UKTAG River Assessment Method

Benthic Invertebrate Fauna

Invertebrates (General Degradation): Walley, Hawkes, Paisley & Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT)

by

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Health and safety statement

WARNING. Working in or around water is inherently dangerous; persons using this standard should be familiar with normal laboratory and field practice. This published monitoring system does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate health and safety practices and to ensure compliance with any national regulatory guidelines.

It is also the responsibility of the user if seeking to practise the method outlined here, to gain appropriate permissions for access to water courses and their biological sampling.

UKTAG Guide to Invertebrates in Rivers

Invertebrates (General Degradation): Walley, Hawkes, Paisley & Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT)

1 Introduction

This classification method enables the assessment of invertebrates in rivers (in relation to general degradation, including organic pollution) according to the requirements of the Water Framework Directive (WFD). WHPT metrics replace the BMWP (Biological Monitoring Working Party) metrics used for status classifications in the first river basin planning cycle. Walley & Hawkes (1996 &1997) and Paisley *et al.* (2007) give a description of the WHPT index, and its derivation.

The River Invertebrate Classification Tool (RICT) (Davy–Bowker et al (2007)) is used to contextualize WHPT scores, by using a RIVPACS (River Invertebrate Prediction And Classification System (Wright (1997)) model to predict site specific reference values and provide a WFD compliant probabilistic classification.

RICT is a web-served application provided by the UK environment agencies, accessed via the RICT Website hosted by the Freshwater Biological Association, Copies of the manual, guidance & background documents are available in the same place. Intending users should be aware training is available within the UK environmental regulatory agencies and from the FBA.

1.1 Metrics

The classification comprises two metrics that are assessed separately and then combined in a “worst of” approach to provide the overall invertebrate classification;

WHPT ASPT (Average Score Per Taxon)

WHPT NTAXA (Number of taxa contributing to the assessment)

RICT output includes an EQR, a face value classification and an estimate of the probability of the result belonging to any of the WFD classes. This is provided individually for both of the metrics.

For the purposes of WFD assessment, WHPT ASPT is applied as an abundance weighted metric.

Ecological Quality Ratios (EQRs) are derived from both of the metrics by RICT, based on observed data and site specific predicted reference values derived from physical and chemical parameters listed in Table 1 below.

Table 1: Predictive variables for RICT

Invariant data	Variant data*
NGR	*Alkalinity*
Slope	*Mean Width*
Discharge Category	*Mean Depth*
Distance from source	*% Boulders/cobbles*
Altitude	*% Pebbles/gravel*
	% Sand
	% Silt/clay

*See RICT Website for details on how to obtain variable data.

1.2 Environmental pressures to which the method is sensitive

The method has been primarily designed to respond to organic pollution, however it is suitable for monitoring other types of impact, and is used for assessing the classification parameter “General degradation”.

1.3 Geographic application

This assessment method is appropriate for UK river waters, provided suitable analogue sites exist in the RICT reference database (see Davy-Bowker *et al.* (2012)). For the purposes of WFD, this means that reliance should only be placed on classifications with site suitability codes of 1-3 (see below). The method is not suitable for assessment of artificial water bodies such as canals or for temporary watercourses such as winterbournes.

1.4 Intercalibration

This is a process whereby all European Member States were required to compare WFD status classification boundary values for each biological quality element (e.g. phytoplankton, macrophytes) to ensure compatible levels are set across all countries. The process involved some adjustments of class boundary values for many of the classification tools in use and this process has influenced some of the calculations used in the WHPT method. Note that only WHPT ASPT has been intercalibrated. Once a classification method has been intercalibrated, the method and boundaries must be adhered to by Member States for the purposes of WFD assessment and reporting.

Intercalibration focussed on the EQRs that define the boundaries between High and Good (H/G) and between Good and Moderate (G/M).

1.5 Sample frequency

For a site to be classified, two macro–invertebrate samples and associated environmental measurements should be collected per year. Samples should be collected in the spring (01-March – 31-May) and autumn (01-September – 31 November). Sites may be classified using invertebrate data from one, two or three years.

1.6 Sample and associated data collection and analysis

The sampling methods used should be compliant with:

- BS EN 27828:1994, ISO 7828-1985 Water quality. Methods for biological testing. Methods of biological sampling: guidance on hand-net sampling of aquatic benthic macro-invertebrates; and/or
- BS EN ISO 9391:1995, BS 6068-5.15:1995 Water quality. Sampling in deep water for macro-invertebrates. Guidance on the use of colonization, qualitative and quantitative samplers.

Samples and associated data should be collected according to standard RIVPACS (River Prediction and Classification System) procedures, see the RICT User Guides The guidance includes macro-invertebrate analysis methods. Macro invertebrate samples should be analysed to RIVPACS taxonomic-level TL2 (Davy-Bowker *et al*., 2010) together with associated log abundances (Table 2), or analysed further, then aggregated to this level.

Table 2: WHPT logarithmic abundance categories

Abundance category	Numerical Abundance
AB1	*1-9*
AB2	*10 – 99*
AB3	*100 – 999*
AB4	*>1000*

2 Procedures for calculating EQRs and generating site/water body classifications

The following sections outline how WHPT EQRs are calculated. Once the two WHPT metrics have been calculated for observed samples, site specific reference values and probabilistic classifications are generated in RICT.

2.1.1 Calculate observed WHPT (ASPT & NTAXA)

For each macro-invertebrate sample calculate WHPT ASPT and WHPT NTAXA.

WHPT ASPT is derived as follows:

WHPT ASPT = Sum AB / WHPT NTAXA

Where AB = value for each taxon according to its abundance, derived from Table 1 and Appendix 1. NTAXA is the number of taxa contributing to the assessment.

A worked example of WHPT index calculation is shown in Appendix 2.

WHPT NTAXA is an index that forms part of the assessment in its own right and is combined with WHPT ASPT as per 1.1.

2.1.2 Generating EQRs and classifying sites

This should be done using RICT. Alternatives are impractical because of the complexity of the model. A detailed guide to the prediction and classification process for WHPT is available on the RICT website. A description of the algorithms and processes behind RICT can be found in Davy-Bowker et al (2007), Clarke & Davy – Bowker (2014) and supporting documentation on the RICT website.

WHPT is combined across seasons by first taking a seasonal mean of the raw index results (ASPT & NTAXA) then generating seasonal classifications (using 1-3 years' worth of data). The seasonal EQRs for each determinand are then combined by averaging, and error terms etc. are applied to produce an overall classification. The process is summarised below in Figure 1.

Three Azure experiments are provided which will automatically generate WFD-UKTAG compliant classifications for the UK. These can be found in the RICT Application section of the FBA site. The experiments generate:

1. Predicted reference values for WHPT ASPT and NTAXA for spring/autumn/combined year.
2. EQRs for the above sites, seasons and season combinations
3. Probabilistic Classifications using the WFD "High/Good/Moderate/Poor Bad" scheme using the EQR boundaries in table 2
4. Ancillary information (such as the assessment suitability code).

Table (2)

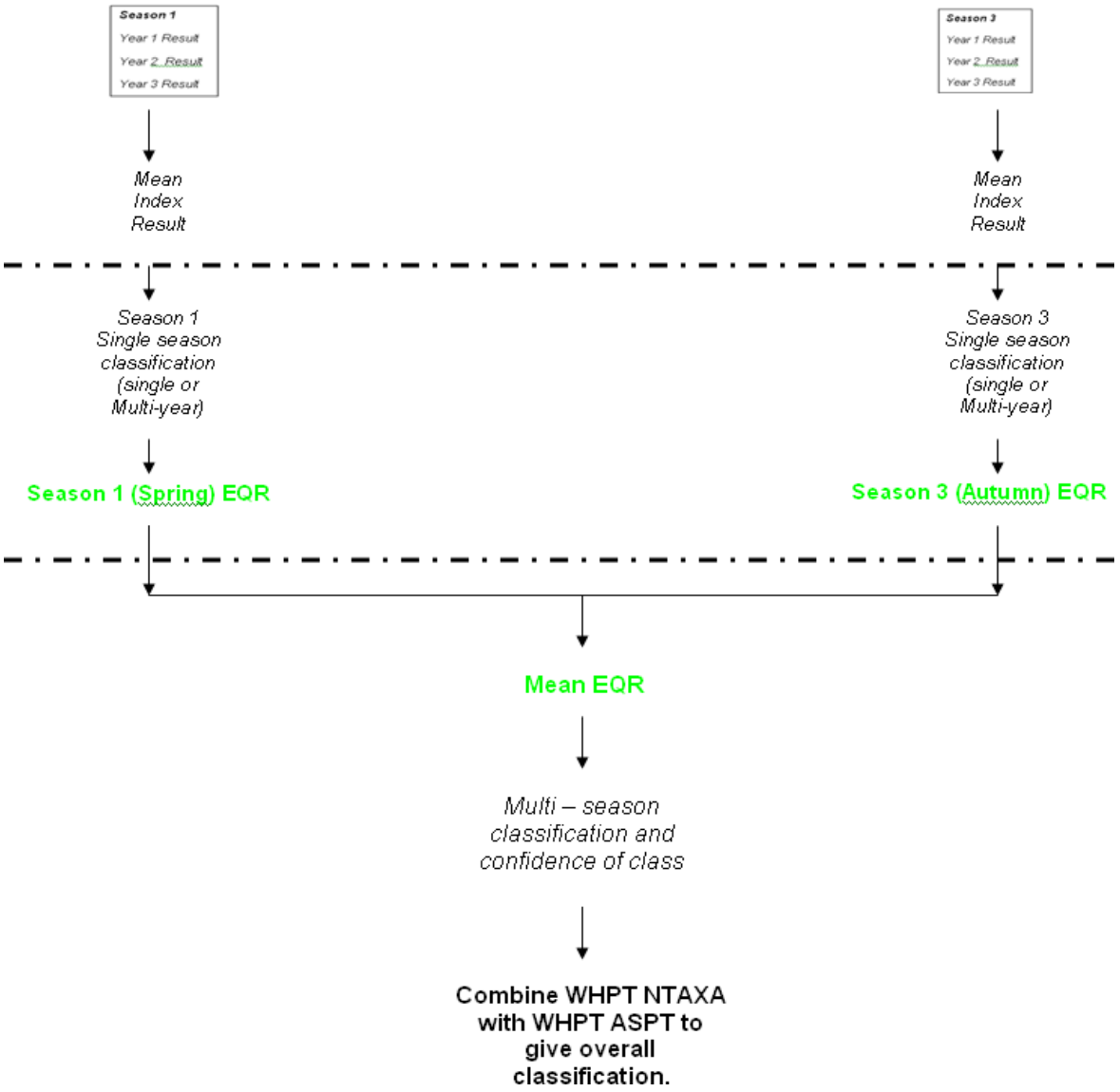
RICT Boundaries for the WHPT ASPT and NTAXA metrics.

Status boundary	WHPT NTAXA EQR	WHPT ASPT EQR
H/G	*0.80*	*0.97*
G/M	*0.68*	*0.86*
M/P	*0.56*	*0.72*
P/B	*0.47*	*0.59*

The experiments to be used for UK classification are:

1. GB Single year Spring/Autumn
2. GB Multi year Spring/Autumn
3. NI Single year Spring/Autumn

Figure 1: RICT Classification overview



Note that 1-3 years' worth of invertebrate index results can be used. The process is applied to both WHPT ASPT & NTAXA.

When the classification has been completed, check the results. The first parameter to check is the suitability code. If it is 4 or greater, the classification will be unreliable.

The probability of the site belonging to each class, EQR and most probable class are normally reported for WFD purposes. Classifications can be combined (across years or within waterbodies) by using:

- A “worst of” approach (use the worst class indicated by any of the results)
- The RICT multi-year classification experiment
- A separate statistical approach, for instance, using VISCOUS software.

Table 4: EQR Class Boundaries

Status boundary	WHPT NTAXA EQR	WHPT ASPT EQR
H/G	*0.80*	*0.97*
G/M	*0.68*	*0.86*
M/P	*0.56*	*0.72*
P/B	*0.47*	*0.59*

H = high, G = good; M = moderate, P = poor, B = bad

3 References

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Appendix 1. Taxa used in the WHPT index

	AB1	AB2	AB3	AB4
TRICLADA (Flatworms)				
Dendrocoelidae	**3.0**	**2.6**	**2.6**	**2.6**
Dugesiidae	**2.8**	**3.1**	**3.1**	**3.1**
Planariidae	**4.7**	**5.4**	**5.4**	**5.4**
MOLLUSCA (Snails, Limpets and Mussels)				
Neritidae	**6.4**	**6.5**	**6.9**	**6.9**
Viviparidae	**5.2**	**6.7**	**6.7**	**6.7**
Unionidae	**5.2**	**6.8**	**6.8**	**6.8**
Sphaeriidae (Pea mussels)	**4.4**	**3.5**	**3.4**	**2.3**
Lymnaeidae	**3.6**	**2.5**	**1.2**	**1.2**
Planorbidae (excl. *Ancylus* group)	**3.2**	**3.0**	**2.4**	**2.4**
Valvatidae	**3.3**	**3.1**	**2.7**	**2.7**
Physidae	**2.7**	**2.0**	**0.4**	**0.4**
Acroloxidae	**3.6**	**3.8**	**3.8**	**3.8**
Ancylus group (= Ancylidae)	**5.8**	**5.5**	**5.5**	**5.5**
Bithyniidae	**3.6**	**3.8**	**3.3**	**3.3**
Dreissenidae	**3.7**	**3.7**	**3.7**	**3.7**
Hydrobiidae	**4.1**	**4.2**	**4.6**	**3.7**
OLIGOCHAETA (worms)				
Oligochaeta	**3.6**	**2.3**	**1.4**	**-0.6**
HIRUDINIA (Leeches)				
Piscicolidae	**5.2**	**4.9**	**4.9**	**4.9**
Glossiphoniidae	**3.4**	**2.5**	**0.8**	**0.8**
Erpobdellidae	**3.6**	**2.0**	**-0.8**	**-0.8**

	AB1	AB2	AB3	AB4
Hirudinidae	**-0.8**	**-0.8**	**-0.8**	**-0.8**
CRUSTACEA (Crayfish, Shrimps and Slaters)				
Astacidae (including non-native species)	**7.9**	**7.9**	**7.9**	**7.9**
Corophiidae	**5.7**	**5.8**	**5.8**	**5.8**
Asellidae	**4.0**	**2.3**	**0.8**	**-1.6**
Crangonyctidae	**3.8**	**4.0**	**3.6**	**3.6**
Gammaridae	**4.2**	**4.5**	**4.6**	**3.9**
Niphargidae	**6.3**	**6.3**	**6.3**	**6.3**
EPHEMEROPTERA (Mayflies)				
Siphlonuridae (including Ameletidae)	**11.3**	**12.2**	**12.2**	**12.2**
Heptageniidae (incl. Arthropleidae)	**8.5**	**10.3**	**11.1**	**11.1**
Ephemeridae	**8.3**	**8.8**	**9.4**	**9.4**
Leptophlebiidae	**8.8**	**9.1**	**9.2**	**9.2**
Ephemerellidae	**7.9**	**8.5**	**9.0**	**9.0**
Potamanthidae	**9.8**	**10.4**	**10.4**	**10.4**
Caenidae	**6.5**	**6.5**	**6.5**	**6.5**
Baetidae	**3.6**	**5.9**	**7.2**	**7.5**
PLECOPTERA (Stoneflies)				
Perlidae	**12.6**	**13.0**	**13.0**	**13.0**
Chloroperlidae	**11.4**	**12.2**	**12.2**	**12.2**
Taeniopterygidae	**11.0**	**11.9**	**12.1**	**12.1**
Perlodidae	**10.5**	**11.5**	**11.5**	**11.5**
Capniidae	**9.7**	**9.4**	**9.4**	**9.4**
Leuctridae	**9.3**	**10.6**	**10.6**	**10.6**
Nemouridae	**8.7**	**10.7**	**10.7**	**10.7**

	AB1	AB2	AB3	AB4
ODONATA (Damselflies)				
Calopterygidae (= Agriidae)	**5.9**	**6.2**	**6.2**	**6.2**
Platycnemididae	**6.0**	**6.0**	**6.0**	**6.0**
Coenagrionidae (= Coenagriidae)	**3.4**	**3.8**	**3.8**	**3.8**
ODONATA (Dragonflies)				
Cordulegasteridae	**9.8**	**9.8**	**9.8**	**9.8**
Aeshnidae	**4.7**	**4.7**	**4.7**	**4.7**
Libellulidae	**4.1**	**4.1**	**4.1**	**4.1**
HEMIPTERA (Bugs)				
Aphelocheiridae	**8.6**	**8.5**	**8.0**	**8.0**
Hydrometridae	**4.3**	**4.3**	**4.3**	**4.3**
Gerridae	**5.2**	**5.5**	**5.5**	**5.5**
Mesoveliidae	**4.7**	**4.7**	**4.7**	**4.7**
Nepidae	**2.9**	**2.9**	**2.9**	**2.9**
Naucoridae	**3.7**	**3.7**	**3.7**	**3.7**
Pleidae	**3.3**	**3.3**	**3.3**	**3.3**
Notonectidae	**3.4**	**3.9**	**3.9**	**3.9**
Corixidae	**3.7**	**3.9**	**3.7**	**3.7**
Veliidae	**4.5**	**3.9**	**3.9**	**3.9**
COLEOPTERA (Beetles)				
Gyrinidae	**8.1**	**9.0**	**9.0**	**9.0**
Scirtidae (= Helododae)	**6.9**	**6.8**	**6.8**	**6.8**
Dryopidae	**6.0**	**6.0**	**6.0**	**6.0**
Elmidae	**5.3**	**7.4**	**8.3**	**8.3**
Haliplidae	**3.6**	**3.4**	**3.4**	**3.4**

	AB1	AB2	AB3	AB4
Paelobiidae (= Hygrobiidae)	**3.8**	**3.8**	**3.8**	**3.8**
Dytiscidae	**4.5**	**4.8**	**4.8**	**4.8**
Hydraenidae	**8.5**	**10.5**	**10.5**	**10.5**
Hydrophilidae	**5.8**	**8.8**	**8.8**	**8.8**
Noteridae	**3.2**	**3.2**	**3.2**	**3.2**
MEGALOPTERA				
Sialidae	**4.2**	**4.4**	**4.4**	**4.4**
NEUROPTERA, PLANIPENNIA				
Sisyridae	**5.7**	**5.7**	**5.7**	**5.7**
TRICHOPTERA (Caddis-flies - caseless)				
Philopotamidae	**11.2**	**11.1**	**11.1**	**11.1**
Polycentropodidae	**8.2**	**8.1**	**8.1**	**8.1**
Hydropsychidae	**5.8**	**7.2**	**7.4**	**7.4**
Glossosomatidae	**7.8**	**7.6**	**7.2**	**7.2**
Psychomyiidae	**5.8**	**5.7**	**5.7**	**5.7**
Rhyacophilidae	**8.1**	**9.2**	**8.3**	**8.3**
TRICHOPTERA (Caddis-flies - cased)				
Odontoceridae	**11.1**	**10.3**	**10.3**	**10.3**
Lepidostomatidae	**9.9**	**10.3**	**10.2**	**10.2**
Goeridae	**8.8**	**8.8**	**9.4**	**9.4**
Brachycentridae	**9.6**	**9.5**	**8.9**	**8.9**
Sericostomatidae	**8.9**	**9.4**	**9.5**	**9.5**
Beraeidae	**8.8**	**7.3**	**7.3**	**7.3**
Molannidae	**6.5**	**7.6**	**7.6**	**7.6**
Leptoceridae	**6.7**	**6.9**	**7.1**	**7.1**

	AB1	AB2	AB3	AB4
Phryganeidae	**5.5**	**5.5**	**5.5**	**5.5**
Limnephilidae (including Apataniidae)	**5.9**	**6.9**	**6.9**	**6.9**
Hydroptilidae	**6.1**	**6.5**	**6.8**	**6.8**
DIPTERA (True flies)				
Simuliidae	**5.5**	**6.1**	**5.8**	**3.9**
Tipulidae (including Cylindrotomidae, Limoniidae & Pedicidae)	**5.4**	**6.9**	**6.9**	**7.1**
Chironomidae	**1.2**	**1.3**	**-0.9**	**-0.9**
Athericidae	**9.3**	**9.5**	**9.5**	**9.5**
Ceratopogonidae	**5.4**	**5.5**	**5.5**	**5.5**
Chaoboridae	**3.0**	**3.0**	**3.0**	**3.0**
Culicidae	**2.0**	**1.9**	**1.9**	**1.9**
Dixidae	**7.0**	**7.0**	**7.0**	**7.0**
Dolichopodidae	**4.9**	**4.9**	**4.9**	**4.9**
Empididae	**7.0**	**7.6**	**7.6**	**7.6**
Ephydridae	**4.4**	**4.4**	**4.4**	**4.4**
Muscidae	**4.0**	**2.6**	**2.6**	**2.6**
Psychodidae	**4.5**	**3.0**	**3.0**	**3.0**
Ptychopteridae	**6.4**	**6.4**	**6.4**	**6.4**
Rhagionidae	**9.6**	**9.6**	**9.6**	**9.6**
Sciomyzidae	**3.4**	**3.4**	**3.4**	**3.4**
Stratiomyidae	**3.6**	**3.6**	**3.6**	**3.6**
Syrphidae	**1.9**	**1.9**	**1.9**	**1.9**
Tabanidae	**7.1**	**7.3**	**7.3**	**7.3**

Appendix 2. Example of WHPT calculation

Location	SAMPLED DATE	Taxon	Abundance	Abundance category	Score
122787 : River Eachaig @ Eckford	01/10/2019	*Baetidae*	*88*	2	5.9
		Chironomidae	*2*	1	1.2
		Chloroperlidae	*1*	1	11.4
		Elmidae	*174*	3	8.3
		Empididae	*1*	1	7
		Glossosomatidae	*17*	2	7.6
		Goeridae	*1*	1	8.8
		Heptageniidae	*55*	2	10.3
		Hydraenidae	*1*	1	8.5
		Hydropsychidae	*13*	2	7.2
		Leuctridae	*4*	1	9.3
		Nemouridae	*5*	1	8.7
		Oligochaeta	*31*	2	2.3
		Pediciidae	*6*	1	5.4
		Rhyacophilidae	*13*	2	9.2
		Sericostomatidae	*1*	1	8.9
		Simuliidae	*6*	1	5.5

Number of Taxa (WHPT NTAXA)	WHPT Score	WHPT ASPT
17	125.5	7.382352941