Marine Strategies/Action Plans by MS
- a coordination exercise across Europe
- ecosystem-based approach to managing human activities
- achieving or maintaining GES

Good Environmental Status is 'the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive...'

OVERARCHING GOAL
achieve Good Environmental Status of EU's marine waters by 2020

**PROTECTED
ECOSYSTEMS**
Clean, healthy,
productive seas

**SUSTAINABLE
USE**
of Europe's
marine resources

**COMMON
APPROACHES**
Cooperation at
EU and
regional level

Requirement for regional coordination

“Member States sharing a marine region...shall cooperate to ensure that... the measures required to achieve...this Directive...are coherent and coordinated across the marine region...”

- *The Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean*

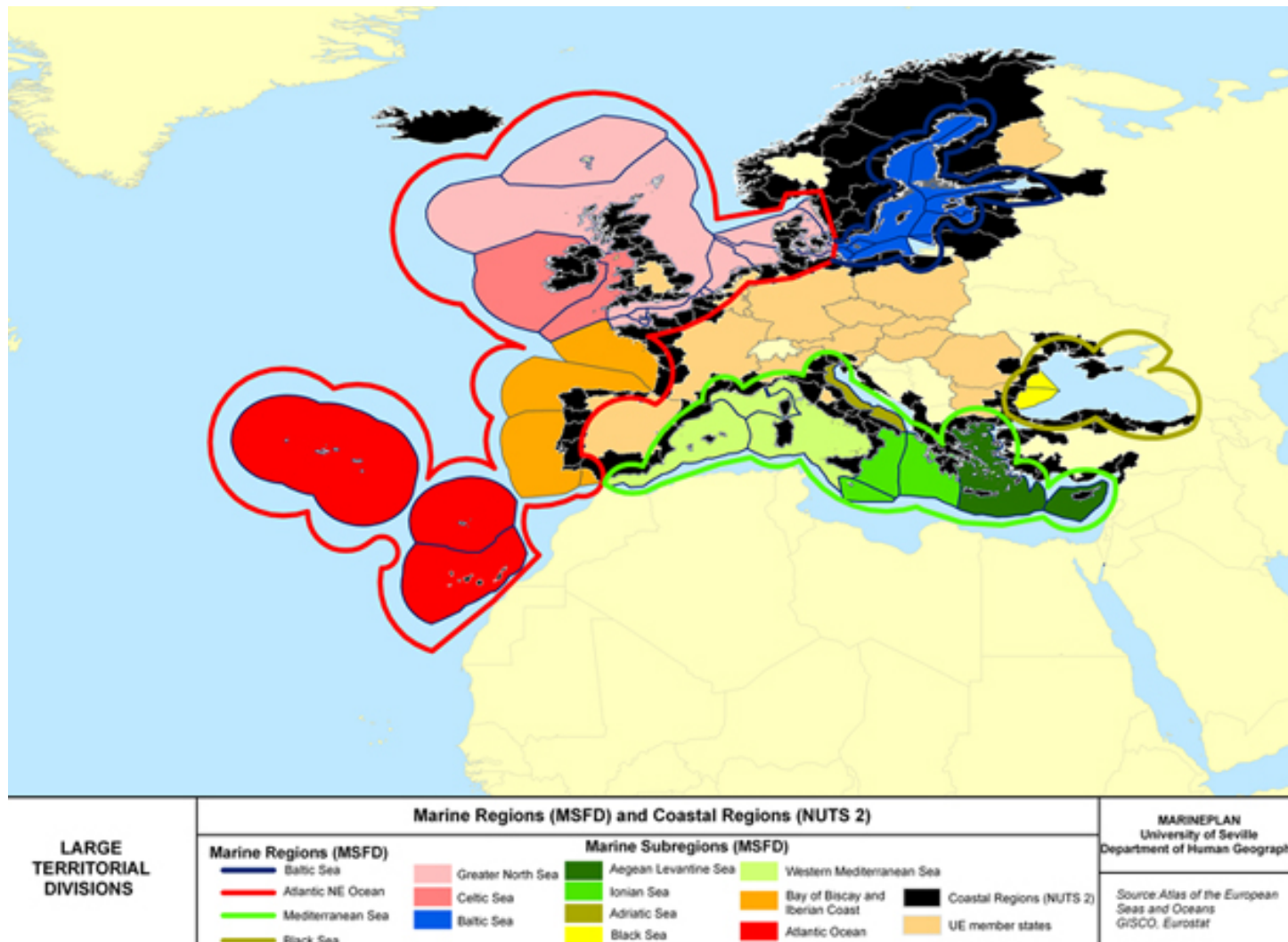


- *The Bucharest Convention on the Protection of the Black Sea against Pollution*

- *The Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea*



- *The OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic*

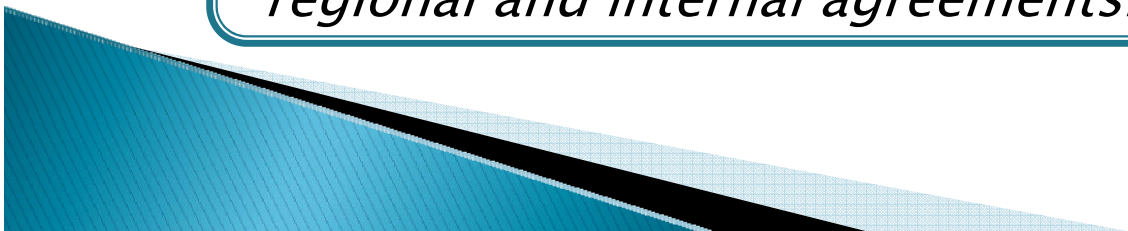


The EU shares the responsibility for the management of the regional seas with non-EU countries such as the 12 countries in the Mediterranean Sea and 4 countries in the Black Sea..

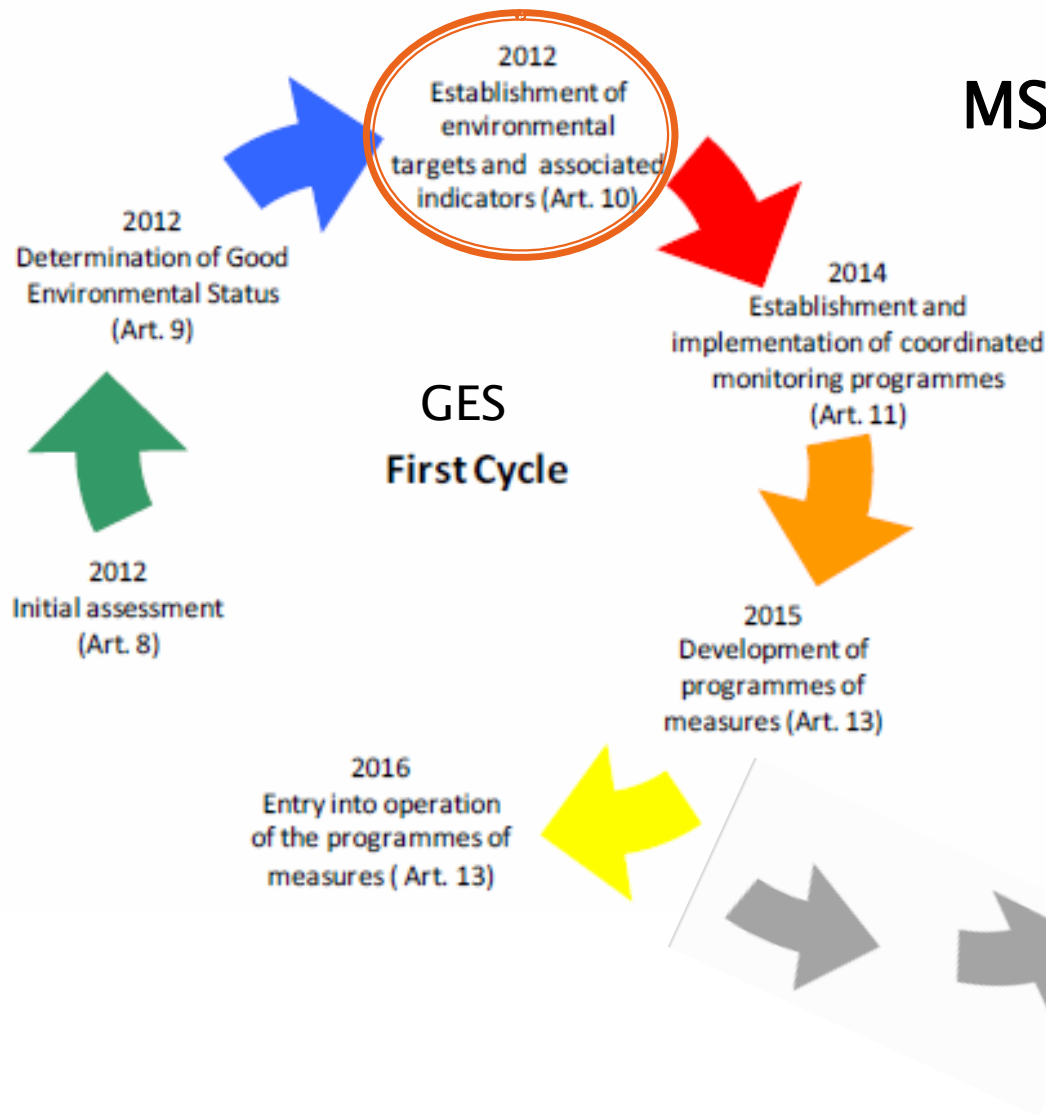
Link to existing legislation

- ▶ Water Framework Directive (WFD, 2000/60/EC)
- ▶ Habitats Directive (HD, 92/43/EEC)
- ▶ Birds Directive (BD, 2009/147/EC)
- ▶ Nitrates Directive (ND, 91/676/EEC)
- ▶ Dangerous Substances Directive (as amended 2006/11/EC)
- ▶ Shellfish Waters Directive (2006/113/EC)
- ▶ Bathing Waters Directive (2006/7/EC)

MSFD establishes a regulatory structure that is intended to bind together a broad range of EU secondary legislation, regional and internal agreements..



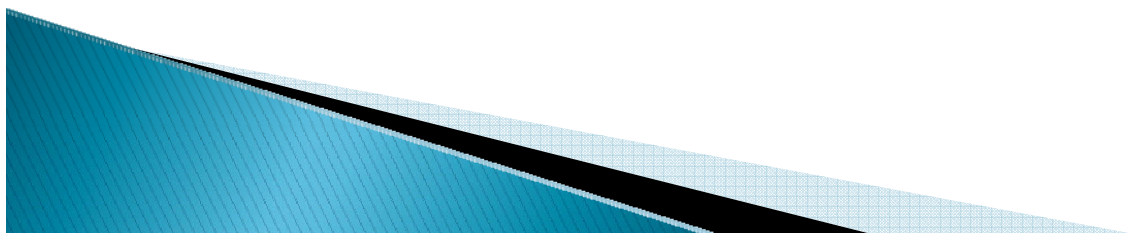
MSFD management cycle

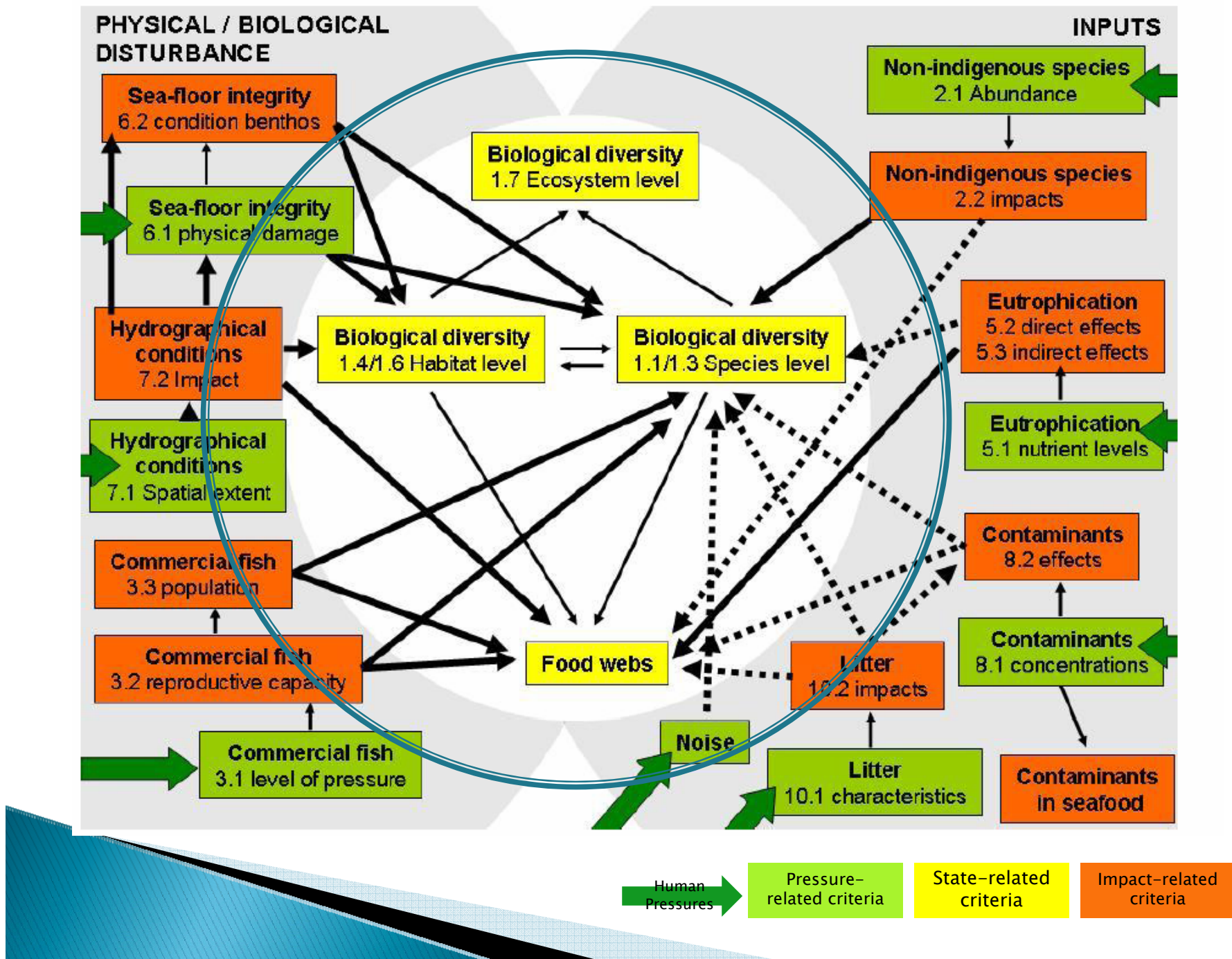


Good environmental status shall be determined at the level of the marine region or subregion... on the basis of the qualitative descriptors in Annex I.

For each qualitative descriptor, there are a number of defined criteria for assessing progress towards GES and related indicators

(COM Decision 2010/477/EU)





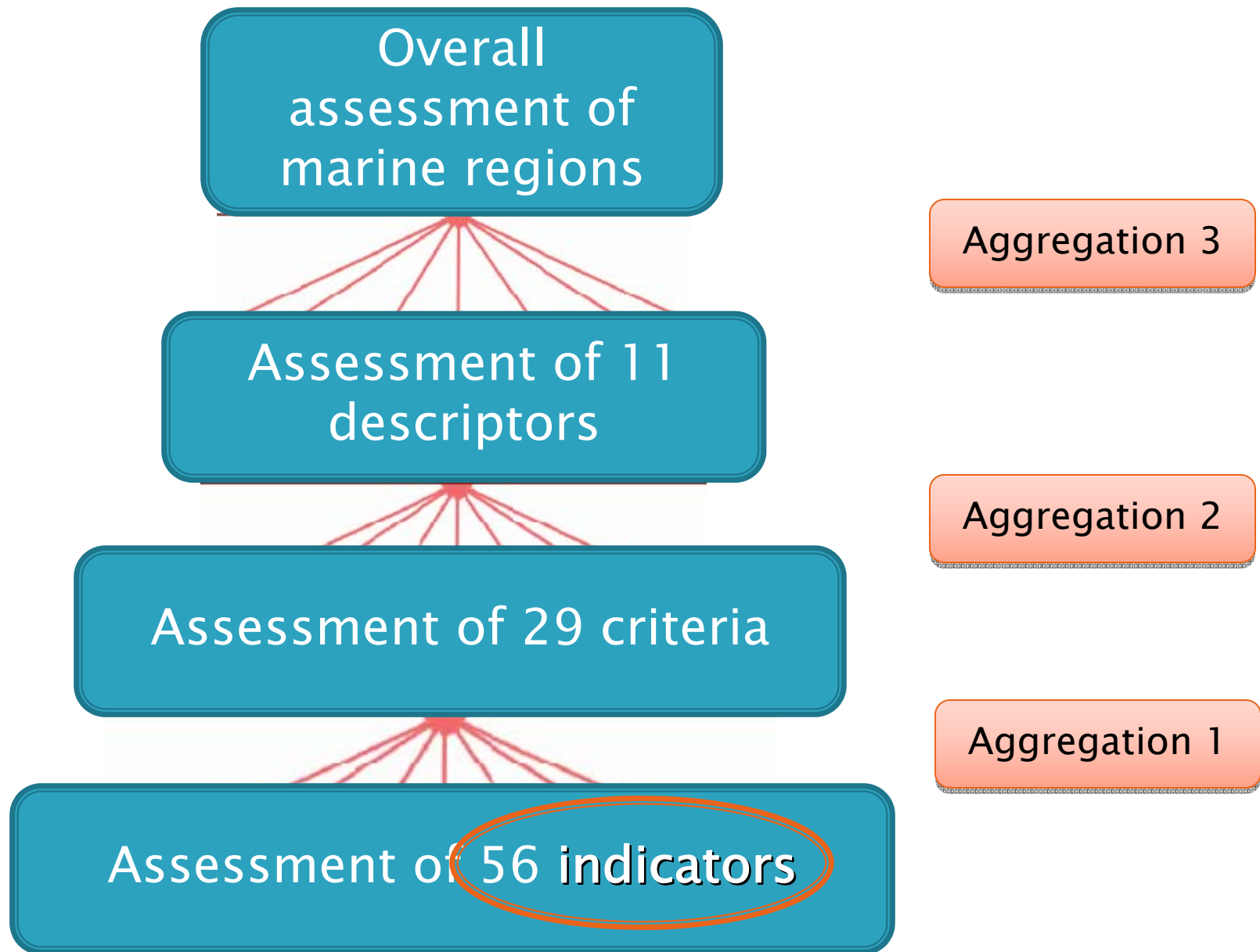
Some important references

- ▶ **Marine Strategy Framework Directive**
 - Directive 2008/56/EC of the European Parliament and of the council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy



Some important references

- ▶ Marine Strategy Framework Directive
 - Directive 2008/56/EC of the European Parliament and of the council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy
- ▶ Task group reports on criteria & methodological standards for MSFD descriptors
- ▶ **Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (2010/477/EU)**
- ▶ **Commission Staff Working Paper on Relationship between the initial assessment of marine waters and the criteria for good environmental status (SEC(2011)1255)**



Modified from Krause et al., 2011

Descriptor	Criteria	Indicators
1. Biodiversity	7	14
2. Non-indigenous species	2	2
3. Commercially exploited fish and shellfish	3	8
4. Food webs	3	3
5. Eutrophication	3	8
6. Seafloor integrity	2	6
7. Hydrographical conditions	2	3
8. Contaminants	2	3
9. Contaminants in fish and other seafood	1	2
10. Marine Litter	2	4
11. Energy/Noise	2	2

Criteria & Indicators

Comm. Decision 2010/477/EU

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 climate conditions.

Criteria	Indicators
1.1 Species distribution	1.1.1 Distributional range 1.1.2 Distributional pattern 1.1.3 Area covered by the species (for sessile/benthic species)
1.2 Population size	1.2.1 Population abundance and/or biomass
1.3. Population condition	1.3.1 Population demographic characteristics 1.3.2 Population genetic structure, where appropriate
1.4. Habitat distribution	1.4.1 Distributional range 1.4.2 Distributional pattern
....

Criteria & Indicators

Comm. Decision 2010/477/EU

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.

Criteria	Indicators
4.1. Productivity (production per unit biomass) of key species or trophic groups	4.1.1 Performance of key predator species using their production per unit biomass (productivity)
4.2. Proportion of selected species at the top of food webs	4.2.1 Large fish (by weight)
4.3. Abundance/distribution of key trophic groups/species	4.3.1 Abundance trends of functionally important selected groups/species

Criteria & Indicators

Comm. Decision 2010/477/EU

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.

Criteria	Indicators
5.1 Nutrients levels	5.1.1 Nutrients concentration in the water column 5.1.2 Nutrient ratios (silica, nitrogen and phosphorus), where appropriate
5.2 Direct effects of nutrient enrichment	5.2.1 Chlorophyll concentration in the water column 5.2.2 Water transparency related to increase in suspended algae, where relevant 5.2.3 Abundance of opportunistic macroalgae 5.2.4 Species shift in floristic composition such as diatom to flagellate ratio..
5.3 Indirect effects of nutrient enrichment	5.3.1 Abundance of perennial seaweeds and seagrasses... 5.3.2 Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned

Criteria & Indicators

Comm. Decision 2010/477/EU

Descriptor 8 Concentrations of contaminants are at levels not giving rise to pollution effects

Criteria	Indicators
8.1. Concentration of contaminants	8.1.1 Concentration of the contaminants measured in the relevant matrix (such as biota, sediment and water) in a way that ensures comparability with the assessments under Directive 2000/60/EC
8.2. Effects of contaminants	<p>8.2.1 Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored</p> <p>8.2.2 Occurrence, origin (where possible), extent of significant acute pollution events (e.g. slicks from oil and oil products) and their impact on biota physically affected by this pollution</p>

Criteria & Indicators

Comm. Decision 2010/477/EU

Descriptor 10 Properties and quantities of **marine litter** do not cause harm to the coastal and marine environment.

Criteria	Indicators
10.1 Characteristics of litter in the marine and coastal environment	10.1.1 Trends in the amount of litter washed ashore and/or deposited on coastlines... 10.1.2 Trends in the amount of litter in the water column (including floating at the surface) and deposited on the sea-floor... 10.1.3 Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro-plastics)
10.2. Impacts of litter on marine life	10.2.1 Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis)

Criteria & Indicators

Comm. Decision 2010/477/EU & Comm. Staff Working Paper SEC(2011)1255)

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 climate conditions.

Criteria	Indicators
1.1 Species distribution	1.1.1 Distributional range 1.1.2 Distributional pattern within the latter, where appropriate 1.1.3 Area covered by the species (for sessile/benthic species)
1.2 Population size	1.2.1 Population abundance and/or biomass, as appropriate
1.3. Population condition	1.3.1 Population demographic characteristics 1.3.2 Population genetic structure, where appropriate
1.4. Habitat distribution	1.4.1 Distributional range 1.4.2 Distributional pattern
....

Pressure

State

Impact

2. Indicator Development

Criteria & Indicators

Comm. Decision 2010/477/EU & Comm. Staff Working Paper SEC(2011)1255)

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.

Criteria	Indicators
5.1 Nutrients levels	5.1.1 Nutrients concentration in the water column 5.1.2 Nutrient ratios (silica, nitrogen and phosphorus), where appropriate
5.2 Direct effects of nutrient enrichment	5.2.1 Chlorophyll concentration in the water column 5.2.2 Water transparency related to increase in suspended algae, where relevant 5.2.3 Abundance of opportunistic macroalgae 5.2.4 Species shift in floristic composition such as diatom to flagellate ratio..
....

Pressure

State

Impact

Criteria & Indicators

Comm. Decision 2010/477/EU & Comm. Staff Working Paper SEC(2011)1255)

Descriptor 10 Properties and quantities of **marine litter** do not cause harm to the coastal and marine environment.

Criteria	Indicators
10.1 Characteristics of litter in the marine and coastal environment	10.1.1 Trends in the amount of litter washed ashore and/or deposited on coastlines... 10.1.2 Trends in the amount of litter in the water column (including floating at the surface) and deposited on the seafloor... 10.1.3 Trends in the amount, distribution and, where possible, composition of micro-particles (in particular microplastics)
10.2. Impacts of litter on marine life	10.2.1 Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis)

Monitoring parameters

Descriptor 1: Biological Diversity

MSFD indicators	WFD ¹	HD ²	BD ³	CFP ⁴	EQS	RSCs
1.1.1 Distributional range	X	X		X		
1.1.2 Distributional pattern within the latter, where appropriate						
1.1.3 Area covered by the species (for sessile/benthic species)	X					HELCOM Black Sea
1.2.1 Population abundance and/or biomass, as appropriate	X		X	X		HELCOM Black Sea
1.3.1 Population demographic characteristics (e.g. body size or age class structure, sex ratio, fecundity rates, survival/mortality rates)		X		X		HELCOM
1.3.2 Population genetic structure, where appropriate						
1.4.1 Distributional range		X				
1.4.2 Distributional pattern						
1.5.1 Habitat area		X	X			
1.5.2 Habitat volume, where relevant		X	X			
1.6.1 Condition of the typical species and communities ⁵	X	X	X	X		HELCOM Black Sea
1.6.2 Relative abundance and/or biomass, as appropriate ⁶	X	X	X	X		HELCOM Black Sea
1.6.3 Physical, hydrological and chemical conditions	X		X		X	OSPAR HELCOM Mediterranean
1.7.1 Composition and relative proportions of ecosystem components (habitats and species) ⁷	X					

Zampoukas et al., 2012

1: only for some species/groups and only in coastal waters



Monitoring parameters

Descriptor 5: 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	X					OSPAR, HELCOM

Zampoukas et al., 2012



Monitoring parameters

Descriptor 10: Marine Litter



MSFD indicators	WFD	HD	BD	CFP	EQS	RSCs
10.1.1 Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source						OSPAR, HELCOM
10.1.2 Trends in the amount of litter in the water column (including floating at the surface) and deposited on the seafloor, including analysis of its composition, spatial distribution and, where possible, source						
10.1.3 Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro-plastics)						
10.2.1 Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis)						OSPAR ¹⁴

14: Developed for one indicator species only which applies to most parts of the North East Atlantic.

Zampoukas et al., 2012

The next step towards achieving good environmental status should be the establishment of environmental targets and monitoring programmes for ongoing assessment...

Environmental targets

- ▶ *‘...a qualitative or quantitative statement on the **desired condition** of the different components of, and pressures and impacts on, marine waters in respect of each marine region or subregion’*
- ▶ set directly in relation to the 11 Descriptors and their related criteria and indicators



Environmental targets



► Types

◦ State-based

- indication of physical, chemical or biological condition
- mostly relevant to Descriptors Biodiversity (D1), Commercial Fish & shellfish (D3), Food webs (D4) and Seafloor integrity (D6)
- *e.g. 'At least 30% of fish (by weight) should be greater than 40 cm in length' (OSPAR, EcoQO)*

◦ Pressure-based

- articulate the desired or acceptable level of a particular pressure which would not prevent the achievement or maintenance of GES
- more easily related to management measures
- *e.g. 'Fishing mortality is at levels consistent with MSY'*

Environmental targets



► Types

◦ Impact-based

- indication of the acceptable level of impact on components of the marine environment arising from a particular/range of pressures
- *e.g. 'Annual by-catch of harbour porpoises should be reduced to below 1.7% of the best population estimate'*

◦ Operational

- allow for the assessment of progress towards full implementation of a specific measure
- *e.g. 'to reduce by 2021 the input of nitrogen and phosphorus by x tonnes' (HELCOM Baltic Sea Action Plan)*

Descriptor 5: Human-induced eutrophication is minimised,....

GES descriptors:
High level,
generic across Europe

5.1 Nutrients levels
5.2 Direct effects of nutrient enrichment
5.3 Indirect effects of nutrient enrichment

GES Criteria:
Characteristics of
what GES means in each MS

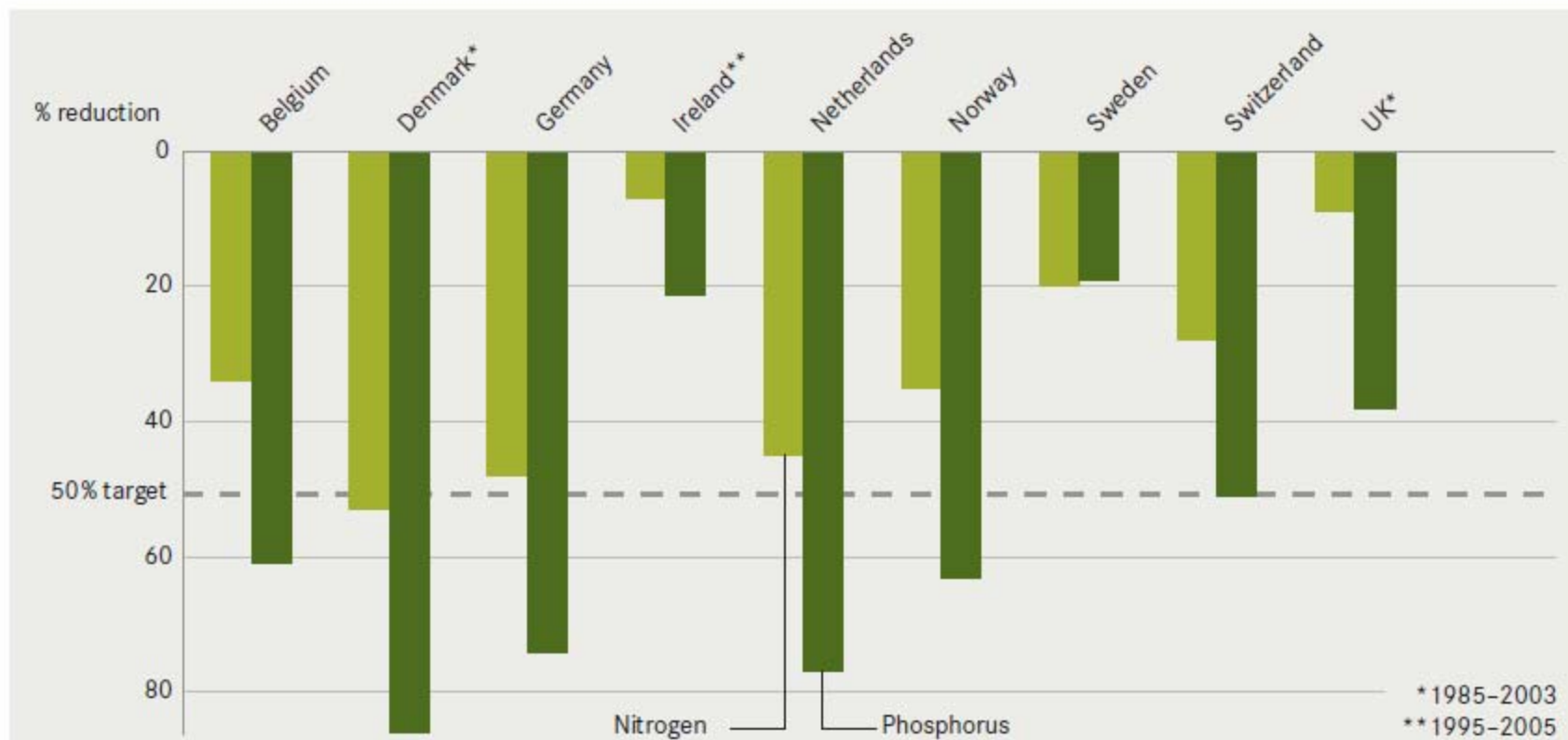
Targets:

- Further reduce riverine inputs of nutrients
- Reduce nutrient inputs via long-range transport from other marine areas
- Further reduce atmospheric inputs of nutrients

Indicators:

- Nutrient concentrations at the transition from freshwater to marine environment in the river mouth
- Spatial distribution of nitrogen and phosphorus in sea water
- Emissions of nitrogen species
- Deposition of nitrogen species on the sea surface

*GES Targets
& Indicators:*
If targets are met,
GES should be achieved



Reduction of discharges and losses of N and P to problem areas reported for 2005 relative to 1995. It is not possible to compare directly the reductions achieved by OSPAR countries owing to differences in periods over which the reduction measures were applied and different methods to calculate reductions.

Descriptor 10: Marine litter
does not cause harm to the
coastal and marine
environment

GES descriptor:
High level,
generic across Europe

10.1 Characteristics of litter in the
marine and coastal environment
10.2 Impacts of litter on marine life
means in each MS

GES Criteria:
Characteristics of
what GES means in each MS

Targets:

- X % of overall reduction in the volume of litter
- Less than 10 % of sea birds having more than 0.1 g plastic particles in their stomach

Indicators:

- Trends in the amount of litter washed ashore and/or deposited on coastlines
- Trends and composition of micro-particles (in particular micro-plastics)

*GES Targets
& Indicators:*
If targets are met,
GES should be achieved

Maritime indicators

- ▶ Maritime activities as a cross-cutting issue
- ▶ Initial assessment also includes an economic and social analysis of the use and of the cost of degradation of the marine environment
- ▶ Strongly linked to socio-economic activities
 - shipping, ports
 - offshore wind energy
 - coastal tourism
- ▶ Focus on Drivers of DPSIR

Maritime Indicators

- ▶ What are the **socio-economic benefits** provided by maritime and coastal activities?
- ▶ What are the **environmental costs** (pressures) associated with activities?
- ▶ What are the **cumulative pressures** arising from maritime and coastal activities?
- ▶ How do these questions differ/compare across **MSFD marine regions**?

Link to GES Descriptors

Ecologic, Germany
Author: Manuel Lago

MSFD Descriptor		Maritime & coastal activities
1.	Biodiversity	<i>Shipping; ports; tourism and recreation;</i>
2.	Marine invasive species	<i>Shipping; aquaculture; tourism and recreation</i>
3.	Fisheries	<i>Fisheries</i>
4.	Food web	<i>Fisheries</i>
5.	Eutrophication	<i>Shipping; tourism; oil and gas production; waste water treatment</i>
6.	Seafloor integrity	<i>Fisheries; shipping and; tourism and recreation; coastal infrastructure; marine aggregates</i>
7.	Hydrography	<i>Coastal infrastructure</i>
8.	Contaminants	<i>Shipping and ports</i>
9.	Contaminants in fish and seafood for human consumption	<i>Shipping and ports; tourism and recreation</i>
10.	Marine litter	<i>Shipping and ports; fisheries; aquaculture; tourism and recreation</i>
11.	Noise	<i>Shipping and ports; fisheries; offshore wind energy production; oil and gas production; dredging</i>

Shortcomings

- ▶ Indicator development
 - difficult to find indicators which are directly linked to a descriptor and to management measures
 - different indicators require different spatial & temporal scales
 - biodiversity, food web versus seafloor integrity and eutrophication
 - collection of marine data is expensive
 - use indicators which can be based on existing data collection programmes
 - use of different types of targets (S,P,I..)
 - coherence required for determining GES and establishing targets at regional/sub regional level
 - insufficient knowledge about marine ecosystems

Need for research

- ▶ Coherent and holistic assessment of GES
 - improved scientific knowledge
- ▶ Limited knowledge on a number of indicators
 - noise, hydrography..
 - cumulative pressures & impacts
- ▶ EU research programme to address these knowledge gaps
 - e.g. PERSEUS

Way forward

- Basis of GES assessment
- Structured/systematic but complex process
- Complex issues/knowledge gaps
- Requires streamlining at 3 levels
National => Regional => European

► Follow-up actions

- Inventory of
- Identification of
 - incl. in a
- Proposals for



MSFD phases & actions	Timing
Assessment of GES in EU waters	2012
Determination of GES	2012
Establish appropriate targets & associated indicators	2012
Establish monitoring programmes	2014
Development of programme of measures	2015
MSFD implementation	2016–2020
Achievement of GES	2020



Questions?

Thanks you
for your attention!

claudette.spiteri@deltares.nl