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Saltmarshes ecological assessment methods

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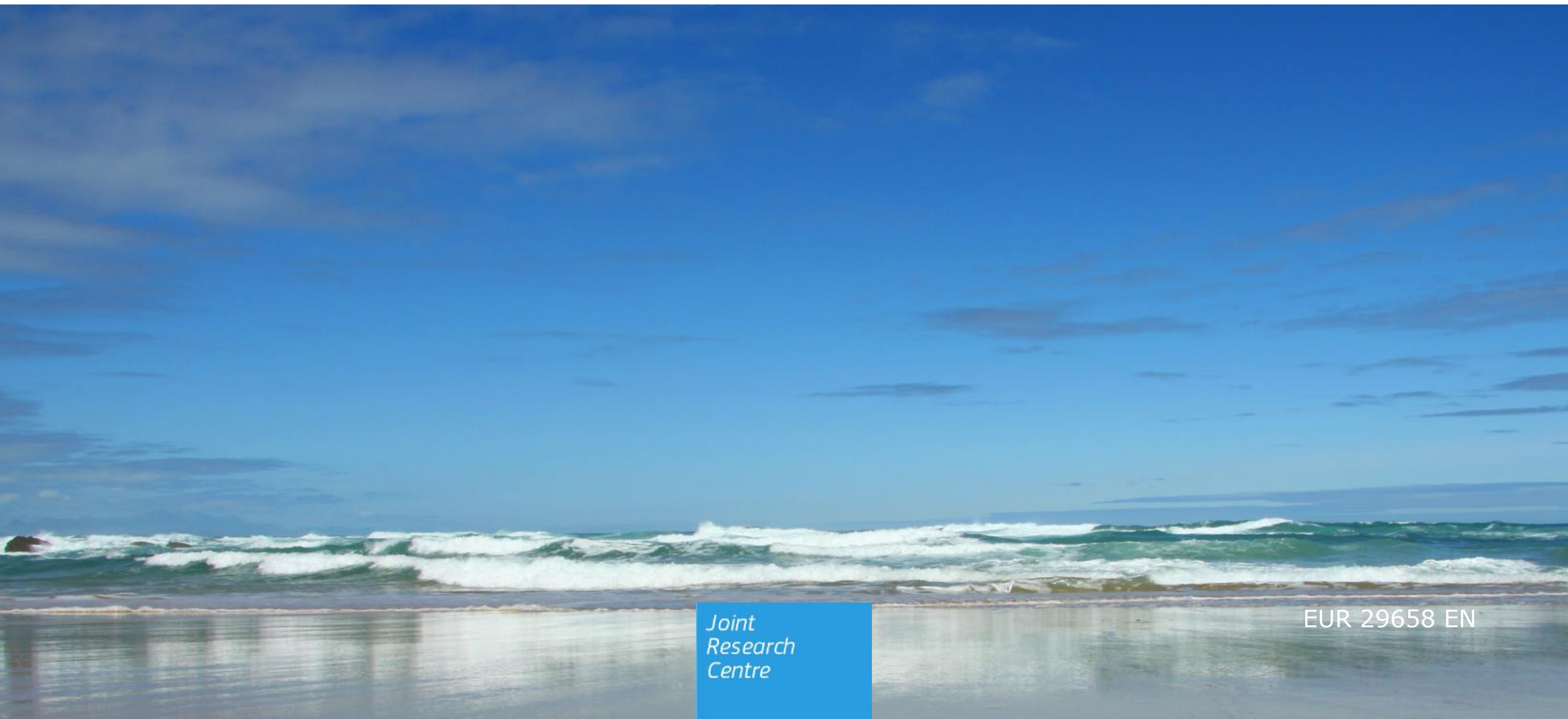

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Abstract

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

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

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

Introduction

This report constitutes a technical description of the Intercalibration Exercise – Phase 3 (IC3) implemented for SALTMARSH, a sub-element of the Biological Quality Element (BQE) ANGIOSPERMS. It reports the results achieved both for Coastal Waters (CW) (NEA 1/26) and Transitional Waters (TW) (NEA 11) in the North East Atlantic Geographical Intercalibration Group (NEA-GIG). The intention is to fulfil gaps and weaknesses identified by the working group in the previous phase, and to contribute to the full acceptance by ECOSTAT of results obtained for the BQE Saltmarsh during this IC. The report is not a full and detailed description of the Intercalibration process, but it compiles important issues and parts from documents produced during early intercalibration phases, which are needed to support either a better understanding of the issues identified as problematic in previous stages as the justification of the decisions taken during the present exercise.

From the previous phase, the main conclusion regarding CW was that intercalibration of saltmarshes within DE, NL and UK (although requiring arrangements between different CW types involved, NEA 1/26 and NEA 3/4) would be probably feasible. Although the involved assessment methods were different, the response they showed against some pressure types (e.g., landclaim, shoreline reinforcement, maintenance dredging, or different combinations of these indices) was similar. Pressure indices were calculated based on the approach suggested by Aubry and Elliot (Aubry and Elliott, 2006).Those relationships were, as expected, negatively correlated but no significant results were found due to the low number of existing data points. To overcome this difficulty, different common metrics were tested (saltmarsh extent, Shannon diversity, mean value between the previous two metrics) but the impossibility of measuring the relationship between those and the pressure amount affecting the systems forced the approach to be rejected by the ECOSTAT experts.

For the TW exercise, seven MS were involved (BE, DE, ES, IE, NL, PT and UK), and a similar approach to the CW was followed there. The response of different methods to some pressure indicators was not always similar, weak correlations were found but also the opposite to expect were obtained. The lack of good correlations was attributed to the low number of data points (one WB corresponds to one data point) and to the deficient amount and quality of pressure data available.

Along the present document the main results, discussions and considerations, possible at the moment, are presented for the sub-BQE SALTMARSH. The two water categories (CW and TW) were tested separately, although a combined (CTW) data analysis is also supplied as supplement (Annex 1).

Part A. Coastal waters

A.1 Geographical scope and participation of Member States

The exercise for sub-BQE saltmarsh in CW category included the participation of four European Member States, covering essentially the northern coastal latitudes (Germany, Ireland, the Netherlands and United Kingdom). Four distinct methodologies (EM-DE, SMAATIE –IE, TSM-NL and SM-UK) were proposed for intercalibration (Table I) The participating MS share not only the presence of saltmarshes in their open coastal waters, but they also considered it as an ecologically meaningful BQE, and so an important key on the assessment of the ecological quality of their waterbodies. For this reason (low significant expression when compared to other BQE) other MS were not participating in the CW exercise.

Table 1 Member States participating in IC3, assessment method and references

Member state	**Method**	**References**
DE - Germany	EM = Assessment of saltmarsh vegetation in coastal and transitional waters	- WISER ID: 130 - Adolph and Arens, 2011.
IE - Ireland	SMAATIE = Saltmarsh Angiosperm Assessment Tool for Ireland	- No WISER ID yet - Devaney and Perrin, 2013.
NL- The Netherlands	TSM = WFD-metrics for natural watertypes: tidal salt marsh	- WISER ID: 259 - Dijkema et al., 2005.
UK- United Kingdom	SM = UK Saltmarsh Tool	- No WISER ID yet - UKTAG, 2013.

A.2 Description of national assessment methods

A.2.1 Methods and required parameters

As explained below, not all assessment methods were considered until the end of this intercalibration exercise due to inconsistencies within the required criteria. However, the different methodologies participating initially in the exercise for saltmarsh CW may be briefly described as follows.

EM - Assessment of saltmarsh vegetation in coastal and transitional waters (DE)

In the coastal waters (CW) and the outer ranges of the transitional waters (TW) saltmarshes are assessed using the parameters "brackish and saltmarsh area" and "vegetation zonation" (Arens, 2006; 2009a; 2009b), addressing, respectively, the quantity and quality aspects of saltmarsh vegetation, and covering the "abundance" and "taxonomic composition" requirements mentioned in WFD. Data are gathered from aerial photos and field mapping (GPS), and the assessment for CW is based on the extent of saltmarsh area (percentage of saltmarsh area of the whole water body) compared to historical references and on the relative extent of vegetation zones (percentage of zones of the whole saltmarsh area). The overall EQR value is obtained by calculating the mean of the mentioned metrics without any additional weighting (Adolph and Arens, 2011).

In general the ecological status has been evaluated only in HMWB (heavily modified water bodies), the ecological potential was assessed.

SMAATIE - Saltmarsh Angiosperm Assessment Tool for Ireland (IE)

The ecological status classifications for angiosperms is based in three key elements of the angiosperms: taxonomic composition, angiosperm abundance and disturbance sensitive taxa. In this context these three key elements were translated as saltmarsh zonation (taxonomic composition), saltmarsh extent (angiosperm abundance) and presence of halophytes (disturbance-sensitive taxa). In total five metrics are used: a) saltmarsh extent as a proportion of the reference area; b) proportion of saltmarsh zones present (taxonomic composition); c) proportion of saltmarsh area covered by the dominant saltmarsh zone (taxonomic composition); d) proportion of saltmarsh composed of *Spartina* (taxonomic composition); and e) proportion of observed taxa to 15 taxa (disturbance-sensitive taxa) (Devaney and Perrin, 2013).

Metrics concerning saltmarsh area (e.g., saltmarsh extent, proportion of saltmarsh area, proportion of dominant vegetation zone or non-native *Spartina*) may use mapping information, satellite imagery and field trip confirmation, to compare current data (e.g., GIS polygons) with reference conditions defined under reliable previous measurements. The halophytic vegetation of saltmarshes can be classified as disturbance sensitive taxa. Significant anthropogenic effects on these stressors can lead to shifts in species composition, or even loss of plant communities. The diversity of saltmarsh taxa compares the registered taxa against a reference value of 15 common saltmarsh halophytes species.

The overall EQR is calculated with the attribution of different weighting for combining the metrics. The sum of the weighted scores, saltmarsh extent (x3), proportion of saltmarsh zones (x1), proportion of dominant saltmarsh zone (x0.5), proportion of *Spartina* area (x0.5), and the proportion of halophytes (x1), is then divided by 6 to provide the final EQR (Devaney and Perrin, 2013).

TSM - WFD-metrics for natural watertypes: tidal salt marsh (NL):

The Dutch assessment procedure comprises two metrics: condition acreage (area) and condition quality (zonation) (Dijkema et al., 2005). The saltmarsh area (abundance) within each water body was assessed based on the extent of saltmarsh area compared against historical references, and, as saltmarshes support a limited number of species and these species define vegetation zones, saltmarsh species (taxonomic composition) were assessed as the relative extent of vegetation zones (and not as species separately). Data are collected using aerial photographs, ground truth and a fixed typology (TMAP/SALT). The overall EQR value is obtained through the calculation of the mean between quality and quantity metrics, without weighting.

SM - UK Saltmarsh Tool (UK)

The UK methodology includes six components in its assessment tool (UKTAG, 2013). They are: a) the saltmarsh extent as a proportion of "historic saltmarsh"; b) the saltmarsh extent as a proportion of the intertidal area available; c) the change in saltmarsh extent over two or more time periods; d) the proportion of saltmarsh zones present in the marsh; e) the proportion of saltmarsh area covered by the dominant saltmarsh zone; and f) the proportion of observed taxa to historical reference value or the proportion of observed taxa from a standard checklist. The metrics concerning saltmarsh area (e.g., proportion of historical area, of intertidal area, 6-year extent trend, proportion of dominant vegetation zone) use mapping information, satellite imagery and field truthing, to compare current data with reference conditions defined by reliable previous measurements. Concerning the zonation metrics, five zones were defined, and its number is compared to the reference number of zones defined for the site: a) pioneer (with *Salicornia* etc.); b) *Spartina*-dominated marsh; c) mid-low (with *Atriplex* [*portulacoides*] and *Puccinellia* [*maritima*]); d) high (with *Festuca rubra*, *Elytrigia* [*atherica* or *repens*], *Bolboschoenus* and *Juncus* [*maritimus*]); e) brackish reed beds (*Phragmites*). The diversity of saltmarsh taxa compares the registered taxa against one of two reference values (historical reference list or a reference value of 15 saltmarsh species).

The overall EQR is calculated with the attribution of different weighting for combining the metrics, lesser weighting (x0.5) is applied to metrics saltmarsh extent relative to the intertidal area, proportion of saltmarsh zones present in the marsh, and the proportion of observed taxa to historical reference. The metrics saltmarsh extent as a proportion of "historic saltmarsh", and the proportion of saltmarsh area covered by the dominant saltmarsh zone have a weighting of x1 and the sum of all metric scores is then divided by 4 (UKTAG, 2013).

A.2.2 Compliance of national assessment methods

During the previous IC exercise, following the WFD compliance checking criteria, it was produced a list of compliance checking results for the used methodologies. That list was updated with new methods and methods evolutions as shown in table II. For a detailed consult of assessment tools see description of methods submitted with this report.

Table 2. Criteria used for checking compliance of differente methodologies particpating in IC3, and compliance results.

Compliance criteria	Compliance checking conclusions
Ecological status is classified by one of five classes (high, good, moderate, poor and bad).	Yes for DE, IE, NL, UK
High, good and moderate ecological status are set in line with the WFD's normative definitions (Boundary setting procedure)	Yes for DE, IE, NL, UK
All relevant parameters indicative of the biological quality element are covered (see Table 1 in the IC Guidance). A combination rule to combine parameter assessment into BQE assessment has to be defined. If parameters are missing, Member States need to demonstrate that the method is sufficiently indicative of the status of the QE as a whole.	Yes for DE, IE, NL, UK*
Assessment is adapted to intercalibration common types that are defined in line with the typological requirements of the WFD Annex II and approved by WG ECOSTAT	Yes for DE, IE, NL, UK
The water body is assessed against type-specific near-natural reference conditions	No for DE, IE, NL, UK RC defined mostly based on historical data, expert judgment and estimated as potential value for some metrics
Assessment results are expressed as EQRs	Yes for DE, IE, NL, UK
Sampling procedure allows for representative information about water body quality/ ecological status in space and time	Yes for DE, IE, NL, UK
All data relevant for assessing the biological parameters specified in the WFD's normative definitions are covered by the sampling procedure	Yes for DE, IE, NL, UK
Selected taxonomic level achieves adequate confidence and precision in classification	Yes for DE, NL, UK**

* Abundance is represented by saltmarsh extent (ie the area of the beds). There are no specific disturbance sensitive species in CW saltmarsh, it is rather the structure of the saltmarsh that is sensitive to hydromorpological disturbance. Hence, the disturbance representative taxa parameter is taken to the level of the different zones in the saltmarsh since they reflect the successfulness of its ecological functioning.
** Taxonomic level considered in NL and DE is saltmarsh zone; UK also looks at species representation within each zone. Definitions of zones differs between MS.

The process was conducted trying to cover the weaknesses detected and to fulfil the recommendations and conclusions achieved by the experts working group during the IC2. At that time it was concluded that:

1. all methods are in compliance with WFD requirements on condition that extent of saltmarsh beds is accepted as parameter for ABUNDANCE and representation of salt

marsh zones or vegetation types as parameter for taxonomic composition and disturbance sensitive taxa;

2. reference conditions are not available from near natural conditions but were defined from a combination of historical data and expert judgement. UK did not define reference conditions for its method but derived a combination rule for parameter assessment with a maximum score by expert judgement;

3. saltmarsh EQR is assessed at the level of the water body, this might cause problems with statistical power for intercalibration.

All CW methodologies were maintained or suffered developments from IC2 to turn them more robust, keeping earlier characteristics, assessment concepts, metrics and combination rules in agreement with WFD requirements, then meaning that results from the compliance checking process could be considered valid for the present IC phase. The new methodologies followed the same criteria and achieved similar results.

A.2.3 National reference conditions

Along the European coast is difficult to find areas where, in some how, the anthropogenic pressure is not present. The absence of abundant data of real undisturbed sites and also the lack of historical data reporting to those conditions, made member states to use different (or a combination of) alternative approaches to derive reference conditions (expert knowledge, best available conditions, modelling). Those methods are described in Table III. From IC 2 it was also identified that ..."except for 2 very small WB in UK (Milford Haven and Farne Islands), which are not representative for the rest of the CWB, and the Wattenmeer der Weser in DE, which is under high natural stress from the long fetch, there are no nearly unimpacted sites in the database." From this, reference conditions were mostly defined based on best available historical data and expert judgment.

Table 3. Criteria used to define national reference conditions, methodology used, location and number of sites identified by different member states participating in IC 3.

Member State	Methodology used to derive reference conditions	Number of reference sites	Location of reference sites	Criteria use for selection of reference sites
DE	Situation in 1860 for areal extent; Expert judgement for vegetation zonation	There are no true reference sites		Absence of eutrophication; mechanical and hydromorphological disturbance within the natural scale
IE	Expert knowledge, Least Disturbed Conditions, historical conditions	There are no true reference sites		N/A
NL	Expert knowledge, Historical data	There are no true reference sites		No sharp division between water bodies (no dykes), allowing exchange of water between water bodies; presence of tidal salt marshes and flood plains; cyclic development of habitat types due to disturbance caused by natural processes; presence of seagrass meadows. No reference sites availably for the Netherlands.
UK	Expert knowledge, Least Disturbed Conditions, historical conditions	There are no true reference sites		N/A

A.2.4 National boundary setting

Mainly due to the reduced amount of data relating the response of saltmarshes, and the species comprised in this Ecological Quality Element, against the variation of different pressure indicators, it has been difficult to identify the exact ecological value that corresponds to a specific disturbance levels that induces to changes in the community. To overcome this difficulty, MSs have adopted mostly to set the boundaries as equidistant values inside the EQR scale (Table IV), which could suffer adjustments during the IC.

Table 4. Boundaries setting protocol

Member State	Specific approach for H/G boundary	Specific approach for G/M boundary	BSP; data for setting; tested against pressure
DE	Expert judgement (Equidistant boundaries)	Expert judgement (Equidistant boundaries)	Equidistant division of the EQR gradient (after normalisation of sub metrics); Best available historical data; No pressure relationship tested
IE	Expert judgement (Equidistant boundaries)	Expert judgement (Equidistant boundaries)	Equidistant division of the EQR gradient (after normalisation of sub metrics); Best available historical data; No pressure relationship tested
NL	Expert judgement (Equidistant boundaries)	Expert judgement (Equidistant boundaries)	Equidistant division of the EQR gradient (after normalisation of sub metrics); Best available historical data; No pressure relationship tested
UK	Expert judgement (Equidistant boundaries)	Expert judgement (Equidistant boundaries)	Equidistant division of the EQR gradient (after normalisation of sub metrics); Best available historical data; No pressure relationship tested

A.3 Results IC Feasibility checking

A.3.1 Typology

The relevant Northeast Atlantic types are shown in the table V. From IC2, the first impression was that feasibility in terms of typology would be probably possible for DE, NL, UK (IE was not participating in IC2). Also that differences between the NEA types for which the methods were appropriate related mainly to salinity. From that, and to avoid dispersion of existing data, was assumed in this exercise that all types (CW 1/26 and NEA3/4) should be analysis together under the same CW category. National types were all included in the mentioned common type.

Table 5. Typologies involved in this Ic exercise, Common types and related national types.

Member State	Common IC type	National types
DE	NEA 1/26 and NEA 4	N2 and N4
IE	NEA 1/26	
NL	NEA 4 and NEA3	K2
UK	NEA 1/26	CW1, CW2, CW4, CW5, CW7, CW8

A.3.2 Assessment concept

In terms of assessment concept, this was also verified during IC2 (Table VI). There were differences between assessment methods and data processing, but it was considered as possible, however, to calculate some common metrics based on a common dataset, so the following results were identified at that time as common to different methodologies:

1. all methods consider extent of saltmarsh relative to an historical reference situation as parameter for abundance;

2. all methods consider relative distribution of zones within the saltmarsh as parameters for disturbance sensitive taxa.

Table 6. Description of assessment concepts of different methodologies participating in IC3 and feasibility results

Method	Assessment concept
DE – EM	Based on extent of saltmarsh area compared to historical reference and relative extent of vegetation zones for CW Gathered by aerial photos and field mapping (GPS)
IE - SMAATIE	Based on taxonomic composition (saltmarsh zonation), angiosperm abundance (saltmarsh extent) and disturbance sensitive taxa (presence of halophytes)
NL – TSM	Based on extent of saltmarsh area compared to historical reference and relative extent of vegetation zones for CW Using aerial photographs, ground truth and a fixed typology (TMAP/SALT)
UK - SM	Includes saltmarsh area compared to historical reference and as proportion of the intertidal, representation and relative extent of vegetation zones, as well as representation of species diversity

The following common metrics were selected:

1. saltmarsh extent as the % of the water body surface area;

2. relative extent of four predefined zones: pioneer, low, mid and upper marsh;

3. an attempt would be made to report on the number of principal and occasional species in each zone. MS were asked to make lists of principal an occasional species in each of the aforementioned zones as a check on the comparability of zones.

But it was also concluded during IC2 that "…even though all WB belong to NEA 1/26 and NEA 3/4 the wide geographical and morphological range of these types should be acknowledged". Also the "…taxonomic differences related to latitude can be neutralised using saltmarsh zonation as 'meta species'". And that "…the impact of morphological differences on the reference salt marsh extent will have to be investigated".

As a remark from the above mentioned, it was also considered that differences existing between assessment methods and data processing exclude, respectively, the use of IC option 1 and IC option 3 as boundaries harmonisation methods. Option 2 was considered the most reliable method to use on boundaries harmonisation, through the direct use of EQR values provided by different assessment methodologies or by the calculation of some common metrics based on a common dataset that could be helpful on indirect comparisons with pressure values affecting the systems.

In order to improve data quality and quantity it was asked to MS to update their data and, when possible, to add new biological and pressure data to the existing database.

A.3.3 Data acceptance criteria

From the previous IC exercise was retained that data should be preserved separate for CW and TW. Although this was the followed procedure, it was also analysed the CTW database all together, to exclude any doubts about the possible generation of positive results for the intercalibration with this procedure.

From an initial dataset with 45 samples submitted by MS (DE 18, IE 14, NL 4, UK 9), 17 samples were selected based on the information they contained on the biology and pressure for each site (Table VII). Samples without any pressure data, presenting an incomplete set of pressure that was not covering the most significant pressure indicators, or without a coherent relationship between the pressure indicators quantified and the quality result, were excluded from the exercise. IE methodology was recently concluded and still several testing procedures are on going, in which are included the pressure relationship (no pressure data were presented for this exercise).

Table 7. Sampling CW sites selected for the exercise. Code, name and sampling date

MS	WB_Code	WB	Date
DE	DE_CW_N2_3100_01	Euhalines Wattenmeer der Ems	2013
DE	DE_CW_N2_4900_01	Wattenmeer Jadebusen und angrenzende Küstenabschnitte	2013
DE	DE_CW_N2_3100_01	Euhalines Wattenmeer der Ems	2004
DE	DE_CW_N2_4900_01	Wattenmeer Jadebusen und angrenzende Küstenabschnitte	2004
UK	GB620301100000	Farne Islands to Newton Haven	2012

UK	GB640402492000	Lincolnshire	201 1
UK	GB640503300000	Norfolk North	201 1
UK	GB640523160000	Wash Outer	201 1
UK	GB641008180000	Loughor Outer	201 1
UK	GB641008220000	Milford Haven Outer	201 1
UK	GB650503200000	Blackwater Outer	201 1
UK	GB650705150000	Solent	200 8
UK	GB680301430000	Holy Island & Budle Bay	201 2
NL		Oosterschelde2001	200 1
NL		Oosterschelde2007	200 7
NL		Waddenzee2001	200 1
NL		Waddenzee2007	200 7

Both the biological and pressure data were validated by MS for this exercise. They kept the same format and were complemented with information missing for any indicator or from MS (as new data). The biological and pressure data used in the exercise can be consulted in the excel file (Correl_EQR_Pressures_20161220.xls) submitted with this report. The general format to use for pressures quantification was agreed in IC2 by participating MS and was the one used in this exercise (Table 8).

Table 8. General criteria used to quantify the selected pressures affecting environmental quality of sampled sites

Pressure indicator	Criteria	No change (0)	Very low (1)	Low (3)	Medium (5)	High (7)	Very high (9)
Land Claim (ha)	- area claimed from the sea or estuary. - consider both: mudflats and tidal marshes. - this indicator includes both anthropogenically induced changes and natural variations.	No change	<0.5% lost over the last decades	<1%	<5% lost	<10%lost	≥ 10% lost
% Shoreline re-enforcement	- intertidal and subtidal area affected by shoreline structures. - Consider both margins. - values as percentage of WB extension/margin.	No development	<5% of the coastline impacted by industrial or urban activities	<30%	< 60%	< 90%	≥ 90%
Maintenance dredging area (ha)	- the area (ha) designated for maintenance dredging in estuaries. - the % in relation to the WB surface area	No dredging	<1% of the surface area dredged	<10%	<30%	<50%	≥ 50%
Maintenance dredging volume (tons)	- the amount (ton) of dredged material from estuar	no disposal	< 5000 tons deposited annually	<100,000 tons	< 1 million tons	< 4 million tons	≥ 4 million tons
Maintenance disposal area (ha)	- the area (ha) where dredged material is dumped in estuaries. - consider both intertidal and subtidal areas.	no disposal	<1% of the subtidal area dredged	<10%	<30%	<50%	≥ 50%
Maintenance disposal volume (tons)	- the amount (ton) of dredged material dumped inside estuaries. - consider both intertidal and subtidal dumped volumes.	no disposal	< 5000 tons deposited annually	<100,000 tons	< 1 million tons	< 4 million tons	≥ 4 million tons
Other fisheries nearshore disturbance	- % of the length of coast (riverbank) affected by fishery. - % of estuarine (WB) area affected by fishery.	No fishery activities	< 10% of the length of coast (riverbank) affected by fishery	<30%	<60%	<90%	≥ 90%
Marina Development	- number of berths in marinas per km2 of WB surfa	No marina	< 100 berths in marina / km2	<150 berths / km2	<300 berths / km2	<500 berths / km2	≥ 500 berths / km2
Tourism and recreation	- % of the length of coast (riverbank) affected by tourism and recreation activity. - % of estuarine (WB) area affected by tourism and recreation activity.	None	< 10% of the length of coast (riverbank) or estuarine area affected by activities	<30%	<60%	<90%	≥ 90%
Nutrients (DIN winter median concentration) (μmol/L)	- TW normalized for 25 salinity; - CW polyhaline normalized for 25 salinity; - CW normalized for 32 salinity.	Winter DIN concentration lower than 6.5 μmol/L	< 10 μmol/L	<30 μmol/L	<60 μmol/L	<90 μmol/L	≥ 90 μmol/L
Natural turbidity: secchi disk (m) (mean)	- use same normalization criteria as for DIN (if possible). - use growing period values (May to September).	Secchi depth transparency ≥ 2.5 m	< 2.5 m	< 2 m	< 1.5 m	< 1 m	< 0.5 m

A.3.4 Pressures addressed

To ensure that intercalibration is a process as clear as possible, where good ecological status represents the same level of quality in each MS, the WFD indicates the use of pressures affecting sites as a yardstick against which the EQR from each MS should be correlated. After the compilation of pressures affecting each site, the different pressure indicators were assigned to different pressure index categories (Table IX). To compare the EQR produced for each site against the pressure affecting it, were used pressure values from the individual pressure indices, the total pressure of pressure categories calculated as a sum of individual pressures contained in that category, and also some combinations of single pressures and/or pressure categories. A correlation matrix was calculated for CW with STATISTICA 7.0 software (StatSoft, Inc. 1984-2004), based on data of pressures, EQRs and common metric values, registered on sites (Table VII). As mentioned above, sites with no pressure data, low-pressure data input or with pressure data clearly poor in quality, were removed from further analyses.

Table 9. Pressures indexes developed and used to compare against EQR calculated for each site

Pressure Index	Pressure Category	Pressure Indicator
Hydromorphologic	Hydromorphologic	Land Claim
		Shoreline re-enforcement
Resource Use	Resource Use	Maintenance dredging area
		Maintenance dredging volume
		Maintenance disposal area
		Maintenance disposal volume
		Other fisheries nearshore disturbance
		Marina Development
		Tourism and recreation
Environtental Quality	Environtental Quality	Nutrients
		Natural turbidity: secchi disk
Hydromorphologic + Resources	Hydromorphologic + Resources Use	
Total Pressure	Hydromorphologic + Resources Use + Environtental Quality	

Correlations between EQR, pressure indexes and biological parameters were analysed for strength and statistical significance and it was not found any significant correlation ($r > 0.3$; $p < 0.05$) affecting simultaneously all MS involved in the exercise (Table X). This result compromises the following steps of the IC exercise since it is not possible to relate EQR values with pressure affecting the sampled systems.

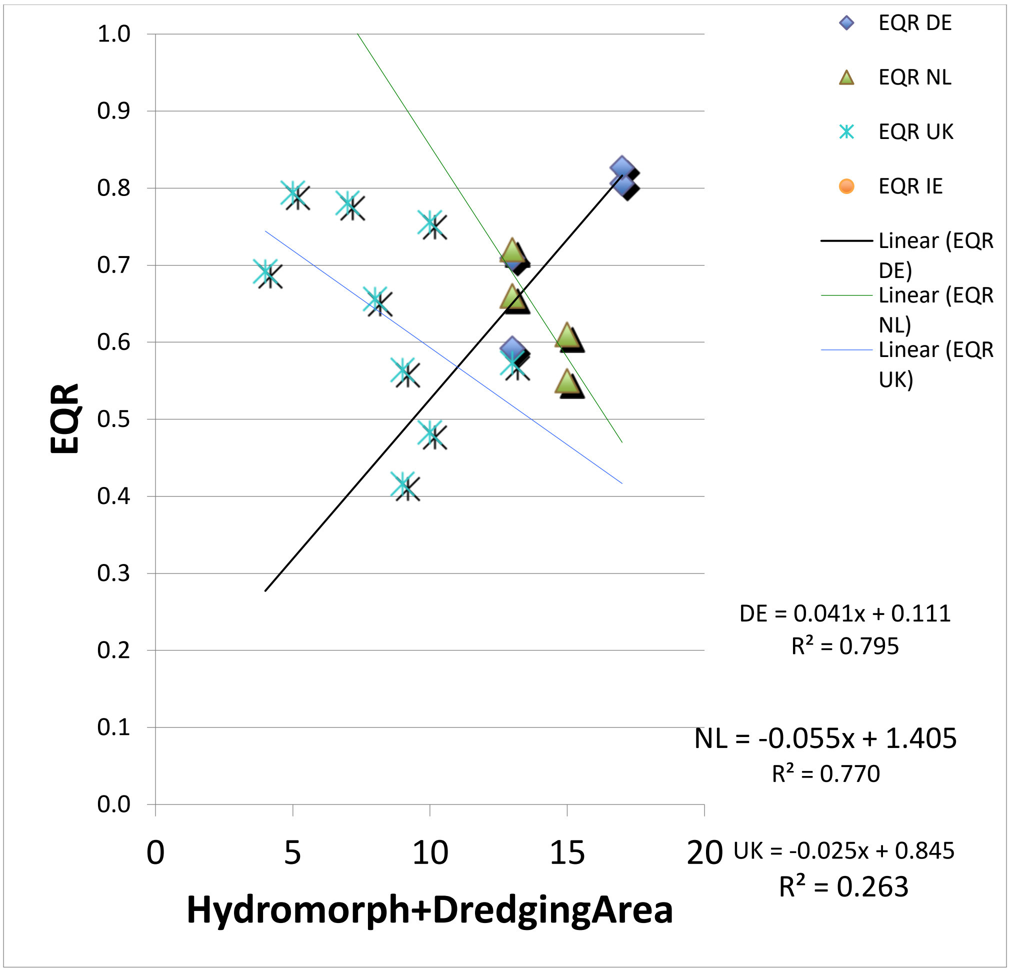
Table 10. Pearson product-moment correlation coefficient calculated for CW for pairs of pressure index EQR values and biological parameters (saltmarsh common metrics). Significant correlations marked in red.

	EQR DE	EQR NL	EQR UK	EQR ALL
EQR_SM_Extent	.9830	--	.8972	.8801
	N=4	N=0	N=9	N=13
	p=.017	p= ---	p=.001	p=.000
EQR_SM_Zones	.8788	--	.4239	-.1026
	N=4	N=0	N=9	N=13
	p=.121	p= ---	p=.256	p=.739
WBAREA	.8918	.8779	-.5331	.0868
	N=4	N=4	N=9	N=17
	p=.108	p=.122	p=.139	p=.740
WB SM	.0260	.9210	-.2088	.1550
	N=4	N=4	N=9	N=17
	p=.974	p=.079	p=.590	p=.553
Land Claim (% WB area)	.8918	.8779	-.6131	-.1923
	N=4	N=4	N=9	N=17
	p=.108	p=.122	p=.079	p=.460
% Shoreline re-enforcement	0.0000	-.8779	-.9036	-.5138
	N=4	N=4	N=5	N=13
	p=1.00	p=.122	p=.035	p=.072
Maintenance dredging area (% WB area)	.8918	-.8779	-.0482	.0769
	N=4	N=4	N=8	N=16
	p=.108	p=.122	p=.910	p=.777
Maintenance dredging volume (tons)	.8918	.8779	--	.7838
	N=4	N=4	N=0	N=8
	p=.108	p=.122	p= ---	p=.021
Maintenance disposal area (% WB area)	.5784	.8779	--	.7628
	N=4	N=4	N=0	N=8
	p=.422	p=.122	p= ---	p=.028
Maintenance disposal volume (tons)	.8918	.8779	--	.6216
	N=4	N=4	N=0	N=8
	p=.108	p=.122	p= ---	p=.100
Other fisheries nearshore disturbance	0.0000	--	--	0.0000
	N=4	N=0	N=0	N=4
	p=1.00	p= ---	p= ---	p=1.00
Marina Development	--	0.0000	--	0.0000

	N=0	N=4	N=0	N=4
	p= ---	p=1.00	p= ---	p=1.00
Marina Development/km2	0.0000	0.0000	--	0.0000
	N=4	N=4	N=0	N=8
	p=1.00	p=1.00	p= ---	p=1.00
Tourism and recreation	0.0000	.8779	--	.2171
	N=4	N=4	N=0	N=8
	p=1.00	p=.122	p= ---	p=.606
Nutrients (DIN winter median concentration) (μmol/L)	0.0000	--	-.6538	-.3549
	N=4	N=0	N=8	N=12
	p=1.00	p= ---	p=.079	p=.258
Natural turbidity: secchi disk (m) (mean)	.8918	--	--	.8918
	N=4	N=0	N=0	N=4
	p=.108	p= ---	p= ---	p=.108
Hydromorph.Pressues	.8918	0.0000	-.5503	-.0150
	N=4	N=4	N=9	N=17
	p=.108	p=1.00	p=.125	p=.955
Hydromorph.Pressues + MaintDredg	.8918	-.8779	-.5131	.0559
	N=4	N=4	N=9	N=17
	p=.108	p=.122	p=.158	p=.831
Resource Pressure	.8931	.8779	.0995	.4084
	N=4	N=4	N=9	N=17
	p=.107	p=.122	p=.799	p=.104
Env.Qual Pressure	.8918	0.0000	-.7212	.1468
	N=4	N=4	N=9	N=17
	p=.108	p=1.00	p=.028	p=.574
Total Pressure	.8950	.8779	-.7105	.3230
	N=4	N=4	N=9	N=17
	p=.105	p=.122	p=.032	p=.206

Although not significant (Table X), strong correlations were found between EQR and the combined value of Hydromorphological + Maintenance Dredging Area pressures (Figure 1) for the NL and UK. The same was partially true also for the Shoreline reinforcement pressure, since a significant correlation was already observed for the UK (Figure 2).

Figure 1. UK, NL and DE EQR response against the combined pressure values (Hydromorphological + Maintenance Dredging Area)



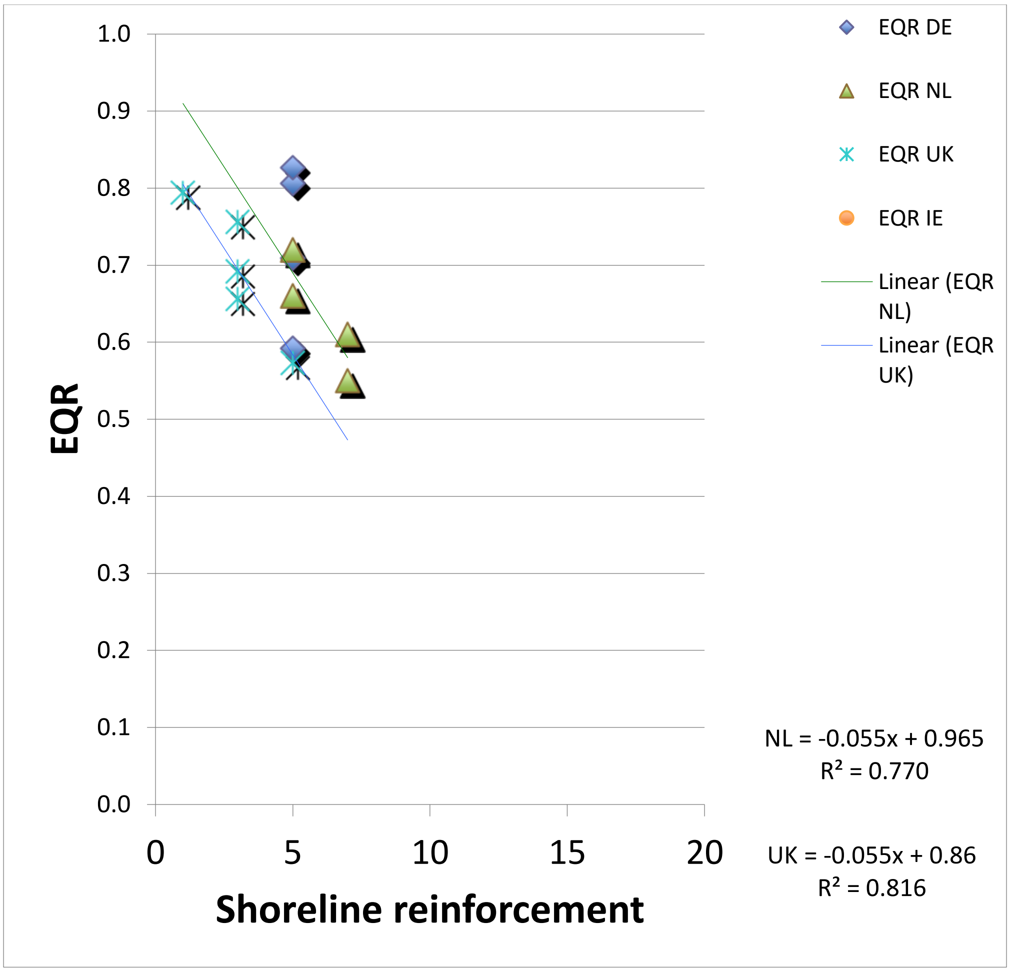


Figure 2. UK and NL EQR response against pressure index (% shoreline reinforcement)

A.4 Benchmark Standarization

A.4.1 common benchmark or reference conditions

Common reference conditions were not defined, as there was not a sufficient number of samples in near-natural conditions in the database. Each method defined reference conditions done following expert judgement, modelling (correlation between metrics and/or physico-chemical parameters), etc .

An alternative procedure for the selection of benchmark sites need to be used in this intercalibration, because the guidance principle cannot be fulfilled using this common dataset: *The benchmarking process must use harmonized criteria independent of national classifications (i.e., countries cannot simply nominate the sites they classify as high status as being their benchmark sites without further checking).* The analyses on the common dataset showed that it was impossible to select 'common' benchmarks sites, based on similar pressure levels the NEA-GIG region. This is related to the high variation in the pressure-response of the methods, which depend on the data availability, data type, assessment method, pressure type and typology.

Since the use of reference benchmarking and alternative benchmarking was not possible, it was tried to apply continuous benchmarking. This alternative requires relevant pressure data being available; The percentage of shoreline reinforcement was, in this exercise, is the most promising pressure to compare against EQR values for the benchmark standardisation step, but more data (spatial and temoral) are needed to improve the improve the significance of pressure-EQR correlations.

A.5 Conclusion on Intercalibration feasibility

With the current available data set the continuous benchmarking standardization has not been possible; No common pressure with significant relation with the EQR methods has been found. **Therefore, IC is not possible, but methods are accepted. National methods are included in the Part 2 of the EC Decision.** This part included the national assesment approaches not intercalibrated due to justified reasons.

Part B.Transitional waters

B.1 Geographical scope and participation of Member States

The exercise for sub-BQE saltmarsh in TW category included the participation of seven European Member States, covering essentially the northern coastal latitudes (Belgium, Germany, Spain, Ireland, the Netherlands, Portugal and United Kingdom). Seven distinct methodologies (TMQI-BE, EM-DE, AQI-ES, SMAATIE-IE, TSM-NL, AQuA-PT and SM-UK) were proposed for intercalibration (Table XI). From these, SMAATIE (IE) and AQuA (PT) are new, and SM (UK) suffered improvements since IC2 (previous phase). The participating MS share not only the presence of saltmarshes in their transitional waters, but they also considered it as an ecologically meaningful BQE, and so an important key on the assessment of the ecological quality of their waterbodies.

Table 11. Member states participating in IC3, assessment method and published references

Member state	Method	References
BE - Belgium	TMQI = Tidal Marsh Quality Index	- WISER ID: 27 - Brys et al., 2005; Speybroeck et al., 2008a; 2008b.
DE - Germany	EM = Assessment of saltmarsh vegetation in coastal and transitional waters	- WISER ID: 130 - Adolph and Arens, 2011.
ES - Spain	AQI = Angiosperm Quality Index	- WISER ID: 249 - García et al., 2009.
IE – Ireland	SMAATIE = Saltmarsh Angiosperm Assessment Tool for Ireland	- No WISER ID yet - Devaney and Perrin, 2013.
NL- The Netherlands	TSM = WFD-metrics for natural watertypes: tidal salt marsh	- WISER ID: 259 - Dijkema et al., 2005.
PT - Portugal	AQuA = Angiosperm Quality Assessment Index	- No WISER ID yet - Caçador et al., 2013.
UK- United Kingdom	SM = UK Saltmarsh Tool	- No WISER ID yet - UKTAG, 2013.

All Member States (MS) have participated when asked to, either through the recompilation of biological and pressure data, the calculation of assessment results, or by the clarification on the architecture and functioning of national methodologies

B.2 Description of national assessment methods

B.2.1 Methods and required parameters

As explained below, not all assessment methods were considered until the end of this intercalibration exercise due to inconsistencies within the required criteria. However, the different methodologies participating initially in the exercise for saltmarsh TW may be briefly described as following.

TMQI - Tidal Marsh Quality Index (BE)

The ecological quality assessment is based on the total area of tidal marshes and on the average quality of all individual tidal marshes within the water body (Brys et al., 2005). The quality index for each individual tidal marsh is determined based on the shape and on the vegetation quality. The latter is in turn based on vegetation diversity, species richness and floristic quality. The habitat area is assessed by comparing the current area with reference values defined for Maximum Ecological Potential (MEP) and Good Ecological Potential (GEP). Vegetation area is assessed at the levels of the ecosystem (the whole basin), water body and site, based on remote sensing maps constructed for saltmarsh and brackish swamp vegetation. The shape index is calculated for each site from the current area and perimeter measurements, meaning that marrow, elongated sites that occur between rivers and dikes tended to have short, steep gradients, and broader sites have greater morphological diversity that should be reflected in plant species richness. Vegetation quality is a weighted combination at the site level of species richness, vegetation diversity and a Floristic Quality Index (FQI). Vegetation diversity is calculated based on Shannon Diversity index (H') and the FQI is calculated using site species lists. After transforming raw metric scores to Ecological Quality Ratios (EQRs) the EQR for individual sites is calculated based on species richness, vegetation diversity and the Floristic Quality Index parameters. At the water body level, the overall EQR is determined from the EQR for habitat area and the mean EQRsite for all sites within that water body. If both parameters are ranked in the same class (High, Good, Moderate, Poor or Bad) the average of the two is calculated, otherwise the lower parameter score is used (Speybroeck et al., 2008a; 2008b).

EM - Assessment of saltmarsh vegetation in coastal and transitional waters (DE)

In their outer ranges, transitional waters (TW) are assessed using the parameters "brackish and saltmarsh area" and "vegetation zonation" (Arens, 2006; 2009). For the upper parts of the TW the parameters used are "brackish and saltmarsh area", "area of near-natural biotope types", "width of reed" and "species and structure of the reeds". Data are gathered from aerial photos and field mapping (GPS), and the assessment for TW is based on the extent of saltmarsh area (percentage of saltmarsh area of the whole water body) compared to historical references and on the relative extent of vegetation zones (percentage of zones of the whole saltmarsh area). The overall EQR value is obtained by calculating the mean of the mentioned metrics without any additional weighting (Adolph and Arens, 2011).

AQI - Angiosperm Quality Index (ES)

The Angiosperm Quality Index (AQI) (García et al., 2009) was developed for evaluating the status of the transitional waters as an integrated assessment for both the WFD and the HD and thus is broader in its scope than just saltmarshes. AQI is based on three parameters: diversity of estuarine habitats; relative deviations from optimal coverage; variations in the surface area of natural tidal habitats.

Diversity of estuarine habitats is quantified using the Gini-Simpson index (IG); Coverage is the proportion of area actually covered by angiosperms (i.e. vegetation density), and the relative deviation from the optimal coverage is estimated in comparison to the optimal coverage of each habitat. The final coverage index is computed by averaging the relative deviances over all habitats. Variation in the surface area of natural tidal habitats (e.g. mudflats, saltmarshes, dunes, beaches, woodland) is calculated based on the area currently occupied by all the natural habitats together in comparison to the total area of the estuary (i.e. transitional water body).

Since the sub-metrics can be understood as rates comparing each situation with a referential state and they are interrelated, the final EQR is calculated through their geometric mean (rather than the arithmetic mean).

SMAATIE - Saltmarsh Angiosperm Assessment Tool for Ireland (IE)

As mentioned for CW, the ecological status classifications for TW angiosperms is based in three key elements of the angiosperms: taxonomic composition, angiosperm abundance and disturbance sensitive taxa. In this context these three key elements were translated as saltmarsh zonation (taxonomic composition), saltmarsh extent (angiosperm abundance) and presence of halophytes (disturbance-sensitive taxa). In total five metrics are used: a) saltmarsh extent as a proportion of the reference area; b) proportion of saltmarsh zones present (taxonomic composition); c) proportion of saltmarsh area covered by the dominant saltmarsh zone (taxonomic composition); d) proportion of saltmarsh composed of *Spartina* (taxonomic composition); and e) proportion of observed taxa to 15 taxa (disturbance-sensitive taxa) (Devaney and Perrin, 2013).

Metrics concerning saltmarsh area (e.g., saltmarsh extent, proportion of saltmarsh area, proportion of dominant vegetation zone or non-native *Spartina*) may use mapping information, satellite imagery and field trip confirmation, to compare current data (e.g., GIS polygons) with reference conditions defined under reliable previous measurements. The halophytic vegetation of saltmarshes can be classified as disturbance sensitive taxa. Significant anthropogenic effects on these stressors can lead to shifts in species composition, or even loss of plant communities. The diversity of saltmarsh taxa compares the registered taxa against a reference value of 15 common saltmarsh halophytes species.

The overall EQR is calculated with the attribution of different weighting for combining the metrics. The sum of the weighted scores, saltmarsh extent (x3), proportion of saltmarsh zones (x1), proportion of dominant saltmarsh zone (x0.5), proportion of Spartina area (x0.5), and the proportion of halophytes (x1), is then divided by 6 to provide the final EQR (Devaney and Perrin, 2013).

TSM - WFD-metrics for natural watertypes: tidal salt marsh (NL):

The Dutch assessment procedure comprises two metrics: condition acreage (area) and condition quality (zonation) (Dijkema et al., 2005). The saltmarsh area (abundance) within each water body was assessed based on the extent of saltmarsh area compared against historical references, and, as saltmarshes support a limited number of species and these species define vegetation zones, saltmarsh species (taxonomic composition) were assessed as the relative extent of vegetation zones (and not as species separately). Data are collected using aerial photographs, ground truth and a fixed typology (TMAP/SALT). The overall EQR value is obtained through the calculation of the mean between quality and quantity metrics, without weighting.

AQuA - Angiosperm Quality Assessment Index (PT)

In this IC exercise, a new assessment methodology is used for the Portuguese saltmarsh BQE. The Angiosperm Quality Assessment Index (AQuA-Index) (Caçador et al., 2013) is a multi-metric ecological index established taking into account the species composition and ecological relations in Portuguese saltmarsh habitats. The five parameters included in AQuA, able to respond well to the variability of ecological conditions, were the Shannon Diversity Index, the Maximum Shannon Diversity Index, the species richness, the Margalef Diversity Index and the Pielou Equitability Index. To address abundance and taxonomic composition requirements, the calculation of AQuA metrics is based on data from saltmarsh area and the abundances of all surveyed species registered along several transects within each saltmarsh. Aerial photograph interpretation is used to extrapolate the total area covered by each species.

To obtain the final EQR, scores derived from each metric are first normalised using a sigmoidal equation limited from 1 to 0. Then, the sum of five parcels (one per metric) resulting from the product of metrics normalized scores by the weighing factor determined in the PCA for each metric produces the AQuA final EQR.

SM - UK Saltmarsh Tool (UK)

The UK methodology includes six components in its assessment tool (UKTAG, 2013). They are: a) the saltmarsh extent as a proportion of "historic saltmarsh"; b) the saltmarsh extent as a proportion of the intertidal area available; c) the change in saltmarsh extent over two or more time periods; d) the proportion of saltmarsh zones present in the marsh; e) the proportion of saltmarsh area covered by the dominant saltmarsh zone; and f) the proportion of observed taxa to historical reference value or the proportion of observed taxa from a standard checklist. The metrics concerning saltmarsh area (e.g., proportion of historical area, of intertidal area, 6-year extent trend, proportion of dominant vegetation zone) use mapping information, satellite imagery and field truthing, to compare current data with reference conditions defined by reliable previous measurements. Concerning the zonation metrics, five zones were defined, and its number is compared to the reference number of zones defined for the site: a) pioneer (with *Salicornia* etc.); b) *Spartina*-dominated marsh; c) mid-low (with *Atriplex* [*portulacoides*] and *Puccinellia* [*maritima*]); d) high (with *Festuca rubra*, *Elytrigia* [*atherica* or *repens*], *Bolboschoenus* and *Juncus* [*maritimus*]); e) brackish reed beds (*Phragmites*). The diversity of saltmarsh taxa compares the registered taxa against one of two reference values (historical reference list or a reference value of 15 saltmarsh species).

The overall EQR is calculated with the attribution of different weighting for combining the metrics, lesser weighting (x0.5) is applied to metrics saltmarsh extent relative to the intertidal area, proportion of saltmarsh zones present in the marsh, and the proportion of observed taxa to historical reference. The metrics saltmarsh extent as a proportion of "historic saltmarsh", and the proportion of saltmarsh area covered by the dominant saltmarsh zone have a weighting of x1 and the sum of all metric scores is then divided by 4.

B2.2 Compliance of national assessment methods

The compliance of metrics used in IC2 by each methodology with WFD requirements has been previously analysed and can be summarised as shown in Table XII. The assessment methodologies, officially proposed by BE, DE, ES, NL and UK, migrated from the previous IC and maintained most of their earlier characteristics and assessment concepts. The UK methodology was improved (without modifying the assessment concept). Two changes have been registered yet, PT changed the national methodology (AQuA) and IE presented the new methodology (SMAATIE) developed for saltmarsh sub-BQE assessment. In general, all methodologies include metrics covering more or less directly both 'TAXONOMIC COMPOSITION' and 'ABUNDANCE' requirements. The presented tools also report into a five quality classes scale, through a 0-1 EQR scale calculated under specific combination rules and compared to defined reference conditions.

For a detailed consultation of assessment tools see the documents attached to this report.

Table 12. Criteria used for checking compliance of different methodologies participating in IC3, and combination rules

Member State	Full BQE method	Taxonomic composition	Abundance	Combination rule of metrics
BE	yes	Yes, Vegetation zones and species diversity as well as floristic quality are assessed	Extent of saltmarsh is proxy for abundance	EQR = (EQR S-W Diversity*2 + EQR Species richness+EQR FQI)/4
DE	yes	Not strictly. Vegetation zones are considered 'meta taxa' not species	Extent of saltmarsh is proxy for abundance	Average metric scores
ES	yes	Richness of estuarine habitats defined by different communities. List of species is possible to obtain for IC purposes	Vegetation cover in terms of density is assessed for each habitat type as well as surface area of natural habitat.	Mean value
IE	yes	Yes (taxa diversity and zones are considered)	Extent of saltmarsh is proxy for abundance	Average (or weighted average)
NL	yes	Not strictly. Vegetation zones are considered 'meta taxa' not species	Extent of saltmarsh is proxy for abundance	Worst quality class
PT	yes	Species richness, diversity and equitability indices calculated from a list of species identified during sampling	Coverage (in terms of density of species is used on calculations of diversity indices)	Mean
UK	yes.	Yes (taxa diversity and zones are considered)	Extent of saltmarsh is proxy for abundance	Average (or weighted average)

B2.3 Reference conditions

The reference condition defined for each national assessment method and the methodology used to derive it can be found in Table XIII. Although specific criteria exist for the definition of reference sites, for the methodology to derive reference conditions and the variation expected inside High and Good quality classes, those sites do not clearly exist throughout the European coasts.

Table 13. Criteria for definition and methodology used to derive reference conditions

Member State	**Methodology used to derive the reference conditions**	**Criteria use for selection of reference sites (if they exist)**
BE	Expert knowledge, Least Disturbed Conditions	Hydromorphological disturbance within natural scale: Free exchange between tidal marshes and flood plains (no dykes). Complete lateral, longitudinal and vertical gradients, with unlimited space for cyclic habitat development under natural dynamics. Gradual transition from estuary to river.
DE	Existing near-natural reference sites, Expert knowledge, Historical data, Modelling (extrapolating model results)	Absence of eutrophication; mechanical and hydromorphological disturbance within the natural scale
ES	Expert knowledge, Historical data	No morphological changes. Limited land claim surface (less than 5% of the sector). Absence of flow changes.
IE	Expert knowledge, Least Disturbed Conditions, historical conditions	The reference conditions are obtained from historical data and expert knowledge.
NL	Expert knowledge, Historical data	No sharp division between water bodies (no dykes), allowing exchange of water etc between water bodies presence of tidal salt marshes and flood plains cyclic development of habitat types due to disturbance caused by natural processes. Presence of fields of sea grass no reference sites availably for the Netherlands.
PT	Expert knowledge, Historical data	The reference conditions are obtained from historical data and expert knowledge.
UK	Expert knowledge, Least Disturbed Conditions, historical conditions	The reference conditions are obtained from historical data and expert knowledge.

Each methodology (except BE) was compiled into a separate calculating excel file, which was constructed directly by MS experts, and where the exact formulation for the methodology included in the IC and the Reference Condition values (RC) were inserted. This gave the opportunity to validate all the calculations submitted by MS national experts.

B.2.4 Boundary setting

As stated above for CW, data relating the response of saltmarshes (or of the species comprised in this Ecological Quality Element) against the variation of different pressure indicators are scarce. For that reason, it has been difficult to identify the exact disturbance level that corresponds to measurable ecological changes in the community. To overcome this difficulty, MSs have adopted mostly to set the boundaries as equidistant values inside the EQR scale (Table XIV), which could suffer adjustments during the IC.

Table 14. Boundary setting protocol

Member State	**Specific approach for H/G boundary**	**Specific approach for G/M boundary**	**BSP; data for setting; tested against pressure**
BE	For extent: threshold slope as morphological reference; for taxonomic composition: Equidistant division of the EQR gradient and K-means clustering.	For extent: area needed to prevent Si limitation in summer; for taxonomic composition: Equidistant division of the EQR gradient and K-means clustering	Best available historical data; No pressure relationship tested
DE	Expert judgement (Equidistant boundaries)	Expert judgement (Equidistant boundaries)	Equidistant division of the EQR gradient (after normalisation of sub metrics); Best available historical data; No pressure relationship tested
ES	Derived from metric variability at near-natural reference sites: 0.85 (High/Good)	0.70 (Good/Moderate)	Best available historical data; No pressure relationship tested
IE	Expert judgement (Equidistant boundaries)	Expert judgement (Equidistant boundaries)	Equidistant division of the EQR gradient (after normalisation of sub metrics); Best available historical data; No pressure relationship tested
NL	Expert judgement (Equidistant boundaries)	Expert judgement (Equidistant boundaries)	Equidistant division of the EQR gradient (after normalisation of sub metrics); Best available historical data; No pressure relationship tested

PT	Expert judgement (Equidistant boundaries)	Expert judgement (Equidistant boundaries)	Equidistant division of the EQR gradient (after normalisation of sub metrics); Best available historical data; No pressure relationship tested
UK	Expert judgement (Equidistant boundaries)	Expert judgement (Equidistant boundaries)	Equidistant division of the EQR gradient (after normalisation of sub metrics); Best available historical data; No pressure relationship tested

B3. Results IC Feasibility checking

B.3.1 Typology

All national method share the TW common type NEA 11, so all national types could enter this IC exercise.

B.3.2 Assessment concept

In general, all methodologies (except for AQI and AQuA) make use of a similar set of measuring data, following the described assessment concepts (Table X).

Table 15. Description of assessment concepts of the methods and feasibility results.

Method	Assessment concept
BE – TMQI	Based on extent of saltmarsh area, on species richness and on floristic quality of vegetation zones. Gathered by aerial photos and field mapping (GPS)
DE – EM	Based on extent of saltmarsh area compared to historical reference and relative extent of vegetation zones for CW Gathered by aerial photos and field mapping (GPS)
IE - SMAATIE	Based on taxonomic composition (saltmarsh zonation), angiosperm abundance (saltmarsh extent) and disturbance sensitive taxa (presence of halophytes)
NL – TSM	Based on extent of saltmarsh area compared to historical reference and relative extent of vegetation zones for CW Using aerial photographs, ground truth and a fixed typology (TMAP/SALT)
PT - AQuA	Transects displayed along saltmarsh areas with identification and estimation of relative abundance of species.
UK - SM	Includes saltmarsh area compared to historical reference and as proportion of the intertidal, representation and relative extent of vegetation zones, as well as representation of species diversity

B.3.3 Data acceptance criteria

From an initial dataset with 112 samples submitted by MS (BE 2, DE 8, ES 10, IE 26, NL 7, PT 21, UK 38), 71 samples were selected based on the information they contained on the biology and pressure for each site (Table XII). Both biological and pressure data were transported from the IC2 database and afterwards validated, and modified if needed, by MS. Samples without any pressure data, presenting an incomplete set of pressure that was not covering the most significant pressure indicators, or without a coherent relationship between the pressure indicators quantified and the quality result, were excluded from the exercise. IE methodology was recently concluded and is still under several testing procedures, in which is included the pressure relationship testing (no pressure data were presented for this exercise). IE was excluded at this step from further intercalibration.

Table 16. Sampling TW sites selected for the exercise. Code, name and sampling date.

MS	WB_Code	WB	Date
BE	BE_VL05_15	Havengeul Ijzer	2003
BE	BE_VL08_43	ZEESCHELDE IV	2004
DE	DE_TW_T1.4000.01	Übergangsgewässer der Weser	2008-2013
DE	DE_TW_T1.3990.01	Übergangsgewässer Ems-Ästuar	2008-2013
DE	DE_TW_T1.4000.01	Übergangsgewässer der Weser	2004-2008
DE	DE_TW_T1.3990.01	Übergangsgewässer Ems-Ästuar	2000-2004
ES		Avilés	
ES		Eo	
ES	ES085MAT000190	Marisma de Joyel	
ES	ES092MAT000140	Ría de Mogro	2009
ES	ES113MAT000110	San Vicente de la Barquera	2009
ES		Villaviciosa	
NL		Eems-Dollard 06	2006
NL		Eems-Dollard 95	1995
NL		Eems-Dollard 99	1999
NL		Westerschelde04	2004
NL		Westerschelde83	1983
NL		Westerschelde92	1992
NL		Westerschelde98	1998
UK	GB540704116000	ADUR	2008
UK	GB510503410700	BURE & WAVENEY & YARE & LOTHING	2011
UK	GB510503403500	BURN & MOW & OVERY & NORTON	2011
UK	GB530804906600	CAMEL	2012
UK	GB520804814400	CARRICK ROADS INNER	2013
UK	GB541006614800	CONWY	2011
UK	GB510804605900	DART	2009
UK	GB531106708200	DEE (N. WALES)	2011
UK	GB510804505600	EXE	2009
UK	GB521006501200	FORYD BAY	2011
UK	GB530503300300	GREAT OUSE	2011
UK	GB530402609201	HUMBER LOWER	2011
UK	GB530402609202	HUMBER MIDDLE	2011
UK	GB530402609203	HUMBER UPPER	2012
UK	GB531005913500	LOUGHOR	2011
UK	GB531207212100	LUNE	2012

UK	GB531006114100	MILFORD HAVEN INNER	2011
UK	GB511006115200	NYFER	2011
UK	GB520503613601	ORWELL	2011
UK	GB570704700000	PAGHAM HARBOUR	2008
UK	GB520804415800	POOLE HARBOUR	2011
UK	GB580705140000	PORTSMOUTH HARBOUR	2008
UK	GB531207112400	RIBBLE	2012
UK	GB530905415401	SEVERN LOWER	2008_2011
UK	GB530905415402	SEVERN MIDDLE	2009
UK	GB530905415403	SEVERN UPPER	2009
UK	GB530207614700	SOLWAY	2012
UK	GB520704202800	SOUTHAMPTON WATER	2008
UK	GB520503403600	STIFFKEY/ GLAVEN	2011
UK	GB520503613602	STOUR (ESSEX)	2011
UK	GB540805015500	TAW / TORRIDGE	2012
UK	GB510302509900	TEES	2009
UK	GB511006206900	TEIFI	2011
UK	GB530603911401	THAMES LOWER	2004_2011
UK	GB530603911402	THAMES MIDDLE	2004_2011
UK	GB510202110000	TWEED	2009
UK	GB530503311300	WASH INNER	2011
UK	GB531207212200	WYRE	2012
PT	PT04MON0681	Mondego-WB1	2010
PT	PT04MON0682	Mondego-WB2	2010
PT	PT06MIR1368	Mira_WB1	2010
PT	PT06MIR1367	Mira_WB2	2010
PT	PT06MIR1374	Mira_WB3	2010
PT	PT04VOU0552	Ria Aveiro-WB1	2010
PT	PT04VOU0547	Ria Aveiro-WB2	2010
PT	PT04VOU0550	Ria Aveiro-WB3	2010
PT	PT04VOU0536	Ria Aveiro-WB4	2010
PT	PT04VOU0514	Ria Aveiro-WB5	2010
PT	PT06SAD1210	Sado_WB2	2010
PT	PT06SAD1222	Sado_WB4	2010
PT	PT06SAD1219	Sado_WB5	2010
PT	PT06SAD1217	Sado_WB6	2010

B.3.4 Pressures addressed

The procedure followed here was similar to the one from CW. After the compilation of pressures affecting each site, the different pressure indicators were assigned to different pressure index categories (Table VI). To compare the EQR produced for each site against the pressure affecting it, were used pressure values from the individual pressure indices, the total pressure of pressure categories calculated as a sum of individual pressures contained in that category, and also some combinations of single pressures and/or pressure categories. A correlation matrix was calculated for TW with STATISTICA 7.0 software (StatSoft, Inc. 1984-2004), based on data of pressures, EQRs and common metric values, registered on sites (Table XIII). As mentioned above, sites with no pressure data, low pressure data input or with pressure data clearly poor in quality, were removed from further analyses.

Table 17. Pearson correlation coefficient for pairs of pressure index, EQR values and biological parameters (saltmarsh common metrics). Significant correlations marked in red

	EQR BE	EQR DE	EQR ES	EQR NL	EQR PT	EQR UK	EQR ALL
EQR_SM_Extent	--	-.8880	--	--	--	.8109	.7790
	N=0	N=4	N=0	N=0	N=0	N=38	N=42
	p= ---	p=.112	p= ---	p= ---	p= ---	p=.000	p=.000
EQR_SM_Zones	--	.9549	--	--	--	.4716	.4847
	N=0	N=4	N=0	N=0	N=0	N=38	N=42
	p= ---	p=.045	p= ---	p= ---	p= ---	p=.003	p=.001
WBAREA	--	.9664	-.2265	-.6121	.1232	.0272	-.0518
	N=2	N=4	N=6	N=7	N=14	N=38	N=71
	p= ---	p=.034	p=.666	p=.144	p=.675	p=.871	p=.668
WB SM	--	-.9095	.1715	-.5194	-.1294	.4021	.1192
	N=2	N=4	N=6	N=7	N=14	N=38	N=71
	p= ---	p=.091	p=.745	p=.232	p=.659	p=.012	p=.322
Land Claim (% WB area)	--	.9549	-.5253	0.0000	.0942	-.3282	-.0748
	N=2	N=4	N=6	N=7	N=14	N=38	N=71
	p= ---	p=.045	p=.285	p=1.00	p=.749	p=.044	p=.535
% Shoreline re-enforcement	--	.9549	-.8770	0.0000	-.5709	-.5050	-.4060
	N=2	N=4	N=6	N=7	N=14	N=38	N=71
	p= ---	p=.045	p=.022	p=1.00	p=.033	p=.001	p=.000
Maintenance dredging area (% WB area)	--	0.0000	-.7084	0.0000	-.0641	-.3678	-.2875
	N=1	N=4	N=6	N=7	N=14	N=38	N=70
	p= ---	p=1.00	p=.115	p=1.00	p=.828	p=.023	p=.016
Maintenance dredging volume (tons)	--	.9549	--	--	--	--	-.9091
	N=0	N=4	N=2	N=0	N=0	N=0	N=6
	p= ---	p=.045	p= ---	p= ---	p= ---	p= ---	p=.012
Maintenance disposal area (% WB area)	--	-.7936	--	--	--	--	-.8207

	N=1	N=4	N=2	N=0	N=0	N=0	N=7
	p= ---	p=.206	p= ---	p= ---	p= ---	p= ---	p=.024
Maintenance disposal volume (tons)	--	.9549	--	--	0.0000	--	-.5190
	N=0	N=4	N=2	N=0	N=3	N=0	N=9
	p= ---	p=.045	p= ---	p= ---	p=1.00	p= ---	p=.152
Other fisheries nearshore disturbance	--	.9549	--	--	-.6101	--	-.1117
	N=0	N=4	N=2	N=0	N=14	N=0	N=20
	p= ---	p=.045	p= ---	p= ---	p=.021	p= ---	p=.639
Marina Development	--	0.0000	--	--	-.5618	--	-.2260
	N=0	N=4	N=2	N=0	N=14	N=0	N=20
	p= ---	p=1.00	p= ---	p= ---	p=.037	p= ---	p=.338
Marina Development/km2	--	0.0000	--	--	-.1785	--	.1234
	N=0	N=4	N=2	N=0	N=14	N=0	N=20
	p= ---	p=1.00	p= ---	p= ---	p=.542	p= ---	p=.604
Tourism and recreation	--	-.9549	--	--	.1437	--	-.2208
	N=0	N=4	N=2	N=0	N=9	N=0	N=15
	p= ---	p=.045	p= ---	p= ---	p=.712	p= ---	p=.429
Nutrients (DIN winter median concentration) (μmol/L)	--	0.0000	--	0.0000	--	-.3962	-.2003
	N=0	N=4	N=2	N=7	N=0	N=38	N=51
	p= ---	p=1.00	p= ---	p=1.00	p= ---	p=.014	p=.159
Natural turbidity: secchi disk (m) (mean)	--	.9549	--	0.0000	--	0.0000	.2507
	N=0	N=4	N=0	N=7	N=0	N=38	N=49
	p= ---	p=.045	p= ---	p=1.00	p= ---	p=1.00	p=.082
Hydromorph.Pressues	--	.9549	-.6719	0.0000	-.1610	-.5266	-.2960
	N=2	N=4	N=6	N=7	N=14	N=38	N=71
	p= ---	p=.045	p=.144	p=1.00	p=.582	p=.001	p=.012
Hydromorph.Pressues + MaintDredg	--	.9549	-.7349	0.0000	-.1266	-.5788	-.3330
	N=2	N=4	N=6	N=7	N=14	N=38	N=71
	p= ---	p=.045	p=.096	p=1.00	p=.666	p=.000	p=.005
Resource Pressure	--	.7371	.1787	0.0000	-.2794	-.3678	-.2490
	N=2	N=4	N=6	N=7	N=14	N=38	N=71
	p= ---	p=.263	p=.735	p=1.00	p=.333	p=.023	p=.036
Env.Qual Pressure	--	.9549	.5303	0.0000	0.0000	-.3962	.0420
	N=2	N=4	N=6	N=7	N=14	N=38	N=71
	p= ---	p=.045	p=.279	p=1.00	p=1.00	p=.014	p=.728
Total Pressure	--	.8972	-.0678	0.0000	-.2418	-.6220	-.2428

	N=2	N=4	N=6	N=7	N=14	N=38	N=71
	p= ---	p=.103	p=.898	p=1.00	p=.405	p=.000	p=.041

Correlations between EQR, pressure indexes and biological parameters were analysed for strength and statistical significance (r > 0.3; p < 0.05). The index 'shoreline reinforcement' was the pressure showing stronger correlation in simultaneous for more MS (DE, ES, PT, UK) involved in the exercise (marked in green in Table XIII). Although significant, the correlation with DE EQR was positive, meaning an EQR increase with pressure increase (marked in yellow in Table XIII). NL EQR didn't show any correlation to pressure variation. This is also seen in the graphical representation of EQR data series against the shoreline reinforcement pressure values (Figure 3).

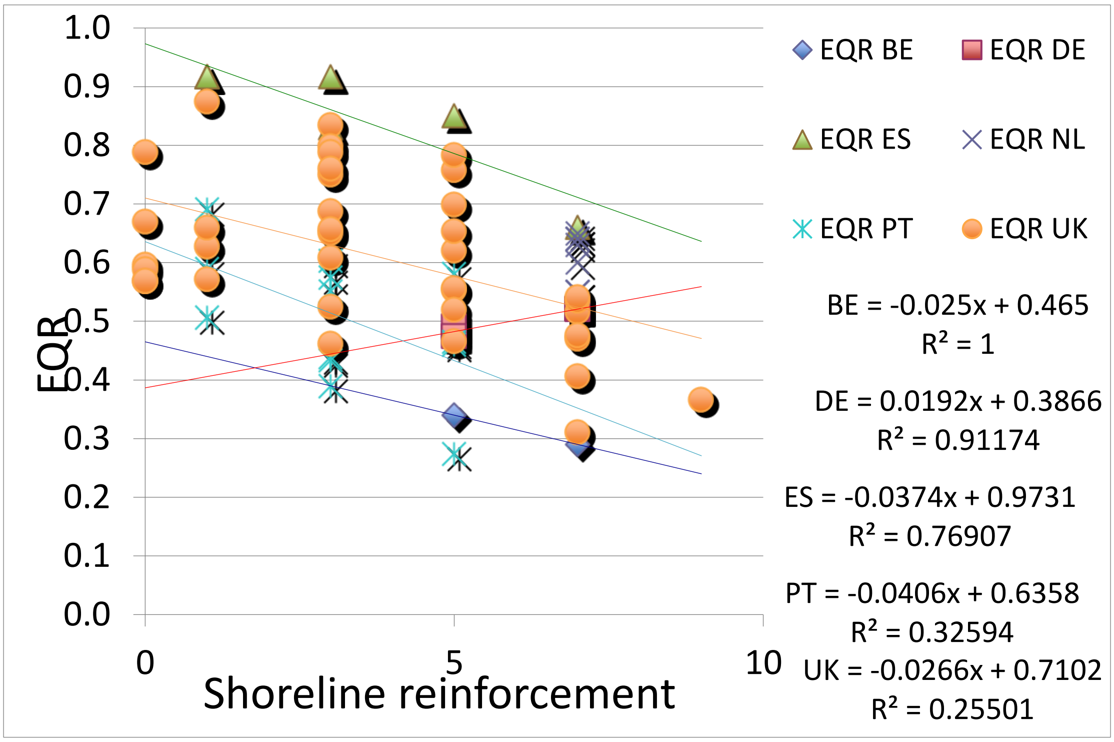


Figure 3. EQR values response against pressure index (%shoreline reinforcement). Trend lines and correlations (presented as R2)

From the above mentioned reasons, the boundaries harmonization for TW was performed as following:

1. methods from ES, PT and UK proceeded in further steps of the intercalibration process;

2. BE was not considered since it presents only two WB data points;

3. DE was not included due to its inverse relationship to pressure;

4. NL was also not included due to the absence of any significant correlation to any pressure index.

After the last exclusions 58 data points remain in the exercise.

B.4 Benchmark standardisation and offsets calculation

When reference sites are not available for all MS, the identification of the relationship between results provided by the different assessment methods may come difficult to recognise. For this reason, an alternative approach has been proposed, the benchmarking. The aim of this technique is then to identify and remove differences among national assessment methods not caused by differences in anthropogenic pressure, but else by systematic discrepancies such as differences on the methodology it self, biogeography, or the typology considered (Annex V, IC Guidance).

Since the benchmarking process must use harmonized criteria independent of national classifications, the EQR results provided by each assessment methodology must be compared to a common metric, which must show a theoretical relationship with changes in the abiotic environment due to pressures. At last, a comprehensive pressure index, able to represent significant pressures affecting the systems, can be used to show the agreement between the ecological response of the BQE and the value registered along the pressure scale. This was the adopted concept here, and the common metric selected was the pressure index presenting the highest significant correlation with the EQR values estimated by different assessment methodologies for the sampling sites, the 'Shoreline Reinforcement (%)' index (see section 11).

To estimate differences between the assessment methods, EQR values from each MS (dependent variables) were compared to the most significant pressure (Shoreline Reinforcement index) (continuous predictor), and the offsets calculated through a General Linear Model (GLM) in STATISTICA 7.0 software (StatSoft, Inc. 1984-2004). The offset calculated for each methodology (Table XIV) was afterwards used to standardise the 58 EQR results and the quality class boundaries, i.e. to reduce the deviation of each national method from the common metric (Shoreline Reinforcement index trend).

Table 18. Offsets calculated for all assessment methods when using the Shoreline Reinforcement index as common metric (GLM in SSTATISTICA 7.0 software)

	ES	PT	UK
Offsets_forStandardisation_Division	0.189966	0.00	-0.036017

B.5 Comparison of assessment methods and boundaries harmonisation

The exercise was conducted by assessment methodology, independently of MSs involved.

The selection of the best calculation method to use on the harmonisation of boundaries depends on the relationship found between methodologies and their standard deviations. It should be select the appropriate calculation method (division or subtraction) by testing if the average value of all national EQRs per survey in the full dataset is significantly correlated with its standard deviation. In case of a significant positive relationship, i.e. national EQRs converge towards the bad end of the quality gradient, division is used. A non-significant relationship, i.e. constant distances between EQRs across the full gradient, required subtraction.

Based on those relationships, and since the required information is not possible to obtain from the database (each site has only one EQR value), the selection of the best methodology was based on the graphical relation trend lines (Figure 3). The converging trend lines dictated division as the best calculation method to use on boundaries harmonisation.

The harmonisation of boundaries was preceeded by the standardisation of the original boundary values and EQR values. EQRs from each assessment method were operated with the specific calculated offset for standardisation (Standard value = EQR / (1+ Offset), after which those were inserted in the adequate Intercalibration Excel Template Sheets - IC_Opt2_div_v1.24.xlsx (developed by Dirk Nemitz, Nigel Willby, Sebastian Birk, 2011). The same subtype was attributed to all samples, which were also classified as belonging to benchmark sites.

After inserting all data, as a significant result, it can be seen the estimated regressions between each methodology and the common view calculated as an average from all the other methodologies varied from $0.26 > R^2 > 0.77$ (Figure 4).

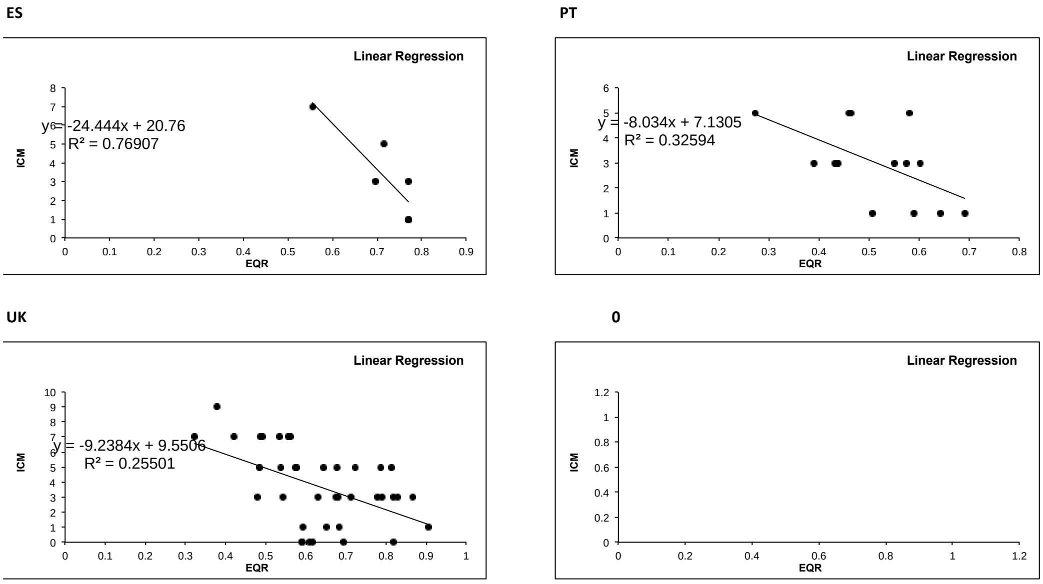


Figure 4. Regression results estimated for each assessment methods against the EQR based on the mean perspective of all other methods.

At last, boundaries bias were calculated (Table XV), and observed that ES method was to relaxed and overcome the allowed class width bias for boundaries H/G and G/M. These boundaries could be adjusted in order to fulfil the requirement of having a class bias lower than 0.25 of the class width (Annex V, IC Guidance) (Table XVI).

To the harmonisation, the H/G and G/M boundaries were adjusted to reduce class width bias. The boundaries were successfully modified and the Spanish method was able to achieve harmonised values when compared to the other partners involved in the exercise (PT and UK). Some of the UK and PT boundaries were too stringent, but since this is not failing the requirements, they were not modified.

Table 19. Results of boundaries before harmonisation. Red cell represent the boundary values needing adjustment

	ES	PT	UK
H/G	0.714	0.800	0.830
G/M	0.504	0.600	0.622

	ES	PT	UK
Max	0.840	1.000	1.037
H/G	0.714	0.800	0.830
G/M	0.504	0.600	0.622
M/P	0.420	0.400	0.415
P/B	0.252	0.200	0.207
CM_Max standardized	0.073	-0.301	-0.011
CM_H/G	1.100	0.234	0.628

standardized			
CM_G/M standardized	2.812	0.770	1.267
CM_M/P standardized	3.496	1.306	1.906
CM_P/B standardized	4.866	1.841	2.545

H width to Max	-1.027	-0.536	-0.639
G width	-1.712	-0.536	-0.639
M width	-0.685	-0.536	-0.639
H/G bias	0.446	-0.420	-0.026
G/M bias	1.195	-0.846	-0.349

H/G bias_CW	-0.260	0.783	0.041
G/M bias_CW	-1.746	1.580	0.547
N of Bm sites	58		

Table 20. Results of boundaries after harmonisation. Red figures represent the boundary values adjusted to reach compliance (bias<0.25 of class width).

	ES	PT	UK
H/G	0.714	0.800	0.830
G/M	0.504	0.600	0.622

	ES	PT	UK
Max	0.840	1.000	1.037
H/G	0.740	0.800	0.830
G/M	0.610	0.600	0.622
M/P	0.420	0.400	0.415
P/B	0.252	0.200	0.207

CM_Max standardized	0.073	-0.301	-0.011
CM_H/G standardized	0.890	0.234	0.628
CM_G/M standardized	1.950	0.770	1.267
CM_M/P standardized	3.496	1.306	1.906

CM_P/B standardized	4.866	1.841	2.545
H width to Max	-0.818	-0.536	-0.639
G width	-1.059	-0.536	-0.639
M width	-1.547	-0.536	-0.639
H/G bias	0.236	-0.420	-0.026
G/M bias	0.333	-0.846	-0.349
H/G bias_CW	-0.223	0.783	0.041
G/M bias_CW	-0.216	1.580	0.547
N of Bm sites	58		

B.6 Results to be included in the EC Decision

After the boundaries harmonisation, those results have to be reversed. The opposite operation to the one used on the standardisation process has to be applied in order to re-establish the original range of values. In this sense, after that operation with offsets, the proposed H/G and G/M boundaries are the ones expressed on Table XVII. The results are included in the part I (methods successfully intercalibrated) of the EC Decision.

Table 21. Boundaries proposed after correction with offsets.

Proposed_Boundaries	ES	PT	UK
High	1.00	1.00	1.00
High/Good	0.88	0.80	0.80
Good/Moderate	0.73	0.60	0.60
Moderate/Poor	0.50	0.40	0.40
Poor/Bad	0.30	0.20	0.20

The national assessment methods not intercalibrated due to justified reasons (see above) are included in the part 2 of the EC Decision. This part included the national methods not intercalibrated due to justified reasons.

B.7 Ecological characteristics

B.7.1 Description of reference or alternative benchmark communities

From WFD guidance documents it can be seen that taxonomic composition, angiosperm abundance and disturbance sensitive taxa are important elements for the assessment of saltmarshes. They are expected to show diversity close to the expected, either for species and saltmarsh zones, where sensitive species do not show a considerable decrease, and to cover the intertidal habitats as expected (depends on the system's hydromorphology) as a continuum from inland areas. But, due to the presence of saltmarshes normally on heavily disturbed sites, the highest expression of those ecological characteristics is not easy to observe along the European coastal systems. Is frequent to register some compression of saltmarsh extent (mainly at from land area), which in turn forces diversity also to decrease. In general, the assessment methodologies have in consideration metrics widely accepted by the scientific community, able to detect modifications on saltmarsh conditions. The most common metrics are the saltmarsh zonation to cover taxonomic composition, saltmarsh extent to cover the angiosperms abundance, and the presence of halophytes as a proxy of the presence of disturbance-sensitive taxa. Based on this, reference conditions are frequently defined as a potential value, since it depends on the suitable habitat available at coastal systems (CW and TW) for saltmarsh colonization.

B.7.2 Description of good status communities

For TW saltmarshes, due to direct destruction and/or erosion, is expected a decrease of saltmarsh extent as anthropogenic pressure increases. Also from pressure increase (e.g., shoreline reinforcement, land claim, nutrients, fisheries, boating, tourism activity), the typical saltmarsh zones may no longer be represented in a more or less even manner and diversity also tends to decreases. The saltmarsh community is on worst status than GOOD when saltmarsh extent is no longer in equilibrium with the natural morphology of the water body, and saltmarsh zones are not all represented as it is observed under undisturbed conditions. The natural dynamics of saltmarshes is also affected by increasing pressure, and there is no place for the normal saltmarsh cycles, with colonization, maturation and erosion, balanced in space and time. The lack of these conditions, as well as the reduction on the number of sensitive species under a reasonable threshold, is a clear indication of degradation needing further attention and the development of correcting measures.

Conclusions

Transitional and coastal waters were analyzed separately with data provided by involved MS. Although for CW four MS were initially involved, only three were able to proceed further in the process. For TW, seven partners were initially involved but in the final only three were able to conclude the exercise. The exclusions had several reasons, such as the absence on pressure data, the low number of data points of the weak or inexistence of any significant correlation between MS EQR and pressure quantified to the WB.

Either for CW and TW the most significant pressure index correlating with more MS was the 'Shoreline Reinforcement %'.

The intercalibration was not possible to conclude for CW, mainly due to the low number of quality data. This was evident from the correlation analysis made between EQR values and pressure, which may be possible to overcome with the inclusion of new information.

For TW the intercalibration was possible for three MS (ES, PT and UK). Others have been successively excluded due to the lack of pressure data, the low number of data points or due to the weak or inexistence of significant correlations between EQR and pressure values.

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Annex I. Approach using CWTW data

Comparison of EQRs against pressure index values (CWTW data).

Most significant pressure was "Shoreline reinforcement" (Table 1).

Table 22. Pearson product-moment correlation coefficient calculated for pairs of pressure index value and EQR using CWTW data.

	EQR BE	EQR DE	EQR ES	EQR NL	EQR PT	EQR UK	EQR IE	EQR ALL
EQR_SM_Extent	-- N=0 p= ---	.8926 N=8 p=.003	-- N=0 p= ---	-- N=0 p= ---	-- N=0 p= ---	.8271 N=47 p=.000	-- N=0 p= ---	.8088 N=55 p=.000
EQR_SM_Zones	-- N=0 p= ---	.8291 N=8 p=.011	-- N=0 p= ---	-- N=0 p= ---	-- N=0 p= ---	.4647 N=47 p=.001	-- N=0 p= ---	.3502 N=55 p=.009
WBAREA	-- N=2 p= ---	.8992 N=8 p=.002	-.2265 N=6 p=.666	.6369 N=11 p=.035	.1232 N=14 p=.675	-.0766 N=47 p=.609	-- N=0 p= ---	.0806 N=88 p=.455
WB SM	-- N=2 p= ---	-.4409 N=8 p=.274	.1715 N=6 p=.745	.6061 N=11 p=.048	-.1294 N=14 p=.659	.3304 N=47 p=.023	-- N=0 p= ---	.1497 N=88 p=.164
Land Claim (% WB area)	-- N=2 p= ---	.3809 N=8 p=.352	-.5253 N=6 p=.285	.6644 N=11 p=.026	.0942 N=14 p=.749	-.3854 N=47 p=.007	-- N=0 p= ---	-.0952 N=88 p=.378
% Shoreline re-enforcement	-- N=2 p= ---	-.4168 N=8 p=.304	-.8770 N=6 p=.022	-.6644 N=11 p=.026	-.5709 N=14 p=.033	-.5255 N=43 p=.000	-- N=0 p= ---	-.3835 N=84 p=.000
Maintenance dredging area **(% WB area)**	-- N=1 p= ---	-.1420 N=8 p=.737	-.7084 N=6 p=.115	-.6644 N=11 p=.026	-.0641 N=14 p=.828	-.3506 N=46 p=.017	-- N=0 p= ---	-.2751 N=86 p=.010
Maintenance dredging volume (tons)	-- N=0 p= ---	-.2785 N=8 p=.504	-- N=2 p= ---	.8779 N=4 p=.122	-- N=0 p= ---	-- N=0 p= ---	-- N=0 p= ---	-.3552 N=14 p=.213
Maintenance disposal area **(% WB area)**	-- N=1 p= ---	.1412 N=8 p=.739	-- N=2 p= ---	.8779 N=4 p=.122	-- N=0 p= ---	-- N=0 p= ---	-- N=0 p= ---	-.3951 N=15 p=.145
Maintenance disposal volume (tons)	-- N=0 p= ---	-.6032 N=8 p=.113	-- N=2 p= ---	.8779 N=4 p=.122	0.0000 N=3 p=1.00	-- N=0 p= ---	-- N=0 p= ---	-.2392 N=17 p=.355
Other fisheries nearshore disturbance	-- N=0 p= ---	-.4168 N=8 p=.304	-- N=2 p= ---	-- N=0 p= ---	-.6101 N=14 p=.021	-- N=0 p= ---	-- N=0 p= ---	-.1858 N=24 p=.385
Marina Development	-- N=0 p= ---	0.0000 N=4 p=1.00	-- N=2 p= ---	0.0000 N=4 p=1.00	-.5618 N=14 p=.037	-- N=0 p= ---	-- N=0 p= ---	-.0570 N=24 p=.791
Marina Development/km2	-- N=0 p= ---	0.0000 N=8 p=1.00	-- N=2 p= ---	0.0000 N=4 p=1.00	-.1785 N=14 p=.542	-- N=0 p= ---	-- N=0 p= ---	.3483 N=28 p=.069
Tourism and recreation	-- N=0 p= ---	.4168 N=8 p=.304	-- N=2 p= ---	.8779 N=4 p=.122	.1437 N=9 p=.712	-- N=0 p= ---	-- N=0 p= ---	.0387 N=23 p=.861
Nutrients (DIN winter median concentration) (μmol/L)	-- N=0 p= ---	-.8649 N=8 p=.006	-- N=2 p= ---	0.0000 N=7 p=1.00	-- N=0 p= ---	-.4066 N=46 p=.005	-- N=0 p= ---	-.2184 N=63 p=.086
Natural turbidity: secchi disk (m) (mean)	-- N=0 p= ---	.3809 N=8 p=.352	-- N=0 p= ---	0.0000 N=7 p=1.00	-- N=0 p= ---	0.0000 N=38 p=1.00	-- N=0 p= ---	.0384 N=53 p=.785
Hydromorph.Pressues	-- N=2 p= ---	.0121 N=8 p=.977	-.6719 N=6 p=.144	0.0000 N=11 p=1.00	-.1610 N=14 p=.582	-.4986 N=47 p=.000	-- N=0 p= ---	-.2716 N=88 p=.010
Hydromorph.Pressues + MaintDredg	-- N=2 p= ---	-.0461 N=8 p=.914	-.7349 N=6 p=.096	-.6644 N=11 p=.026	-.1266 N=14 p=.666	-.5324 N=47 p=.000	-- N=0 p= ---	-.3010 N=88 p=.004
Resource Pressure	-- N=2 p= ---	-.3714 N=8 p=.365	.1787 N=6 p=.735	.6314 N=11 p=.037	-.2794 N=14 p=.333	-.3125 N=47 p=.032	-- N=0 p= ---	-.0700 N=88 p=.517
Env.Qual Pressure	-- N=2 p= ---	-.3422 N=8 p=.407	.5303 N=6 p=.279	-.2495 N=11 p=.459	0.0000 N=14 p=1.00	-.3029 N=47 p=.038	-- N=0 p= ---	-.0022 N=88 p=.983
Total Pressure	-- N=2 p= ---	-.3074 N=8 p=.459	-.0678 N=6 p=.898	.6959 N=11 p=.017	-.2418 N=14 p=.405	-.4661 N=47 p=.001	-- N=0 p= ---	-.1402 N=88 p=.193

Except for DE and IE (no pressure data) all other MS EQR's correlated significantly with Shoreline reinforcement pressure, decreasing the EQR as expected with the increase of pressure value (Fig.1).

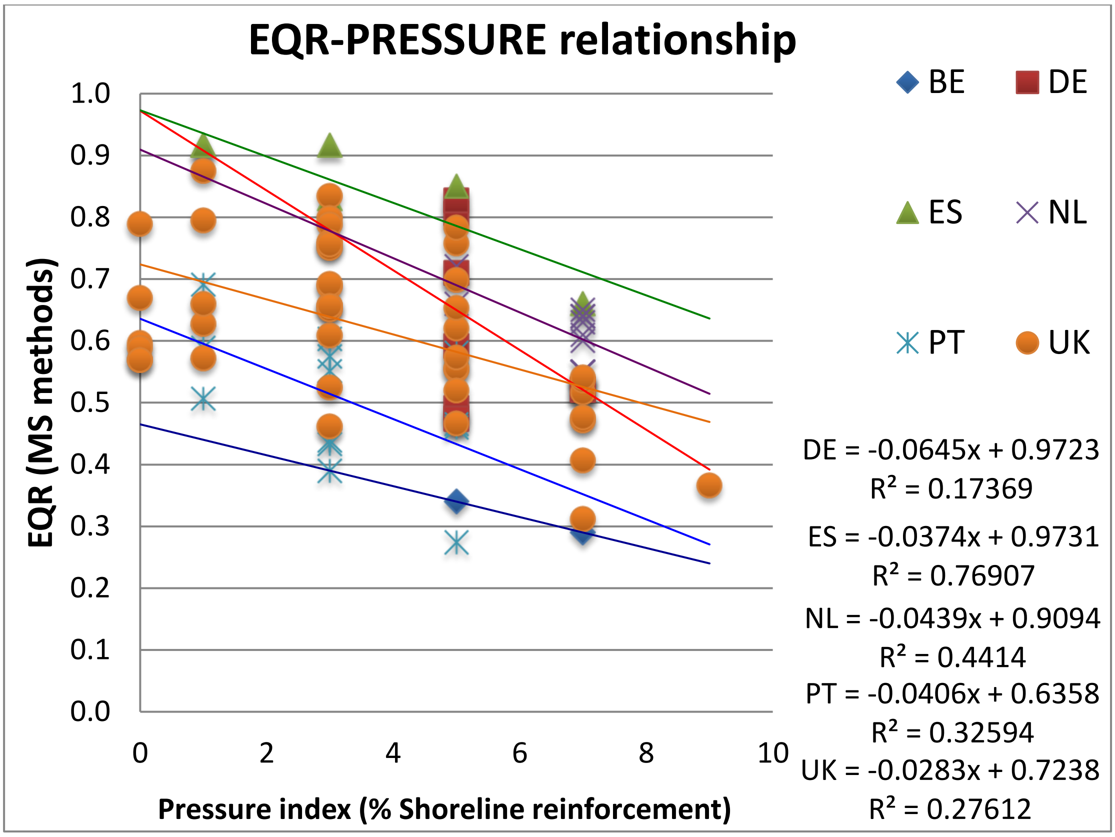

Figure 5. EQR response against pressure index (%shoreline reinforcement) using CWTW data

Benchmark standardization and offsets calculation

Offsets were determined against shoreline reinforcement pressure values (Table 2).

Table 23. Offsets calculated for CTW data (Statistica software)

	BE	DE	ES	NL	PT	UK	IE
Offsets_forStandardisation_Divi	-0.232793	0.054079	0.217069	0.090308	0.00	-0.001090	

The estimated Offsets were used to standardize EQR values before the boundaries harmonization exercise. The division method was used.

Boundaries harmonization

The boundaries harmonization was performed on IC_Opt2_div_v1.24.xlsx files, Option_2, for division method, using CTW data. The regression lines produced during the analysis show a negative response against all methods (Fig.2), but only for ES, NL, PT and UK it was significant (Table 1).

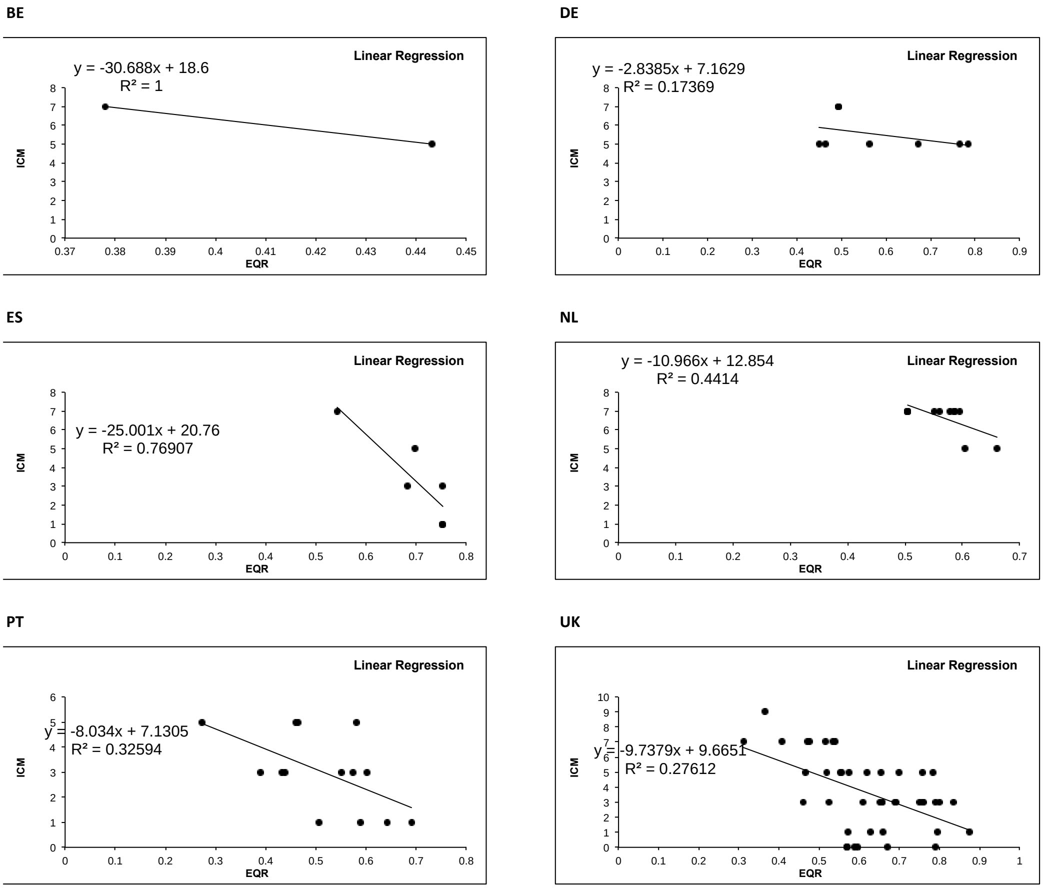

Figure 6. Regression lines between EQR and ICM (% shoreline reinforcement), for each MS using CWTW data.

Boundaries adjustment

After boundaries adjustment exercise, it is possible to see that harmonization was not possible for DE and NL for H/G classes boundary.

Table 3. Results of boundary values after harmonization using CWTW data. Red cells represent the boundary values not possible to adjust.

	BE	DE	ES	NL	PT	UK
H/G	1.108	0.759	0.698	0.734	0.800	0.801
G/M	0.978	0.569	0.493	0.550	0.600	0.601

	BE	DE	ES	NL	PT	UK
Max	1.303	0.949	0.822	0.917	1.000	1.001
H/G	1.108	0.949	0.790	0.917	0.800	0.890
G/M	0.978	0.920	0.670	0.590	0.600	0.670
M/P	0.652	0.379	0.411	0.367	0.400	0.400
P/B	0.326	0.190	0.246	0.183	0.200	0.200
CM_Max standardized	-3.567	0.894	0.073	0.399	-0.301	-0.028
CM_H/G standardized	-2.567	0.894	0.336	0.400	0.234	0.333
CM_G/M standardized	-1.900	0.910	1.336	0.912	0.770	1.047
CM_M/P standardized	-0.233	1.217	3.496	1.262	1.306	1.922
CM_P/B standardized	1.433	1.325	4.866	1.549	1.841	2.572
H width to Max	-1.000	0.000	-0.264	0.000	-0.536	-0.361
G width	-0.667	-0.016	-1.000	-0.512	-0.536	-0.714
M width	-1.667	-0.307	-2.160	-0.350	-0.536	-0.875
H/G bias	-2.746	0.714	0.157	0.220	0.055	0.153
G/M bias	-2.740	0.071	0.497	0.072	-0.070	0.207
H/G bias_CW	2.746	-43.379	-0.157	-0.430	-0.102	-0.214
G/M bias_CW	4.109	-0.231	-0.230	-0.207	0.130	-0.237
N of Bm sites	171					

Proposed values for quality class boundaries

After harmonization, the achieved boundary values were converted into MSs classification view (Table 4), by applying the Offsets on the inverse operation of standardization (section 1.2). This allowed the translation of achieved boundary class values into each MS's scale.

Table 24. Proposed values for quality class boundaries after harmonization using CWTW data

Proposed_Boundaries	BE	DE	ES	NL	PT	UK	IE
High	1.000	1.000	1.000	1.000	1.000	1.000	
High/Good	0.850	1.000	0.961	1.000	0.800	0.889	
Good/Moderate	0.750	0.970	0.815	0.643	0.600	0.669	
Moderate/Poor	0.500	0.400	0.500	0.400	0.400	0.400	
Poor/Bad	0.250	0.200	0.300	0.200	0.200	0.200	

For DE and NL was impossible to harmonize H/G boundary with Division method.

Conclusion

Harmonization of G/M boundary was possible for BE, DE, ES, NL, PT and UK (IE not integrated in this analysis), using Option_2 and division method. Harmonization of H/G boundary was not possible to DE and NL.

Annex 2. EQR values

EQR values produced by assessment methods selected to participate in the exercise.

MS	WB_Code	WB	WB_Cat.	EQR BE	EQR DE	EQR ES	EQR NL	EQR PT	EQR UK	EQR IE
BE	BE_VL05_15	Havengeul Ijzer	TW	0.29						
BE	BE_VL08_43	ZEESCHELDE IV	TW	0.34						
DE	DE_TW_T1.4000.01	Übergangsgewässer der Weser	TW		0.49					
DE	DE_TW_T1.3990.01	Übergangsgewässer Ems-Ästuar	TW		0.52					
DE	DE_TW_T1.4000.01	Übergangsgewässer der Weser	TW		0.47					
DE	DE_TW_T1.3990.01	Übergangsgewässer Ems-Ästuar	TW		0.52					
ES		Avilés	TW			0.66				
ES		Eo	TW			0.83				
ES	ES085MAT000190	Marisma de Joyel	TW			0.92				
ES	ES092MAT000140	Ría de Mogro	TW			0.92				
ES	ES113MAT000110	San Vicente de la Barquera	TW			0.92				
ES		Villaviciosa	TW			0.85				
NL		Eems-Dollard 06	TW				0.64			
NL		Eems-Dollard 95	TW				0.64			
NL		Eems-Dollard 99	TW				0.63			
NL		Westerschelde04	TW				0.65			
NL		Westerschelde83	TW				0.60			
NL		Westerschelde92	TW				0.55			
NL		Westerschelde98	TW				0.55			
UK	GB540704116000	ADUR	TW						0.31	
UK	GB510503410700	BURE & WAVENEY & YARE & LOTHING	TW						0.37	
UK	GB510503403500	BURN & MOW & OVERY & NORTON	TW						0.75	
UK	GB530804906600	CAMEL	TW						0.52	
UK	GB520804814400	CARRICK ROADS INNER	TW						0.61	
UK	GB541006614800	CONWY	TW						0.62	
UK	GB510804605900	DART	TW						0.69	
UK	GB531106708200	DEE (N. WALES)	TW						0.76	

UK	GB510804505600	EXE	TW	0.52
UK	GB521006501200	FORYD BAY	TW	0.70
UK	GB530503300300	GREAT OUSE	TW	0.54
UK	GB530402609201	HUMBER LOWER	TW	0.57
UK	GB530402609202	HUMBER MIDDLE	TW	0.60
UK	GB530402609203	HUMBER UPPER	TW	0.59
UK	GB531005913500	LOUGHOR	TW	0.83
UK	GB531207212100	LUNE	TW	0.65
UK	GB531006114100	MILFORD HAVEN INNER	TW	0.87
UK	GB511006115200	NYFER	TW	0.79
UK	GB520503613601	ORWELL	TW	0.47
UK	GB570704700000	PAGHAM HARBOUR	TW	0.55
UK	GB520804415800	POOLE HARBOUR	TW	0.80
UK	GB580705140000	PORTSMOUTH HARBOUR	TW	0.41
UK	GB531207112400	RIBBLE	TW	0.66
UK	GB530905415401	SEVERN LOWER	TW	0.56
UK	GB530905415402	SEVERN MIDDLE	TW	0.52
UK	GB530905415403	SEVERN UPPER	TW	0.47
UK	GB530207614700	SOLWAY	TW	0.79
UK	GB520704202800	SOUTHAMPTON WATER	TW	0.78
UK	GB520503403600	STIFFKEY/ GLAVEN	TW	0.76
UK	GB520503613602	STOUR (ESSEX)	TW	0.46
UK	GB540805015500	TAW / TORRIDGE	TW	0.65
UK	GB510302509900	TEES	TW	0.54
UK	GB511006206900	TEIFI	TW	0.63
UK	GB530603911401	THAMES LOWER	TW	0.48
UK	GB530603911402	THAMES MIDDLE	TW	0.57

UK	GB510202110000	TWEED	TW			0.66
UK	GB530503311300	WASH INNER	TW			0.67
UK	GB531207212200	WYRE	TW			0.57
PT	PT04MON0681	Mondego-WB1	TW		0.55	
PT	PT04MON0682	Mondego-WB2	TW		0.59	
PT	PT06MIR1368	Mira_WB1	TW		0.44	
PT	PT06MIR1367	Mira_WB2	TW		0.69	
PT	PT06MIR1374	Mira_WB3	TW		0.51	
PT	PT04VOU0552	Ria Aveiro-WB1	TW		0.46	
PT	PT04VOU0547	Ria Aveiro-WB2	TW		0.58	
PT	PT04VOU0550	Ria Aveiro-WB3	TW		0.46	
PT	PT04VOU0536	Ria Aveiro-WB4	TW		0.27	
PT	PT04VOU0514	Ria Aveiro-WB5	TW		0.39	
PT	PT06SAD1210	Sado_WB2	TW		0.64	
PT	PT06SAD1222	Sado_WB4	TW		0.57	
PT	PT06SAD1219	Sado_WB5	TW		0.60	
PT	PT06SAD1217	Sado_WB6	TW		0.43	
DE	DE_CW_N2_3100_01	Euhalines Wattenmeer der Ems	CW	0.59		
DE	DE_CW_N2_4900_01	Wattenmeer Jadebusen und angrenzende Küstenabschnitte	CW	0.81		
DE	DE_CW_N2_3100_01	Euhalines Wattenmeer der Ems	CW	0.71		
DE	DE_CW_N2_4900_01	Wattenmeer Jadebusen und angrenzende Küstenabschnitte	CW	0.83		
UK	GB620301100000	Farne Islands to Newton Haven	CW			0.69
UK	GB64050330	Norfolk North	CW			0.66

	0000				
UK	GB641008220000	Milford Haven Outer	CW		0.79
UK	GB650705150000	Solent	CW		0.57
UK	GB680301430000	Holy Island & Budle Bay	CW		0.76
NL		Oosterschelde2001	CW	0.61	
NL		Oosterschelde2007	CW	0.55	
NL		Waddenzee2001	CW	0.66	
NL		Waddenzee2007	CW	0.72	

Annex 3. Pressure values

Pressure values registered for different sampling sites

MS	WB	WB_Cat.	Land Claim (% WB area)	% Shoreline re-enforcement	Maintenance dredging area (% WB area)	Hydro morph. Pressues	Hydro morph. Pressues + MaintDredg	Resource Pressure	Env.Qual Pressure	Total Pressure
BE	Havengeul Ijzer	TW	9	7		16	16	0	0	16
BE	ZEESCHELDE IV	TW	9	5	3	14	17	6	0	20
DE	Übergangsgewässer der Weser	TW	7	5	3	12	15	25	12	49
DE	Übergangsgewässer Ems-Ästuar	TW	9	7	3	16	19	29	14	59
DE	Übergangsgewässer der Weser	TW	7	5	3	12	15	27	12	51
DE	Übergangsgewässer Ems-Ästuar	TW	9	7	3	16	19	29	14	59
ES	Avilés	TW	9	7	5	16	21	5	0	21
ES	Eo	TW	5	3	5	8	13	5	0	13
ES	Marisma de Joyel	TW	0	1	0	1	1	0	0	1
ES	Ría de Mogro	TW	0	1	0	1	1	6	9	16
ES	San Vicente de la Barquera	TW	9	3	3	12	15	17	9	38
ES	Villaviciosa	TW	9	5	1	14	15	1	0	15
NL	Eems-Dollard 06	TW	5	7	3	12	15	3	9	24
NL	Eems-Dollard 95	TW	5	7	3	12	15	3	9	24
NL	Eems-Dollard 99	TW	5	7	3	12	15	3	9	24
NL	Westerschelde04	TW	5	7	3	12	15	3	9	24
NL	Westerschelde83	TW	5	7	3	12	15	3	9	24
NL	Westerschelde92	TW	5	7	3	12	15	3	9	24
NL	Westerschelde98	TW	5	7	3	12	15	3	9	24
UK	ADUR	TW	9	7	5	16	21	5	14	35
UK	BURE & WAVENEY & YARE & LOTHING	TW	9	9	1	18	19	1	18	37
UK	BURN & MOW & OVERY & NORTON	TW	9	3	0	12	12	0	9	21
UK	CAMEL	TW	7	3	1	10	11	1	14	25
UK	CARRICK ROADS INNER	TW	5	3	1	8	9	1	18	27
UK	CONWY	TW	9	5	0	14	14	0	12	26
UK	DART	TW	5	3	0	8	8	0	14	22
UK	DEE (N. WALES)	TW	9	5	1	14	15	1	9	24
UK	EXE	TW	9	7	1	16	17	1	18	35
UK	FORYD BAY	TW	9	5	0	14	14	0	12	26
UK	GREAT OUSE	TW	9	7	3	16	19	3	18	37

UK	HUMBER LOWER	TW	9	0	3	9	12	3	18	30
UK	HUMBER MIDDLE	TW	9	0	1	9	10	1	18	28
UK	HUMBER UPPER	TW	9	0	1	9	10	1	18	28
UK	LOUGHOR	TW	9	3	0	12	12	0	9	21
UK	LUNE	TW	9	3	0	12	12	0	14	26
UK	MILFORD HAVEN INNER	TW	5	1	1	6	7	1	16	23
UK	NYFER	TW	7	0	0	7	7	0	9	16
UK	ORWELL	TW	9	7	5	16	21	5	18	39
UK	PAGHAM HARBOUR	TW	9	5	0	14	14	0	12	26
UK	POOLE HARBOUR	TW	9	3	3	12	15	3	16	31
UK	PORTSMOUTH HARBOUR	TW	9	7	5	16	21	5	12	33
UK	RIBBLE	TW	9	3	3	12	15	3	18	33
UK	SEVERN LOWER	TW	9	5	1	14	15	1	18	33
UK	SEVERN MIDDLE	TW	9	5	0	14	14	0	18	32
UK	SEVERN UPPER	TW	9	5	0	14	14	0	18	32
UK	SOLWAY	TW	7	3	0	10	10	0	14	24
UK	SOUTHAMPTON WATER	TW	7	5	5	12	17	5	18	35
UK	STIFFKEY/ GLAVEN	TW	9	3	0	12	12	0	9	21
UK	STOUR (ESSEX)	TW	9	3	3	12	15	3	16	31
UK	TAW / TORRIDGE	TW	9	5	0	14	14	0	14	28
UK	TEES	TW	9	7	7	16	23	7	18	41
UK	TEIFI	TW	5	1	0	6	6	0	9	15
UK	THAMES LOWER	TW	9	7	3	16	19	3	16	35
UK	THAMES MIDDLE	TW	9	0	5	9	14	5	18	32
UK	TWEED	TW	3	1	3	4	7	3	18	25
UK	WASH INNER	TW	9	0	1	9	10	1	16	26
UK	WYRE	TW	9	1	0	10	10	0	12	22
PT	Mondego-WB1	TW	7	3	7	12	17	15	0	27
PT	Mondego-WB2	TW	5	1	1	8	7	5	0	13
PT	Mira_WB1	TW	3	3	0	6	6	6	0	12
PT	Mira_WB2	TW	0	1	0	1	1	4	0	5
PT	Mira_WB3	TW	0	1	0	1	1	4	0	5
PT	Ria Aveiro-WB1	TW	3	5	4	6	12	11	0	17
PT	Ria Aveiro-WB2	TW	7	5	6	14	18	15	0	29
PT	Ria Aveiro-WB3	TW	3	5	4	10	12	13	0	23
PT	Ria Aveiro-WB4	TW	3	5	4	8	12	13	0	21
PT	Ria Aveiro-WB5	TW	3	3	4	8	10	13	0	21
PT	Sado_WB2	TW	3	1	5	4	9	13	0	17
PT	Sado_WB4	TW	3	3	0	6	6	4	0	10
PT	Sado_WB5	TW	3	3	3	6	9	7	0	13
PT	Sado_WB6	TW	0	3	0	3	3	6	0	9

DE	Euhalines Wattenmeer der Ems	CW	7	5	1	12	13	15	10	37
DE	Wattenmeer Jadebusen und angrenzende Küstenabschnitte	CW	9	5	3	14	17	23	12	49
DE	Euhalines Wattenmeer der Ems	CW	7	5	1	12	13	15	10	37
DE	Wattenmeer Jadebusen und angrenzende Küstenabschnitte	CW	9	5	3	14	17	25	12	51
UK	Farne Islands to Newton Haven	CW	1	3	0	4	4	0	1	5
UK	Norfolk North	CW	5	3	0	8	8	0	5	13
UK	Milford Haven Outer	CW	1	1	3	2	5	3	3	8
UK	Solent	CW	5	5	3	10	13	3	3	16
UK	Holy Island & Budle Bay	CW	7	3	0	10	10	0	3	13
NL	Oosterschelde2001	CW	5	7	3	12	15	6	0	18
NL	Oosterschelde2007	CW	5	7	3	12	15	6	0	18
NL	Waddenzee2001	CW	7	5	1	12	13	26	0	38
NL	Waddenzee2007	CW	7	5	1	12	13	26	0	38

List of abbreviations and definitions

Key Terms

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

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

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

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

Common metric: A biological metric widely applicable within a GIG or across GIGs, which can be used to derive a comparable understanding of reference conditions/alternative benchmark and boundary setting procedure among different countries/water body types
Compliance criteria: List of criteria evaluating whether assessment methods are meeting the requirements of the Water Framework Directive.

Continuous benchmarking: Option to perform the benchmark standardisation: Biological differences between national datasets were determined based on the country offsets (i.e. intercept and/or slope deviates) from the global pressure-biology relationship established using general linear models across the combined extent of the pressure gradient afforded by all countries

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

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

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

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

Joint Research Centre (JRC): European Commission Joint Research Centre which provides scientific and technical support for EU policy-making

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

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

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

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

Abbreviations:

Be:Belgium

CW: Coastal waters

CWTW: Coastal and transitional waters

DE: Germany

ES: Spain

FR: France

G/M: Good-Moderate Boundary

H/G: High-Good Boundary

IC: Intercalibration

IC2: Intercalibration exercise, phase 2

IC3: Intercalibration exercise, phase 3

ICM: Intercalibration Common Metric

IE: Ireland

NEA GIG: North East Atlantic Geographic Intercalibration Group

NL: Netherlands

PT: Portugal

RefCond: Reference Conditions

TW: Transitional waters

UK: United Kingdom

WFD: Water Framework Directive

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