

## **RIVERS – Invertebrates – WHPT**

### **The Effect of the Change to WHPT on Bias**

#### **(3.1 Calculation of the observed value of each parameter)**

The proposed changes to the index used for WFD reporting (from BMWP/ASPT to WHPT) have considerable implications for the calculation of bias. However, before discussing these points in detail, it is important to clarify exactly what bias is and the fundamental part it plays in the proper use of biological indices for estimation of EQR.

Bias is essentially the underestimate of scoring taxa brought about by procedural errors during laboratory processing of samples (i.e. taxa that are overlooked in sorting or mis-identified). Such errors mean that the 'true' score for a sample is underestimated and, thus, there is an inherent tendency to underestimate the ecological quality of a given site. Hence, bias is not specific to the BMWP/ASPT index, but is inherent to any index that is compared to a reference to produce an EQR. Bias correction is used to correct EQR so that any difference in reported quality (relative to reference condition) is due to differences in 'true' ecological quality and not due to procedural errors.

Bias can be quantified/estimated through having an external audit, where a proportion of samples are re-processed and compared to the primary analysis. This allows a bias correction to be applied. However, a crucial point is that bias is specific to the index being used. The correct estimate of bias must be used.

There are three major aspects to the change to WHPT that will influence bias in a way that has not been fully accounted for.

1. Extended list of WHPT-scoring taxa compared with BMWP-scoring taxa.
2. Addition of abundance categories in assigning a score to each taxa
3. Seasonal estimation of WHPT.

#### **Extended list of taxa**

WHPT includes a considerably longer list of scoring taxa compared to the BMWP/ASPT index and includes numerous dipteran families that are cryptic and commonly missed in sample sorting. Three of the families to be included (Empididae, Ceratopogonidae and Psychodidae) are consistently in the top 5 most frequently missed taxa for Environment Agency samples. Based on audit work for the Environment Agency from 2004 to 2010, the dipteran taxa to be included in WHPT account for, on average, 22.5% of the sample gains by primary analysts. These gains are non-scoring under the BMWP index and as such do not have any influence on ASPT scores, but they will contribute to a considerable underestimate in WHPT scores.

#### **Abundance weighting of scores**

The use of log-abundance categories introduces a further source of bias that has previously never been accounted for. The scores for some taxa vary greatly with abundance and, because abundance estimation is susceptible to human error during processing, it is an aspect that requires auditing.

Auditing will be able to provide a measure of bias due to errors in abundance estimation, which can then be used for correction.

### **Seasonal estimation**

It is recognised that WHPT requires seasonal estimation of EQRs and that seasonal abundance data cannot be pooled in the same way as for seasonal BMWP presence/absence data. It is necessary, therefore, to have *seasonal estimates of bias* that can be applied to the index prior to taking an annual average.

In conclusion **it is certainly not the case that bias estimation can be dropped from the derivation of WHPT EQRs**, particularly as bias is likely to be larger than for previous indices. The extent to which the new index increases bias can only be assessed by robust auditing procedures.

### **The Effect of the Change to WHPT on Uncertainty**

The introduction of WHPT to replace ASPT/NTAXA is in effect two modifications.

- 1) A new index relating the response of invertebrate taxa to pressure.
- 2) An introduction of an abundance element to the index scores.

These have two separate effects on accuracy and precision of estimates of ecological quality.

- 1) If it is proven that the new index (WHPT) is better aligned with pressure than the previous index this change is beneficial, as it will result in a more accurate estimation of pressure.
- 2) The abundance element has been introduced to improve the amount of information obtained from the invertebrate community and, hence, the accuracy of estimation of pressure. However, abundance is dependent upon sampling effort and, therefore, WHPT scores are more susceptible to inter-operator variability than indices based on presence/absence of taxa. ASPT was introduced (rather than BMWP) specifically to address the effect of variation in sampling effort among workers. It is recommended that the variability (uncertainty) in WHPT associated with variation in sampling effort among workers should be quantified (e.g. through a BAMS study). Although the abundance element of WHPT may improve accuracy of estimates of pressure this will be counteracted by a reduction in precision.

## **RIVERS – Invertebrates - WFD–AWIC**

### **LAKES – Invertebrates - LAMM**

Akin to the use of WHPT, the proposed use of the WFD-AWIC and LAMM indices has considerable implications for the calculation of bias. As stated above, bias is essentially the underestimate of EQR brought about by procedural errors during laboratory processing of samples (i.e. taxa that are overlooked in sorting or mis-identified). It is inherent to any index that is compared to a reference to produce an EQR. Bias correction is used to correct EQR so that any difference in reported quality is due to differences in 'true' ecological quality and not due to procedural errors.

Bias can be quantified/estimated through having an external audit, where a proportion of samples are re-processed and compared to the primary analysis. This allows a bias correction to be applied. However, bias is specific to the index being used. The correct estimate of bias must be used.

There are two aspects to the use of WFD-AWIC and LAMM that will influence bias in a way that has not been fully accounted for.

1. The list of WFD-AWIC and LAMM-scoring taxa compared with BMWP-scoring taxa.
2. Addition of abundance categories in assigning a score to each taxa

#### **Extended list of taxa**

WFD-AWIC and LAMM use TL5, and hence a different list of scoring taxa compared to the BMWP/ASPT index which are taken to a higher degree of resolution. A quality assurance audit of samples processed to this higher resolution will be required to estimate the effect of sample processing errors on WFD-AWIC and LAMM, which can then be used for correction.

#### **Abundance weighting of scores**

The use of log-abundance categories introduces a further source of bias that has previously never been accounted for. The scores for some taxa vary greatly with abundance and, because abundance estimation is susceptible to human error during processing, it is an aspect that requires auditing. Auditing will be able to provide a measure of bias due to errors in abundance estimation, which can then be used for correction.