UKTAG LAKE ASSESSMENT METHODS
BENTHIC INVERTEBRATE FAUNA

CHIRONOMID PUPAL EXUVIAE TECHNIQUE (CPET)

by
Water Framework Directive - United Kingdom Technical Advisory Group (WFD-UKTAG)

Publisher: **Water Framework Directive - United Kingdom Advisory Group (WFD-UKTAG)**
SNIFFER
25 Greenside Place
Edinburgh
EH1 3AA
Scotland
www.wfduk.org

December 2008

ISBN: 978-1-906934-04-0

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 LAKE ASSESSMENT METHODS
BENTHIC INVERTEBRATE FAUNA

CHIRONOMID PUPAL EXUVIAE TECHNIQUE (CPET)

1. Introduction

This method statement describes a monitoring system for monitoring, assessing and classifying lakes 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 lakes in England, Scotland and Wales.

1.2 Quality element assessed by the method

The method enables an assessment of the condition of the quality element, "benthic invertebrates", listed in Table 1.2.2 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 nutrient enrichment.

1.4 Parameters used to assess the quality element

The method assesses the condition of the quality element using a parameter based on the composition of chironomid species or groups of species in the lake. The parameter is indicative of the impact of nutrient enrichment on the quality element.

2. Sampling and analysis

Four samples should normally be collected from April until October.
The surface of the lake should be skimmed with a hand net (nominal mesh size: 250 µm) with an extendable handle.

Using sub-samples, two hundred chironomid pupal exuviae trapped in the hand net and listed in Column 1 of Table 1 should be identified from each sample to produce a single list of taxa present in the lake for that year . If only 2 samples are available 500 pupal exuviae should be examined from each sample.

The sampling and analytical methods should conform to BS EN 15196 : 2006 Water Quality - Guidance on sampling and processing of the pupal exuviae of Chironomidae for ecological assessment.

3. Procedure for deriving the ecological quality ratio for the parameter

3.1 Calculation of the observed value of the parameter

To calculate the observed value of the parameter, each taxon listed in Column 1 of Table 1 and identified as present in the lake should be assigned the corresponding nutrient sensitivity score in Column 2 of Table 1.
The observed value for the parameter is given by the equation:

$$\text{Observed value of parameter} = \text{score}_{total} \div \text{taxa}_{total}$$

where:
"score_{total}" = the sum of the nutrient sensitivity scores in Column 2 of Table 1 for each different taxon listed in Column 1 of that Table and identified as present in the lake; and
"taxa_{total}" = the total number of taxa listed in Column 1 of Table 1 identified as present in the lake.

3.2 Calculation of reference value for the parameter

Reference conditions were derived from spatial data, a statistical model was used to determine site specific reference criteria.

The value for the parameter in the reference conditions applicable to the lake should be calculated using the following equation:

$$\text{Reference value for parameter} = -1.13 - [0.357 \times \text{Log}_{10}S] - [0.455 \times \text{Log}_{10}D_{mean}] + [0.376 \times \text{Log}_{10}RT_{mean}] + [0.364 \times \log_{10}CA]$$

where:
"D_{mean}" is the mean depth of the lake in metres ;
"S" means the surface area of the lake in hectares;
"CA" is the catchment area of the lake in hectares excluding the surface area of the lake; and
"RT_{mean}" is the mean length of time in days that water is retained in the lake and is calculated using the equation:

$$RT_{mean} = [D_{mean} \times S \times 1{,}000 \times 365] \div [(CA + S) \times RO_{net}]$$

"RO_{net}" is the net rainfall for the catchment in mm per year

3.3 Calculation of the ecological quality ratio for the parameter

The ecological quality ratio (EQR_{CPET}) for the parameter should be calculated using the following equation:

$$EQR_{CPET} \quad \{[2 - (\text{observed value of parameter} + 1)] \div [2 - (\text{reference value for parameter} + 1)\} \div 1.18$$

3.4 Application of the method for the purposes of classification

When using the method for the purposes of classifying the ecological status or potential of a water body, the ecological quality ratio for the parameter should be used.

4. Glossary

"Exuviae" are moulted exoskeletons of arthropods

Table 1: Lake chironomid taxa and associated scores used in calculating the observed value for the parameter[1].

Column 1	Column 2
Chirnomid Taxon	**Nutrient sensitivity score**
Ablabesmyia longistyla	-0.24
Ablabesmyia monilis	-0.35
Ablabesmyia phatta	0.65
Acamptocladius	-0.82
Acricotopus lucens	1.08
Apsectrotanypus trifascipennis	-1.36
Arctopelopia	-0.71
Brillia bifida	-0.23
Bryophaenocladius	-0.1
Chaetocladius	-0.62
Chironomus (lobo) dissidens	0.84
Chironomus anthracinus	0.05
Chironomus holomelas	-0.81
Chironomus other	0.65
Chironomus piger	0.91
Chironomus plumosus group	0.99
Cladopelma	0.22
Cladotanytarsus atridorsum	0.44
Cladotanytarsus lepidocalcar	0.85
Cladotanytarsus new pupal sp.	0.19
Cladotanytarsus other	0.06
Cladotanytarsus vanderwulpi	-0.86
Clinotanypus nervosus	0.32
Conchapelopia melanops	-0.94
Conchapelopia other	-1.14
Corynoneura arctica group	-0.46
Corynoneura fittkaui	-0.56
Corynoneura scutellata group	0.12
Corynoneurella paludosa	-0.1
Cricotopus (Cricotopus) other	-0.17
Cricotopus (I) brevipalpis	-0.65
Cricotopus (I) sylvestris (Fab)	0.96
Cricotopus (Isocladius) group	-0.11
Cricotopus (Isocladius) Pe	0.54
Cricotopus bicinctus	-0.3
Cricotopus intersectus group	0.95
Cryptochironomus obreptans group	0.46
Cryptochironomus redekei group	0.6
Cryptotendipes	0.19

[1] **Taxa categories other than species and genera are defined in Wilson & Ruse (2005).**

Table 1: Lake chironomid taxa and associated scores used in calculating the observed value for the parameter[1].

Column 1	Column 2
Chirnomid Taxon	**Nutrient sensitivity score**
Demeijerea rufipes	0.83
Demicryptochironomus	-0.31
Diamesa	-0.3
Dicrotendipes nervosus	0.56
Dicrotendipes notatus	0.88
Dicrotendipes other	0.15
Dicrotendipes tritomus	-0.56
Einfeldia pagana	0.48
Endochironomus	0.81
Eukiefferiella claripennis	-0.51
Eukiefferiella coerulescens	-0.85
Eukiefferiella other	-0.7
Georthocladius luteicornis	-0.92
Glyptotendipes (cau)	0.47
Glyptotendipes (sensu stricto)	0.76
Guttipelopia guttipennis	0.99
Harnischia	0.34
Heleniella ornaticollis	-0.34
Heterotanytarsus apicalis	-0.73
Heterotrissocladius	-0.7
Kiefferulus tendipediformis	0.8
Labrundinia longipalpis	0.42
Larsia	-0.45
Lauterborniella agrayloides	-0.73
Limnophyes	-0.17
Macropelopia adaucta	-0.81
Macropelopia nebulosa	-0.73
Metriocnemus	0.17
Microchironomus tener	1.06
Micropsectra atrofasciata	-0.14
Micropsectra fuscus	-0.35
Micropsectra junci	-0.09
Micropsectra other	0.06
Microtendipes	0.17
Microtendipes britteni	-1.59
Nanocladius balticus	-0.6
Nanocladius other	0.3
Neozavrelia longappendiculata	-0.97
Neozavrelia other	-0.48
Nilotanypus dubius	-1.4
Nilothauma brayi	-0.66
Orthocladius (Eudactylocladius)	-0.17

Table 1: Lake chironomid taxa and associated scores used in calculating the observed value for the parameter[1].

Column 1	Column 2
Chirnomid Taxon	**Nutrient sensitivity score**
Orthocladius (Euorthocladius)	0.31
Orthocladius (sensu stricto) other	0.03
Orthocladius consobrinus	0.09
Orthocladius frigidus	-0.82
Orthocladius holsatus	0.56
Orthocladius rubicundus	-0.26
Pagastiella orophila	-0.68
Parachironomus arcuatus	0.55
Parachironomus biannulatus	0.95
Parachironomus other	0.37
Parachironomus tenuicaudatus	0.33
Paracladius conversus	1.17
Paracladopelma camptolabis group	-0.6
Paracladopelma nigritula	-1.09
Parakiefferiella coronata	-1.11
Parakiefferiella fennica	-1.43
Parakiefferiella other	-0.56
Parakiefferiella Pe 1	-0.38
Paramerina	-0.69
Parametriocnemus	0.4
Paraphaenocladius	-0.51
Parapsectra nana	-0.46
Paratanytarsus laccophilus	-0.18
Paratanytarsus other	-0.07
Paratanytarsus tenellulus	0.99
Paratendipes	0.02
Paratrichocladius other	-0.88
Paratrichocladius rufiventris	-0.35
Phaenopsectra	-0.41
Polypedilum arundinetum	-0.6
Polypedilum nubeculosum group	0.39
Polypedilum nubens	-0.36
Polypedilum other	-0.06
Polypedilum pullum group	-0.25
Polypedilum sordens group	0.66
Potthastia gaedii group	-0.49
Potthastia longimana group	-0.88
Procladius (holotanypus)	0.29
Procladius (Psilotanypus)	0.71
Procladius crassinervis	-0.05
Prodiamesa olivacea	0.43
Protanypus morio	-0.51

Table 1: Lake chironomid taxa and associated scores used in calculating the observed value for the parameter[1].

Column 1	Column 2
Chirnomid Taxon	**Nutrient sensitivity score**
Psectrocladius (sensu stricto) Ot	0.03
Psectrocladius barbatipes	-0.83
Psectrocladius barbimanus	1.19
Psectrocladius calcaratus	-0.81
Psectrocladius obvius	0.12
Psectrocladius octomaculatus	-1.3
Psectrocladius platypus	-0.69
Psectrotanypus varius	1.16
Pseudochironomus prasinatus	-0.34
Pseudorthocladius	-0.63
Pseudosmittia	-0.75
Rheocricotopus (Psilocricotopus)	-1.14
Rheocricotopus (sensu stricto)	0.42
Rheotanytarsus	-0.21
Sergentia	-0.67
Smittia	0.05
Stempellina almi	0.17
Stempellina bausei	-0.76
Stempellinella	-0.53
Stenochironomus	-0.12
Stictochironomus	-0.68
Synendotendipes	0.4
Synorthocladius semivirens	-0.57
Tanypus other	0.97
Tanypus punctipennis	1.34
Tanytarsus anderseni	0.3
Tanytarsus brundini	-0.59
Tanytarsus buchonius	-0.33
Tanytarsus chinyensis	-0.59
Tanytarsus ejuncidus group	0.39
Tanytarsus mendax	0.89
Tanytarsus pallidicornis	0.2
Tanytarsus part 1	-0.16
Tanytarsus part 2	0.03
Tanytarsus part 3	-0.77
Tanytarsus sylvaticus	0.86
Thienemanniella	-0.25
Thienemannimyia	-0.88
Tribelos intextus	0.15
Trissopelopia longimana	-1.18
Tvetenia other	-0.37
Virgatanytarsus	-0.68

Table 1: Lake chironomid taxa and associated scores used in calculating the observed value for the parameter[1].

Column 1	Column 2
Chirnomid Taxon	**Nutrient sensitivity score**
Xenochironomus xenolabis	-0.49
Zalutschia humphresiae	-0.68
Zavrelimyia	-1.39

Annex 1: Worked example

The following taxa were obtained from a pond in southern England:

Taxon	Nutrient sensitivity score
Ablabesmyia monilis	-0.35
Acricotopus lucens	1.08
Chironomus (lobo) dissidans	0.84
Chironomus plumosus group	0.99
Cladotanytarsus atridorsum	0.44
Cladotanytarsus other	0.06
Corynoneura scutellata group	0.12
Cricotopus (I) sylvestris (Fab)	0.96
Cricotopus intersectus group	0.95
Cryptochironomus obreptans group	0.46
Cryptochironomus redekei group	0.6
Dicrotendipes nervosus	0.56
Endochironomus	0.81
Glyptotendipes (sensu stricto)	0.76
Metriocnemus	0.17
Micropsectra other	0.06
Paratanytarsus tenellulus	0.99
Polypedilum nubeculosum group	0.39
Polypedilum pullum group	-0.25
Procladius (holotanypus)	0.29
Procladius (Psilotanypus)	0.71
Prodiamesa olivacea	0.43
Psectrocladius (ss) other	0.03
Psectrocladius barbimanus	1.19
Psectrocladius obvius	0.12
Pseudochironomus prasinatus	-0.34
Tanypus other	0.97
Tanytarsus mendax	0.89
Tanytarsus part 2	0.03

The following environmental data were also obtained:

Variable	Value
Surface area (S)	29.2 hectares
Mean depth (D_{mean})	2.7 metres
Retention time (RT_{mean})	358 days
Catchment area (CA)	232 hectares

The observed value of the parameter is given by:

(a) Summing the nutrient sensitivity scores for the chironomid taxa in the sample = 13.96

(b) Dividing the result given in step (a) above by the total number of chironomid taxa in the sample (29). This produces an observed value for the parameter of 0.48.

The reference value for the parameter in the lake is calculated using the equation in Section 3.2. This gives a reference value for the parameter of -0.03.

EQR = $\{[2 - (0.48 + 1)] \div [2 - (-0.03 + 1)\} \div 1.18 = 0.43$

Annex 2: Further reading

Ruse, L. (2002). Chironomid pupal exuviae as indicators of lake status. *Archiv für Hydrobiologie* 153: 367-390.

Wilson R. S. and L. P. Ruse (2005). A guide to the identification of genera of chironomid pupal exuviae occurring in Britain and Ireland. *Freshwater Biological Association Special Publication no. 13.*