

Proposed angiosperm standards for transitional waters and coastal waters for application with the sea grass bed assessment method	
Column 1	Column 2
Condition of the quality element	EQR
High	0.80
Good	0.60
Moderate	0.40
Poor	0.20

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Not yet approved by UKTAG or UK Agencies. May be subject to editorial amendments prior to publication

**UKTAG TRANSITIONAL AND COASTAL WATER ASSESSMENT
METHODS
ANGIOSPERMS
SEA GRASS (ZOSTERA) BED ASSESSMENT**

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FINAL DRAFT

1. INTRODUCTION

This method statement describes a monitoring system for monitoring, assessing and classifying transitional waters and coastal waters in accordance with the requirements of Article 8; Section 1.3 of Annex II; and Annex V of the Water Framework Directive (2000/60/EC).

1.1. Geographic application of the method

The method can be applied to transitional waters and coastal waters in England, Northern Ireland, Scotland and Wales

1.2. Quality element assessed by the method

The method enables an assessment of the condition of the quality element, "angiosperms", listed in Tables 1.2.3 and 1.2.4 of Annex V to the Water Framework Directive.

1.3. Pressures to which the method is known to be sensitive

The method has been designed to detect the impact on the quality element of general physical disturbance and nutrients.

1.4. Parameters used to assess the quality element

The method assesses the condition of the quality element by combining information on the parameters listed below. The results for each parameter are then used to produce an ecological quality ratio for the combined parameters:

- (i) Taxonomic composition;
- (ii) Shoot density;
- (iii) Spatial extent of the angiosperm bed.

2. SAMPLING AND ANALYSIS

Within this method, "sampling" means the identification and quantification of angiosperm communities within beds at sites in the intertidal zone of shores of transitional or coastal waters for the purpose of estimating the Ecological Quality Ratio.

Sampling should conform to the standards of EN 14996.

2.1. Sampling method

2.1.1. Sampling Sites

Sampling sites should be chosen to be representative of the undisturbed and disturbed parts of the intertidal zone of a water body in respect of its angiosperm community composition & patchiness, angiosperm shoot density & extent.

2.1.2. Method

Each site should be sampled visually or photographically, and with a quadrat grid. The extent of angiosperm beds may in some cases be measured by remote imagery from the air or from space.

2.1.2.1. Presence or absence of angiosperms

The presence and absence of two species of *Zostera* (*Z. noltii* and *Z. angustifolia*) and of the genus *Ruppia* (*R. maritima* and *R. cirrhosa*) should be determined visually at the chosen site.

2.1.2.2. Angiosperm shoot density

A grid of quadrats of sufficient number to obtain a representative estimate of angiosperm shoot density (the proportion of area covered by seagrass) should be used to cover the angiosperm bed. The quadrat size should usually be one metre square unless smaller quadrats are justified by the patchiness of the bed. At least three stratified randomized quadrats should be used per discrete patch of angiosperms unless the patch is less than three quadrats in area.

2.1.2.3. Angiosperm bed spatial extent

The areal extent of continuous bed (that bed where shoot density exceeds 5%) should be recorded. Estimates based on aerial photography should be checked by ground observation.

2.1.3. Sample number, timing and frequency

Angiosperm beds should be sampled in the period June to September inclusive. The change in spatial extent of an angiosperm bed should be derived from surveys in successive years.

2.2. Analytical method

2.2.1. Taxonomic composition

The presence or absence of the indigenous and expected indicator species should be determined by taxonomic inspection.

2.2.2. Shoot density

The shoot density in each quadrat should be estimated as the fractional areal cover of the quadrat by angiosperms.

The shoot density at a site should be estimated as the average shoot density of the quadrats.

2.2.3. Spatial Extent of bed

The area of the continuous angiosperm bed should be estimated photographically, visually or by mapped survey.

3. PROCEDURE FOR DERIVING THE ECOLOGICAL QUALITY RATIO FOR THE PARAMETER

3.1. Calculation of the observed values for each parameter

3.1.1. Taxonomic composition

The taxonomic composition should be derived from the number of angiosperm species present in the bed relative to the number of expected & indigenous species shown in column 1 of Table 1, and according to the corresponding row of column 2 of Table 1.

Table 1: Taxonomic composition

Column 1	Column 2
Number of expected & indigenous species	Taxonomic composition
4	Number of species present / 4
3	Number of species present / 3
2	Number of species present / 2
1	Number of species present

3.1.2. Shoot loss

The shoot loss should be estimated as:

$$\text{Shoot loss} = (1 - \text{shoot density}) \quad \text{Equation (1a)}$$

or, if fractional cover is expressed as a percentage, as

$$\text{Shoot loss} = (100 - \text{percentage cover}) / 100 \quad \text{Equation (1b)}$$

3.1.3. Extent loss

The extent loss should be estimated as:

$$\text{Extent loss} = \frac{(\text{continuous bed area in previous survey} - \text{continuous bed area})}{(\text{continuous bed area in previous survey})} \quad \text{Equation (2)}$$

3.2. Calculation of the reference values for each parameter

Reference values for the indicative parameters are shown in Column 2 of Table 2 and Column 2 of Table 3.

Table 2: Taxonomic composition, reference values and scores

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Taxonomic composition (expressed as a fraction)	1	3/4, 2/3	1/2	1/3, 1/4	0
Score	0.9	0.7	0.5	0.3	0.1

Table 3: Shoot loss & Extent loss, reference values and scores

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Shoot loss, as a percentage	0	5	15	25	35	100
Extent loss, as a percentage	0	10	30	50	70	100
Score	1	0.80	0.60	0.40	0.20	0

3.3. Calculation of the EQR value

Each indicative parameter measurement from 3.1 should be converted to a parameter score according to the appropriate table (Table 2 or Table 3) for that parameter.

3.3.1. Attribution of scores

3.3.1.1. Parameter values on a table boundary

If a parameter measurement is equal to a value in the relevant parameter row, the parameter score should be derived from the corresponding bottom (“Score”) row in the same column as that value.

3.3.1.2. Parameter values between table boundaries

If a parameter measurement lies between two adjacent boundary values in the relevant parameter row, the parameter score should be derived by linear interpolation of the corresponding two adjacent scores from the bottom (“Score”) row of the table in the same columns as the two boundary values.

The linear interpolation between upper and lower boundaries takes the form:

$$\text{score} = (\text{parameter estimate} - \text{lower boundary}) / (\text{upper boundary} - \text{lower boundary}) * (\text{score at upper boundary} - \text{score at lower boundary}) + \text{score at lower boundary} \quad \text{Equation (3)}$$

3.3.2. Taxonomic composition

A score should be attributed to the taxonomic composition derived by 3.1.1, according to Table 2.

3.3.3. Shoot Loss

A score should be attributed to the shoot loss derived by 3.1.2, according to Table 3.

3.3.4. Extent Loss

A score should be attributed to the extent loss derived by 3.1.3, according to Table 3.

3.3.5. Calculating the ecological quality ratio for the combined parameters

The Ecological Quality Ratio (EQR) for the combined parameters should be estimated as the numerical average of the indicative parameter scores estimated according to 3.3.2, 3.3.3 and 3.3.4.

FINAL DRAFT

Annex A LISTING INDICATORS

The indicators of the method are the species:

Zostera noltii, *Zostera marina* & *Zostera angustifolia* and angiosperms of the genus *Ruppia* (*R. maritima* and *R. cirrhosa*).

FINAL DRAFT

Annex B WORKED EXAMPLE

B.1 MEASUREMENTS

A site in south-west England was sampled in June with the following results:

Zostera noltii was present.

The shoot density at the site as the average of quadrat shoot density measurements was 0.49 (49%).

The area of the continuous angiosperm bed at the site was 0.15 km². The area of continuous angiosperm bed on the previous survey was 0.22 km².

B.2 TAXONOMIC COMPOSITION

The number of species present was one (*Zostera noltii*).

Historically, the site supported *Zostera noltii* and *Z. angustifolia*: the number of expected and indigenous species is two.

The taxonomic composition was derived from 3.1.1. Table 4 highlights the relevant row of Table 2.

Table 4: Taxonomic composition. Number of species = 1; expected & indigenous species = 2.

Column 1	Column 2
Number of expected & indigenous species	Taxonomic composition
4	Number of species present / 4
3	Number of species present / 3
2	Number of species present / 2
1	Number of species present

The taxonomic composition was therefore:

taxonomic composition = number of species present / 2 = 1/2 = 0.5.

B.3 SHOOT LOSS

The shoot loss was estimated according to 3.1.2 and equation 1a as:

Shoot loss = (1 – shoot density) = (1 - 0.49) = 0.51

B.4 EXTENT LOSS

The extent loss was estimated according to 3.1.3 and equation (2) as:

Extent loss = (previous continuous bed area - continuous bed area) / (previous continuous bed area)

= (0.22 – 0.15) / (0.22) = 0.07/0.22 = 0.32

B.5 SCORES FOR THE INDICATIVE PARAMETERS

A score was estimated for taxonomic composition according to 3.3. Table 5 highlights the example.

Table 5: Taxonomic composition: reference values and scores

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Taxonomic composition (expressed as a fraction)	1	3/4, 2/3	1/2	1/3, 1/4	0
Score	0.9	0.7	0.5	0.3	0.1

Scores for shoot loss and extent loss were estimated according to 3.3. Table 6 and Table 7 are modified from Table 3 so as to show the results.

Table 6: Shoot loss: reference values and scores

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Shoot loss, as a percentage	0	5	15	25	35	100
Score	1	0.80	0.60	0.40	0.20	0
Measured shoot loss	51					
Shoot loss score	0.15					

Table 7: Extent loss: reference values and scores

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Extent loss, as a percentage	0	10	30	50	70	100
Score	1	0.80	0.60	0.40	0.20	0
Measured extent loss	32					
Extent loss score	0.58					

B.6 ECOLOGICAL QUALITY RATIO

The Ecological Quality Ratio (EQR) was estimated as the numerical average of the indicative parameter scores:

$$\text{EQR} = (0.5 + 0.15 + 0.58) / 3 = 0.41, \text{ corresponding to a class of Good.}$$

Annex C FURTHER READING

Burdick, D.M. & Kendrick, G.A. (2001). Standards for seagrass collection, identification and sample design, In: Short, F.T., Coles, R.G. (Eds.), *Global Seagrass Research Methods*. Elsevier Science B.V., Amsterdam, pp. 79-100.

Duarte, C.M. & Kirkman, H. (2001). Methods for the measurement of seagrass abundance and depth distribution. In: Short, F.T., Coles, R.G. (Eds.), *Global Seagrass Research Methods*. Elsevier Science B.V., Amsterdam, pp. 141-153.

Foden, J & Brazier D.P. (2007). Angiosperms (seagrass) within the EU Water Framework Directive, a UK Perspective. *Marine Pollution Bulletin*, 55(1-6); 181-195.

Foden, J & D. J. de Jong (2007) Assessment metrics for littoral seagrass under the European Water Framework Directive; outcomes of UK intercalibration with the Netherlands. *Hydrobiologia* DOI 10.1007/s10750-006-0402-y

Stace, C. (1997). *New Flora of the British Isles* (2nd Edition). Cambridge University Press. ISBN 0521589355

BS EN 14996:2006: Water quality. Guidance on assuring the quality of biological and ecological assessments in the aquatic environment