



## Confidence of Class for Saltmarsh and Furoid Extent WFD Classification Tools



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## Summary

The Water Framework Directive (WFD) requires the Environment Agency to classify all surface waterbodies into one of five status classes (High, Good, Moderate, Poor or Bad) and to quantify the level of confidence associated with waterbody classifications (termed a 'confidence of class' assessment).

The Environment Agency has recently developed classification tools for two new biological quality elements – saltmarsh and furoid extent – and commissioned WRc to develop a statistical methodology for quantifying the risk of water body mis-classification. The methodology was then implemented in the form of two MS Excel spreadsheet tools:

- SKIPPER, which calculates confidence of class for the saltmarsh tool; and,
- TREASURE, which calculates confidence of class for the furoid extent tool.

This report describes the sources of uncertainty that are considered in the confidence of class assessment, documents the statistical methodology used to quantify and combine these errors, and highlights any approximations or assumptions that are made.



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# 1. Introduction

## 1.1 Background

The Water Framework Directive (WFD) requires the Environment Agency (EA) to classify all surface waterbodies into one of five status classes: High, Good, Moderate, Poor or Bad. In addition, the Agency is required to quantify the level of confidence associated with waterbody classifications. These estimates need to be stated in the river basin management plan and will guide the development of cost-effective programmes of measures.

In an ideal world of comprehensive monitoring data containing no errors, waterbodies would always be assigned to their true class with 100% confidence, but in reality estimates of the truth based on monitoring are always subject to error. Understanding and managing the risk of misclassification as a result of uncertainties in the results of monitoring is important on two counts; first, because of the potential to fail to act in cases where a waterbody has been wrongly classified as being of better status than it is, and secondly because of the risk of wasting resources on waterbodies that have been wrongly classified as worse than they are.

The ecological status of transitional (estuarine) and coastal water bodies is assessed using a variety of biological quality elements, including saltmarsh and estuarine fucoids. For each quality element, the ecological status of the water body is measured by an Ecological Quality Ratio (EQR), which comprises one or more metrics that measure different aspects of biological community. For example, the saltmarsh assessment tool has six metrics. EQRs take a value between 0 and 1, and this range is split into five status classes (Bad, Poor, Moderate, Good and High).

For classification purposes, the estimated EQR is translated directly into a face value class. However, because it is not possible to survey biological community perfectly across whole waterbody, there will always be some sampling error and measurement error, which will lead to uncertainty in the estimate of the EQR. This uncertainty can be quantified as the expected difference between the observed EQR and the true underlying EQR, which can then be used to calculate the probability of the waterbody being in each of the five status classes. From this it is possible to determine the most probable class (the one with the highest probability) and state what level of confidence we have that the true status is good or better, and moderate or worse. This is termed a confidence of class (CofC) assessment.

## 1.2 Scope of project

The Environment Agency has recently developed classification tools for two new biological quality elements – saltmarsh and fucoid extent – and commissioned WRc to develop a statistical methodology for quantifying the risk of water body mis-classification. The methodology was then implemented in the form of two MS Excel spreadsheet tools:

- SKIPPER, which calculates confidence of class for the saltmarsh tool; and,
- TREASURE, which calculates confidence of class for the furoid extent tool.

This report briefly summarises the work undertaken and documents the statistical methodology used in the spreadsheet tools. Chapter 2 summarises the classification approach for the saltmarsh tool and documents the statistical calculations used to perform the confidence of class assessment, and Chapter 3 summarises the classification approach for the furoid extent tool and documents the statistical calculations used to perform the confidence of class assessment.

## 2. Saltmarsh Tool

### 2.1 Overview of classification process

The WFD saltmarsh tool assesses the ecological health of saltmarsh habitats in transitional and coastal waters. It is a multimetric index composed of six individual components known as metrics, these are:

1. saltmarsh extent as proportion of “historic saltmarsh” (SMAh);
2. saltmarsh extent as proportion of the intertidal (SMAi);
3. change in saltmarsh extent over two or more time periods ( $\Delta$ SMA);
4. proportion of saltmarsh zones present (Zn/5);
5. proportion of saltmarsh area covered by the dominant saltmarsh zone (ZnMax);
6. proportion of observed taxa to historical reference value or proportion of observed taxa to 15 taxa (Th or T15).

Each metric is scored, and then converted to an EQR between 0 and 1. Table 2.1 summarises the class boundaries for each metric, and shows how metric scores translate into EQR values. Three metrics – SMAh,  $\Delta$ SMA, and Th/T15 – can potentially yield EQRs greater than 1, in which case they are truncated to 1.

**Table 2.1 Metric and EQR class boundaries for the saltmarsh tool**

SMAh	SMAi	$\Delta$ SMA	Zn/5	ZnMaz	Th or T15	EQR
100%	100%	1.00	1.0	20%	1.0	<b>1.0</b>
80%	50%	0.90	0.8	30%	0.8	<b>0.8</b>
60%	25%	0.75	0.6	40%	0.6	<b>0.6</b>
40%	10%	0.50	0.4	60%	0.4	<b>0.4</b>
20%	5%	0.25	0.2	80%	0.2	<b>0.2</b>
0%	0%	0.00	0.0	100%	0.0	<b>0.0</b>

The final, multi-metric EQR is calculated as a weighted average of the six metrics. Th is used in preference to T15. The multi-metric EQR ranges from 0 to 1 and provides an overall measure of saltmarsh changes in response to anthropogenic pressures.

For further details on the saltmarsh tool, including how the survey data are collected, processed and interpreted, see: '*Practitioners Guide to the Saltmarsh Tool – Water Framework Directive: Transitional and Coastal Waters*'.

## 2.2 Calculating the metric scores

### 2.2.1 Metric 1: Saltmarsh extent as a proportion of historic saltmarsh (SMA<sub>h</sub>)

#### Metric calculation

Metric 1 divides the most recently measured saltmarsh extent ( $X_r$ ) by the historic extent ( $X_h$ ):

$$SMA_h = \frac{X_r}{X_h}$$

The metric generally takes values between 0 and 1, but can take values >1 if the historic extent has been under-estimated or the area of saltmarsh has grown. Scores >1 are truncated to 1.

The metric is not calculated if there was no saltmarsh historically.

#### Sources of error

The current areal extent of the saltmarsh is assumed to be measured with a precision of  $P_r$  % at 95% confidence. The level of precision is defined by the user and can be set via the Settings worksheet. The default is  $\pm 5\%$ . Errors are assumed to be Normally distributed.

The historic reference is assumed to be known without error.

#### Standard error calculation

The SE is 0 if there is no saltmarsh present ( $X_r = 0$ ).

If there is saltmarsh present, the SE is calculated as:

$$SE(SMA_h) = \frac{X_r}{X_h} * \frac{P_r/100}{1.96}$$

### 2.2.2 Metric 2: Saltmarsh extent as a proportion of the intertidal (SMA<sub>i</sub>)

#### Metric calculation

Metric 2 divides the most recently measured saltmarsh extent ( $X_r$ ) by the intertidal area ( $X_a$ ):

$$SMA_i = \frac{X_r}{X_a}$$

The metric takes values between 0 and 1. The metric is not calculated if the intertidal area is not known.

### Sources of error

The current areal extent of the saltmarsh is assumed to be measured with a precision of  $P_r$  % at 95% confidence. The level of precision is defined by the user and can be set via the Settings worksheet. The default is  $\pm 5\%$ . Errors are assumed to be Normally distributed.

The intertidal area is assumed to be known without error.

### Standard error calculation

If there is no saltmarsh present, the SE is 0.

If there is saltmarsh present, the SE is calculated as:

$$SE(SMA_i) = \frac{X_r}{X_a} * \frac{P_r/100}{1.96}$$

## 2.2.3 Metric 3: Change in saltmarsh extent ( $\Delta SMA$ )

### Metric calculation

Metric 3 calculates the proportional change in areal extent between the previous survey ( $X_1$ ) and the most recent survey ( $X_2$ ):

$$\Delta SMA = \frac{X_2}{X_1}$$

The metric takes values  $\geq 0$ . Scores  $> 1$  indicate that the saltmarsh has grown in area since the previous survey, and are truncated to 1. If  $X_1 = 0$  and  $X_2 > 0$ , then the metric takes a value of 1.

The metric is not calculated if  $X_1$  or  $X_2$  are unknown (i.e. there has been only one survey).

### Sources of error

The areal extent of the saltmarsh is assumed to be measured with a precision of  $P_r$  % at 95% confidence. The level of precision is defined by the user and can be set via the Settings worksheet. The default is  $\pm 5\%$ . Errors in the measurement of the saltmarsh area in the two time periods are assumed to be Normally distributed, equal and independent.

## Standard error calculation

If saltmarsh is absent in either survey, the SE is 0.

If saltmarsh is present in both surveys, the SE is approximated by:

$$SE(\Delta SMA) = \Delta SMA * \sqrt{2 * \left(\frac{P_r/100}{1.96}\right)^2}$$

This is a close approximation of the true SE so long as the metric score is close to 1 (i.e.  $X_2 \approx X_1$ ). The SE will be over-estimated when the metric score is much less than 1 and under-estimated when the metric score is much more than 1.

## 2.2.4 Metric 4: Proportion of saltmarsh zones present (Zn/5)

### Metric calculation

Metric 4 is calculated as the proportion of saltmarsh zones present (out of five). It takes values between 0 and 1.

### Sources of error

It is assumed that all zones will be detected if present, hence there is no error associated with this metric.

### Standard error calculation

The SE is assumed to be 0.

## 2.2.5 Metric 5: Proportion of saltmarsh area covered by the dominant saltmarsh zone (ZnMax)

### Metric calculation

Metric 5 is calculated by dividing the area of largest saltmarsh zone ( $X_{max}$ ) by the combined area of all five saltmarsh zones ( $X_c$ ):

$$ZnMax = \frac{X_{max}}{X_c}$$

The metric takes values between 0.2 (no dominance) and 1 (total dominance by one functional zone).

The metric is not calculated if saltmarsh is absent.

## Sources of error

The area of each saltmarsh zone is assumed to be measured with a precision of  $P_z$  % at 95% confidence. The level of precision is defined by the user and can be set via the Settings worksheet. The default is  $\pm 5\%$ . Errors in the measurement of each saltmarsh zone are assumed to be Normally distributed, equal and independent.

Note that the combined saltmarsh area ( $X_c$ ) may not exactly match the total saltmarsh area ( $X_r$ ) used in metrics 1, 2 and 3. The errors associated with  $X_c$  and  $X_r$  are not necessarily the same either.

## Standard error calculation

The relative SE of the largest zone's area is:

$$SE(X_{max}) = \frac{P_z/100}{1.96} * X_{max}$$

The SE of the combined saltmarsh area is:

$$SE(X_c) = \sqrt{\left(\frac{P_z/100}{1.96}\right)^2 * \sum_{i=1}^5 X_i^2}$$

The SE of the ZnMax metric is approximated by:

$$SE(ZnMax) = ZnMax * \sqrt{\left(\frac{SE(X_{max})}{X_{max}}\right)^2 + \left(\frac{SE(X_c)}{X_c}\right)^2}$$

This is only an approximation of the true SE, because the SE of the combined saltmarsh area will be correlated to some extent with the SE of the largest area. The SE will be over-estimated by roughly 20% when the saltmarsh zones are of equal area (i.e. ZnMax = 0.2).

The SE is 0 if there is only one zone present.

## 2.2.6 Metric 6: Taxa count as proportion of historic reference (Th) or 15 taxa (T15)

### Metric calculation

Metric 6 is calculated by dividing the observed number of taxa ( $X_o$ ) by the number of reference taxa ( $X_e$ ):

$$T_{h \text{ or } 15} = \frac{X_o}{X_e}$$

The reference value is derived either from National Biodiversity Network (NBN) historic data or, failing that, from a reduced list of 15 common taxa.

The metric takes values  $\geq 0$ . Scores  $>1$  indicate that more taxa were observed than recorded historically. These scores are truncated to 1.

### Sources of error

The observed number of taxa is assumed to be under-estimated by a fixed percentage,  $P_o$ %. This bias is defined by the user and can be set via the Settings worksheet. The data are not corrected for this potential bias (i.e. the classification is slightly pessimistic), and instead the bias is treated as a Normally distributed random error.

The reference number of taxa is assumed to be known without error.

### Standard error calculation

The SE calculations are the same regardless of which reference value is used.  $T_h$  is used in this example.

The lower 95% confidence limit for  $T_h$  is taken to be  $T_h$ , and the upper 95% confidence limit is calculated as:

$$\frac{T_h}{1 - P_o/100}$$

The SE of metric 6 is then calculated as:

$$SE(T_h) = \frac{\frac{T_h}{1 - P_o/100} - T_h}{2 * 1.96} = \frac{T_h * \frac{1}{1 - P_o/100} - \frac{1 - P_o/100}{1 - P_o/100}}{2 * 1.96} = \frac{T_h}{2 * 1.96} * \frac{P_o/100}{1 - P_o/100}$$

## 2.3 Calculating the metric EQRs

Having calculated each metric score and its standard error (see Section 2.2 above), the next step is to convert the metric score into an EQR and to calculate the SE of the estimated EQR.

### EQR Calculation

For three of the metrics – SMAh, Zn/5 and Th/T15 – the metric scores are directly proportional to the EQRs, so no conversion is needed (except that metric scores above 1 are truncated).

For the other three metrics, the face value metric scores are converted to an EQR (0-1) scale by interpolating linearly between the class boundaries.

## SE Calculation

The standard error of each metric EQR is approximated as follows:

1. The metric score and its SE are used to calculate upper and lower 95% confidence limits around the metric score ( $\pm 1.96 * SE$ ).
2. The upper and lower 95% confidence limits are converted from metric scores to EQRs (using the normalisation process described above). Upper and lower confidence limits >1 are truncated to 1.
3. The upper and lower confidence 95% limits around the EQR are used to estimate the SE of the EQR:

$$SE_{EQR} = \frac{U95CL - L95CL}{2 * 1.96}$$

Each of the six metrics therefore yields an EQR and an associated SE which measures the degree of uncertainty in the EQR estimate.

## 2.4 Calculating the Final EQR

### Calculation

The final, multi-metric EQR ( $EQR_{MM}$ ) is calculated as a weighted average of the available metrics ( $EQR_i$ ), and takes values between 0 and 1. It is calculated when at least four of the six component metrics have been estimated:

$$EQR_{MM} = \frac{\sum_{i=1}^6 w_i * EQR_i}{\sum_{i=1}^6 w_i}$$

SMAh, Zn/5 and Th have a weighting of 1.0, SMAi, ZnMax and T15 have a weighting of 0.5, and  $\Delta$ SMA has a weighting of 1.5. Th is used in preference to T15.

### Sources of error

The six metrics each quantify a different aspect of the saltmarsh community, and together constitute the entire population of metrics used by the tool. The uncertainty in the final EQR therefore depends not on the variability among the six metric EQRs, but on the error associated with each metric EQR.

The measurement error in each component metric EQR is assumed to be random and Normally distributed, and is quantified by a standard error ( $SE_i$ ).

Because some survey data is used to compute more than one metric, their errors are assumed to be perfectly correlated. This is a worst-case assumption, and yields a pessimistic confidence of class assessment.

### Standard error calculation

The SE of the final EQR is calculated as a weighted average of the SE of the contributing metrics ( $SE_i$ ):

$$SE(EQR_{MM}) = \frac{\sum_{i=1}^6 w_i * SE_i}{\sum_{i=1}^6 w_i}$$

### Confidence of class

The multi-metric EQR and its associated SE are used to calculate the confidence that the true EQR falls in each of the five status classes.

Following the approach of Ellis & Adriaenssens (2006), we chose not to assume that the uncertainty is Normally distributed around the specified true EQR value. Although this model is quite acceptable for most EQR values, it becomes unsatisfactory at either extreme, because the assumed distribution 'spills' outside the permitted 0-1 range.

For this reason we applied a logit transformation, whereby the estimated EQR is transformed to a new variable  $Z$  given by:

$$Z = \ln\left(\frac{EQR_{MM}}{1 - EQR_{MM}}\right)$$

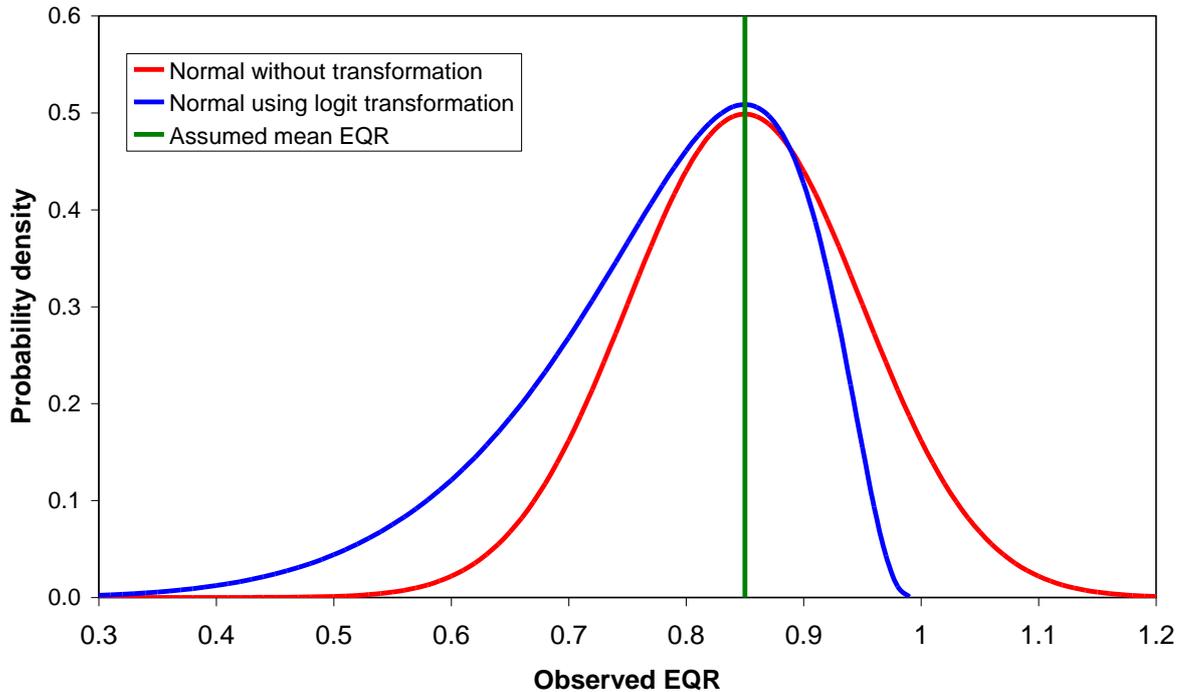
And the SE of  $Z$  is given by:

$$SE(Z) = \frac{SE(EQR_{MM})}{EQR_{MM} * (1 - EQR_{MM})}$$

where  $\ln$  denotes 'logs to base e'. As  $EQR_{MM}$  runs from 0 to 1, the transformed variable  $Z$  runs from  $-\infty$  to  $+\infty$ , and so there is no longer any risk of spillage. Thus it is possible to safely use the assumption of Normal error in the logit world, and then transform the resulting distribution back into the EQR world.

Figure 2.1 shows the situation in which the EQR and standard error are 0.85 and 0.10, respectively. Under the simple Normality assumption, an appreciable part of the right-hand tail spills beyond  $EQR = 1$ . In contrast, the logit transformation ensures that the error distribution ends asymptotically at 1 (at the expense of a longer left-hand tail so as to achieve the required standard deviation).

**Figure 2.1 Illustration of the effect of the logit transformation of EQR**



Let the four status class boundaries be denoted by  $L_5, L_4, L_3$  and  $L_2$  (in the order Bad/Poor  $\rightarrow$  Good/High). Suppose we observe a transformed EQR value of  $Z$ , with a standard error of  $SE(Z)$ . The aim is to determine the levels of confidence we have that the true quality (at the time and place of sampling) is respectively in Class 5, 4, 3, 2 and 1. To do this, we first do four calculations. For each In-transformed class boundary ‘ $i$ ’ in turn, we ask the question: What is the probability  $p_i$  of observing an EQR of  $Z$  or better if the true mean quality,  $\mu$ , were on the  $L_i$  boundary? This can be calculated as:

$$p_i = 1 - \Phi\left(\frac{Z - \mu}{SE(Z)}\right)$$

where  $\Phi$  denotes the cumulative Normal probability.

We can turn this into a confidence statement by inverting it in the customary way, giving:

$$\text{Confidence } (Z \geq L_i) = 100(1 - p_i)$$

This enables us to make the following five statements:

- Confidence of class 5 (Bad) =  $100p_5$ .

- Confidence of class 4 (Poor) =  $100(p_4 - p_5)$ .
- Confidence of class 3 (Moderate) =  $100(p_3 - p_4)$ .
- Confidence of class 2 (Good) =  $100(p_2 - p_3)$ .
- Confidence of class 1 (High) =  $100(1 - p_2)$ .

Note that these five quantities sum to 100%.

## 3. Furoid Extent Tool

### 3.1 Overview of classification process

The WFD furoid extent tool assesses the ecological status of macroalgae in transitional waters. The tool is designed to detect the impact of toxic substances on the distribution of the furoid macroalgal species.

The WFD status class boundaries are defined on the presence of furoid zones (Table 3.1). The High, Good and Moderate classes are defined in terms of the median salinity at the freshwater (upstream) limit of the furoid in the estuary. Where no furoids are present, the Poor and Bad classes are defined in terms of the presence/absence of other macroalgal species.

**Table 3.1 Definition of furoid extent status classes**

Status Class	Description	EQR
High	Zone B (furoid dominated zone) extends upstream to a point where the median salinity is below 6 and possibly to tidal freshwater	0.8 – 1.0
Good	Zone B (furoid dominated zone) extends upstream to a point where the median salinity is between 6 and 12	0.6 – 0.8
Moderate	Zone B (furoid dominated zone) extends upstream to a point where the median salinity is between 12 and 30	0.4 – 0.6
Poor	No zone B (furoid dominated zone) present in the estuary – only zone C species present, even in lower estuary	0.2 – 0.4
Bad	No macroscopic algal community visible in estuary	0.0 – 0.2

The status of the water body is scored as an EQR ranging from 0 to 1. Where a water body has several significant arms, each arm is surveyed separately and their EQRs are averaged to yield an overall water body EQR.

This report is concerned solely with estimating the status of transitional water bodies using salinity data; the qualitative classification of Poor and Bad status is assumed to be straightforward and not subject to error.

For further details on the furoid extent tool, including how the survey data are collected, processed and interpreted, see: *'Practitioners Guide to Furoid Extent Tool – Water Framework Directive: Transitional Waters'*.

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## 3.2 Calculating the salinity metric for each arm

### 3.2.1 Calculation

The salinity metric is calculated for every arm in every water body.

First, a survey is undertaken to determine the upstream fucoid limit. Salinity at that location is then monitored continuously using *in situ* probes for a minimum of four two-week periods spanning a range of high and low conditions. Each two-week survey period is timed to include both spring and neap tides.

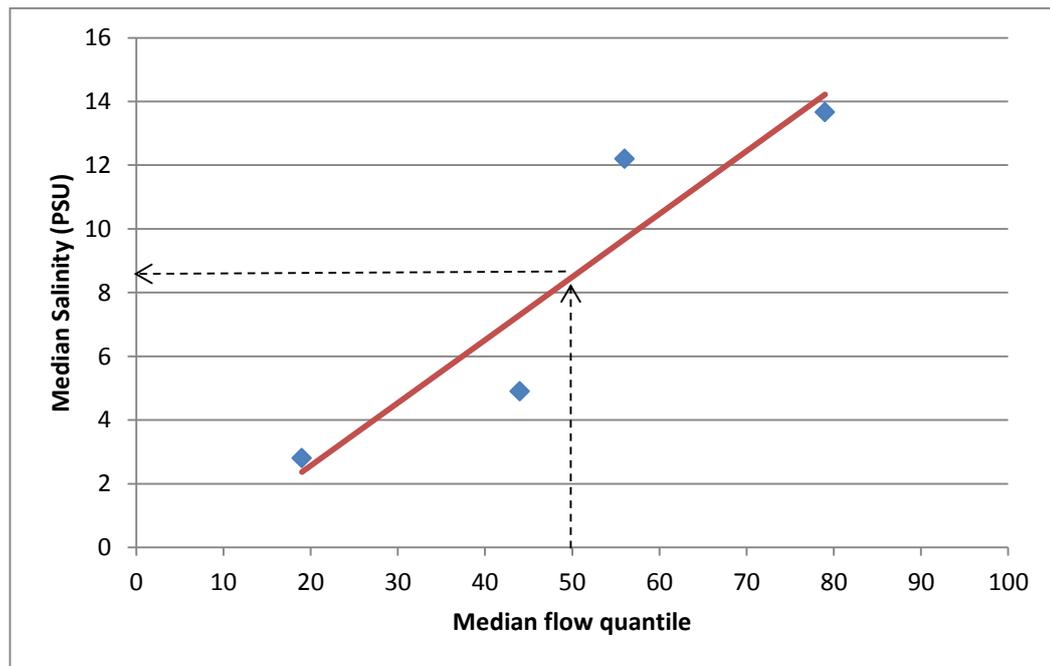
The salinity data is then processed to remove measurements taken when the probe was exposed to the air, and to ensure that tidal and flow conditions are fairly represented. The cleaned data is used to calculate the median salinity during each survey.

The median flow during each two-week survey and the preceding two weeks is calculated using data from a suitable upstream gauging station. The median flow is then expressed as a quantile of the long-term (10 year) flow duration curve.

The median salinity during each survey is regressed against the corresponding median flow using a standard linear regression model. The regression relationship is then used to predict the median salinity at the long-term median flow ( $Q_{50}$ ). This is the normalised salinity metric ( $S_{Q50}$ ).

Table 3.1 shows an example for a hypothetical water body with four survey data points. The median salinity at the long-term median flow is estimated to be 8.49 PSU.

Figure 3.1 Example salinity-flow regression model



### 3.2.2 Sources of error

It is assumed that the upstream fucoid limit has been properly identified. In reality, the upstream limit will sometimes be under-estimated. Where this is the case, the measured salinities will over-estimate those at the true upstream limit, so introducing a pessimistic bias to the classification result. It is not possible to estimate the degree of bias and so no correction is made.

It is assumed that the measurements taken during each two-week survey provide an accurate measure of the salinity conditions experienced by the fucoids at that location.

The main source of error is therefore the 'lack of fit' in the salinity-flow regression model, which leads to uncertainty in the calculated salinity metric.

### 3.2.3 Standard error calculation

The uncertainty in the normalised salinity metric ( $S_{Q50}$ ) is quantified by the standard error of the regression prediction (SE):

$$SE(S_{Q50}) = \sigma \sqrt{\frac{1}{n} + \frac{(x_0 - \bar{x})^2}{\sum_{i=1}^n (x_i - \bar{x})^2}}$$

where:

- $\sigma$  = the residual standard error of regression model;
- $n$  = the number of surveys (minimum of 4);
- $x_0$  = the long term median flow ( $Q_{50}$ );
- $x_i$  = the median flow during the  $i^{\text{th}}$  survey; and,
- $\bar{x}$  = the average of the median flows across the  $n$  surveys.

### 3.3 Calculating the EQR for each arm

Having calculated the salinity metric and its standard error (see Section 3.2 above), the next step is to convert the metric score into an EQR and to calculate its SE.

#### EQR Calculation

The normalised salinity metric is converted to an EQR (0-1) scale by interpolating linearly between the class boundaries (Table 3.1).

In the unlikely event that the salinity metric is greater than 30 PSU (i.e. below the Moderate/Poor boundary), the EQR is set at 0.4.

#### SE Calculation

The standard error of the EQR is approximated as follows:

1. The salinity metric score and its SE are used to calculate upper and lower 95% confidence limits ( $\pm 1.96 * SE$ ), assuming normally distributed errors.
2. The upper and lower 95% confidence limits are converted from metric scores to EQRs (using the process described above). Upper and lower confidence limits  $< 0.4$  are truncated to 0.4.
3. The upper and lower confidence 95% limits around the EQR are used to estimate the SE of the EQR:

$$SE_{EQR} = \frac{U95CL - L95CL}{2 * 1.96}$$

The  $SE_{EQR}$  measures the degree of uncertainty in the EQR estimate.

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## 3.4 Calculating the water body EQR

### Calculation

If the water body has just a single arm, the EQR of the arm ( $EQR_A$ ) is taken to be the EQR of the water body ( $EQR_{WB}$ ).

If the water body has multiple arms, the water body EQR is calculated as the arithmetic mean of the EQRs for all the arms in the water body.

### Sources of error

Where a water body has multiple arms, those arms together constitute the entire population of arms (rather than a random sample from a larger number of arms). The uncertainty in the water body EQR therefore depends not on the variability among the arm EQRs, but on the error associated with each EQR.

The error in each EQR is assumed to be random and Normally distributed, and is quantified by a SE.

### Standard error calculation

Given that multiple arms are likely to be surveyed at the same times, the errors in the arm EQRs are assumed to be perfectly correlated. This is a worst-case assumption, and yields a pessimistic confidence of class assessment. The SE of the water body EQR is therefore calculated by averaging the SEs of the EQRs for the various arms.

Note: The Welch-Satterthwaite formula is not used to calculate the degrees of freedom for this SE because the errors in the arm EQRs are assumed to be perfectly correlated, rather than independent.

### Confidence of class

The water body EQR and its associated SE are used to calculate the confidence that the true EQR falls in each of the five status classes. This follows exactly the same approach as used by the saltmarsh tool (see Section 2.4).



## References

Ellis, J.C. and Adriaenssens, V. (2006) Uncertainty estimation for monitoring results by the WFD biological classification tools. EA Science Report GEHO1006BLOR\_E\_P, October 2006.