UKTAG LAKE ASSESSMENT METHODS
MACROPHYTES AND PHYTOBENTHOS

PHYTOBENTHOS - DIATOM ASSESSMENT OF LAKE ECOLOGICAL QUALITY (DARLEQ[1])

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

[1] Formally known as Diatom Assessment of Lake Ecological status (DALES)

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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 watercourses and their biological sampling.

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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, Northern Ireland, Scotland and Wales.

1.2 Quality element assessed by the method

The method enables the assessment of the condition of the quality element, "macrophytes and phytobenthos", 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 the parameter, "lake trophic diatom index". This parameter is indicative of the impact of nutrient enrichment on the quality element. It is calculated using information on benthic diatom species and groups of such species.

2. Sampling and analysis

To apply the method, samples of benthic diatom species should be collected by brushing or scraping the upper surface of cobbles or small boulders obtained from the littoral zones of lakes in order to remove the biofilm.

Where the bed of the lake is dominated by fine sediments, samples should be collected from submerged stems of emergent macrophytes such as *Phragmites australis*, *Sparganium erectum*, *Glyceria maxima* or *Typha* species.

The sampling method used should follow the general principles set out in the standard method EN 13946 : 2003 Water quality – Guidance standard for the routine sampling and pre-treatment of benthic diatoms from rivers.

Samples should be analysed to identify the presence, and number of valves, of each of the diatom taxa listed in Column 1 of Table 1 below.

The analytical method used should conform to EN 14407 : 2004 Water quality – Guidance standard for the identification, enumeration and interpretation of benthic diatom samples from running waters.

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 of the parameter is then given by the equation:

$$\text{Observed value of lake trophic diatom index} = (W \times 25) - 25$$

where:
"W" is given by the equation:

$$W = \frac{\sum_{j=1}^{n} a_j \times s_j}{\sum_{j=1}^{n} a_j}$$

"a_j" is the number of valves of taxon j, where "j" represents a taxon listed in Column 1 of Table 1 and present in the sample. "j" has a value of 1 to "n" indicating which of the all the taxa (total number = "n") listed in Column 1 and present in the sample it represents; and
"s_j" is the nutrient sensitivity score in column 2 of Table 1corresponding to the taxon in column 1 of that Table represented by j.

3.2 Calculation of the reference value for the parameter

Reference conditions were derived using absence of pressure, reference lake list from other projects, expert judgement and palaeolimnological work.

The value for the parameter in the reference conditions applicable to the lake should be the value in Column 2 of Table 2 which corresponds to the annual mean alkalinity in Column 1 of Table 2 which is applicable to the lake.

3.3 Calculation of the ecological quality ratio for the parameter

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

$$EQR_{DARLEQ} = (100 - \text{observed value of lake trophic diatom index}) \div (100 - \text{reference value for lake trophic diatom index})$$

Where the calculated EQR_{DARLEQ} is > 1, its value should be set to "1".

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 annual mean value of the ecological quality ratio for the parameter should be used.

4 Glossary

"Biofilm" means a thin coating on submerged surfaces, composed of algae and other microorganisms in a polysaccharide matrix, along with trapped organic and inorganic particles.
"Boulder" means mineral substratum with a diameter > 256 mm.
"Cobble" means mineral substratum with a diameter > 64 mm and ≤ 256 mm.
"Valve" is one half of the silicate shell which surrounds the cell contents of each individual diatom. The valves usually separate during sample treatment.

Table 1: List of diatom taxa and associated nutrient sensitivity scores for the purposes of calculating the value of the parameter, lake trophic diatom index

Column 1	Column 2
Diatom taxa	**Nutrient sensitivity score**
Achnanthes calcar Cleve	3
Achnanthes carissima Lange-Bertalot	5
Achnanthes coarctata (Breb. in W. Sm.) Grun. in Cleve & Grun.	3
Achnanthes conspicua A. Mayer	4
Achnanthes curtissima J.R. Carter	3
Achnanthes exigua Grun. in Cleve & Grun.	4
Achnanthes frigida Hust. in A. Schmidt	3
Achnanthes joursacense Herib.	3
Achnanthes kriegeri Krasske	3
Achnanthes kryophila J.B. Petersen	3
Achnanthes laevis Ostr.	2
Achnanthes minuscula Hust.	5
Achnanthes oblongella Ostr.	2

Table 1: List of diatom taxa and associated nutrient sensitivity scores for the purposes of calculating the value of the parameter, lake trophic diatom index

Column 1	Column 2
Diatom taxa	**Nutrient sensitivity score**
Achnanthes oestrupii (A. Cleve-Euler) Hust.	3
Achnanthes pseudoswazi J.R. Carter	1
Achnanthes ricula Hohn & Hellerman 1963	5
Achnanthes rosenstockii Lange-Bertalot 1989	5
Achnanthes saccula J.R. Carter in J.R. Carter & Watts	3
Achnanthes silvahercynia Lange-Bertalot 1989	2
Achnanthes sp. Bory	4
Achnanthes straubiana Lamge-Bertalot	1
Achnanthes suchlandtii Hust.	4
Achnanthes ventralis (Krasske) Lange-Bertalot	1
Achnanthes ziegleri Lange-Bertalot 1991	2
Achnanthidium biasolettiana (Grunow) L. Bukhtiyarova	4
Achnanthidium minutissimum (Kütz.) Czarnecki 1994	2
Amphipleura kriegerana (Krasske) Hust.	1
Amphipleura pellucida (Kutz.) Kutz.	1
Amphipleura sp. (Grunow) L. Bukhtiyarova	1
Amphora delicatissima Krasske ex Hust.	5
Amphora dusenii Brun	3
Amphora fogediana Krammer	4
Amphora inariensis Krammer	4
Amphora libyca Ehr.	4
Amphora ovalis (Kutz.) Kutz.	4
Amphora pediculus (Kutz.) Grun.	4
Amphora sp. Ehrenb. ex. Kütz.	5
Amphora veneta Kutz.	5
Aneumastus tuscula (Ehrenb.) Mann & Stickle	1
Anomoeoneis follis (Ehrenb.) Cleve	1
Aulacoseira subarctica (O.Mull.) Haworth	2
Brachysira brebissonii fo. *brebissonii* R. Ross in Hartley	1
Brachysira neoexilis Lange-Bertalot	1
Brachysira procera L-B & Moser	2
Brachysira serians (Breb. ex Kutz.) Round & Mann	1
Brachysira sp. Kutz.	1
Brachysira styriaca (Grun. in Van Heurck) R. Ross in Hartley	1
Brachysira vitrea (Grun.) R. Ross in Hartley	1
Caloneis bacillum (Grun.) Cleve	4
Caloneis silicula (Ehrenb.) Cleve	2
Caloneis sp. Cleve	2
Cavinula cocconeiformis (Greg. ex Greville) Mann & Stickle	3
Cavinula variostriata (Krasske) Mann	3
Cocconeis disculus (Schum.) Cleve	3
Cocconeis neothumensis Krammer	3

Table 1: List of diatom taxa and associated nutrient sensitivity scores for the purposes of calculating the value of the parameter, lake trophic diatom index

Column 1	Column 2
Diatom taxa	**Nutrient sensitivity score**
Cocconeis pediculus Ehrenb.	4
Cocconeis placentula Ehrenb.	3
Cocconeis pseudothumensis Reichardt 1982	3
Craticula accomoda (Hust) Mann	5
Craticula halophila (Grun. ex Heurck) Mann	4
Ctenophora pulchella (Ralfs ex Kutz.) Williams & Round	3
Cymbella aequalis W. Sm. ex Grev.	1
Cymbella affinis Kutz.	1
Cymbella aspera (Ehrenb.) H. Perag. in Pell.	1
Cymbella brehmii Hust.	3
Cymbella cesatii (Rabenh.) Grun. in A. Schmidt	1
Cymbella cistula (Ehrenb. in Hempr. & Ehrenb.) Kirchner	2
Cymbella cuspidata Kutz.	4
Cymbella cymbiformis Ag.	1
Cymbella delicatula Kutz.	1
Cymbella descripta (Hust.) Krammer & Lange-Bertalot	1
Cymbella gaeumannii Meister	2
Cymbella helvetica Kutz.	2
Cymbella hustedtii Krasske	4
Cymbella incerta Grun. in Cleve & Moller	2
Cymbella lacustris (Ag.) Cleve	3
Cymbella lanceolata (Ag.) Ag.	2
Cymbella lapponica Grun. ex Cleve	1
Cymbella leptoceras (Ehr.) Grun.	2
Cymbella leptoceros var. *angusta* Grun.	4
Cymbella microcephala fo. *microcephala* Grun. in Van Heurck	1
Cymbella naviculiformis Auersw. ex Heib.	2
Cymbella perpusilla A. Cleve	2
Cymbella pusilla Grun. ex A. Schmidt	1
Cymbella reinhardtii Grun. ex A. Schmidt	5
Cymbella sp. Ag.	2
Cymbella subaequalis Grun. in Van Heurck	4
Cymbella turgidula Grun.	3
Cymbellonitzschia diluviana Hust.	4
Denticula kuetzingii Grun.	4
Denticula tenuis Kutz.	1
Diadesmis contenta (Grun. ex Van Heurck) Mann	3
Diatoma mesodon (Ehrenber) Kutzing	1
Diatoma moniliformis Kutz	1
Diatoma tenue Ag.	2
Diatoma vulgare Bory	4
Diploneis elliptica (Kutz.) Cleve	3

Table 1: List of diatom taxa and associated nutrient sensitivity scores for the purposes of calculating the value of the parameter, lake trophic diatom index

Column 1	Column 2
Diatom taxa	**Nutrient sensitivity score**
Diploneis marginestriata Hust.	3
Diploneis oblongella (Naegeli ex Kutz.) R. Ross	3
Diploneis ovalis (Hilse) Cleve	3
Diploneis parma Cleve	4
Diploneis sp. Ehrenberg	1
Ellerbeckia arenaria (Moore) Crawford	5
Encyonema caespitosum Kutz.	3
Encyonema gracile Ehrenberg	2
Encyonema hebridicum Grun. ex Cleve	1
Encyonema minutum (Hilse in Rabenhorst) Mann	4
Encyonema reichardtii (Krammer) Mann	4
Encyonema silesiacum (Bleisch in Rabenhorst) Mann	3
Epithemia adnata (Kutz.) Rabenh.	2
Epithemia argus (Ehrenb.) Kutz.	1
Epithemia sorex Kütz.	3
Epithemia sp. Bréb.	3
Eucocconeis flexella Kütz.	2
Eunotia arculus (Grunow) Lange-Bert et Nörpel	1
Eunotia arcus Ehrenb.	1
Eunotia bidentula W. Sm.	1
Eunotia bilunaris (Ehrenb.) F.W. Mills	3
Eunotia diodon Ehrenb.	1
Eunotia elegans Ostr.	1
Eunotia exigua (Breb. ex Kutz.) Rabenh.	1
Eunotia faba (Ehrenb.) Grun. in Van Heurck	1
Eunotia fallax A. Cleve	1
Eunotia flexuosa Kutz.	1
Eunotia formica Ehrenb.	2
Eunotia glacialis Meister	1
Eunotia implicata Norpel, Lange-Bertalot & Alles	1
Eunotia incisa W. Sm. ex Greg.	2
Eunotia intermedia (Hust) Norpel, Lange-Bertalot & Alles	1
Eunotia meisteri Hust.	1
Eunotia microcephala Krasske ex Hust.	1
Eunotia minor (Kutz) Grunow in Van Heurck	4
Eunotia monodon var. *bidens* (W. Sm.) Hust.	1
Eunotia muscicola Krasske	1
Eunotia muscicola var. *tridentula* Norpel & Lange-Bertalot 1991	2
Eunotia naegelii Migula	1
Eunotia paludosa Grun.	1
Eunotia paludosa var. *trinacria* (Krasske) Norpel 1991	4
Eunotia pectinalis (O.F. Mull.) Rabenh.	1

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Column 1	Column 2
Diatom taxa	**Nutrient sensitivity score**
Eunotia pirla Carter et Flower	1
Eunotia praerupta Ehrenb.	2
Eunotia rhomboidea Hust.	1
Eunotia rhyncocephela Hustedt	1
Eunotia serra Ehrenb.	1
Eunotia serra var. *diadema* (Ehrenb.) Patr.	1
Eunotia soleirolii (Kutz) Rabenhorst	1
Eunotia sp. Ehrenb	2
Eunotia subarcuatoides Alles, Norpel, Lange-Bertalot	2
Eunotia sudetica O. Mull.	1
Eunotia tenella (Grun. in Van Heurck) A. Cleve	2
Fragilaria bidens Heib.	4
Fragilaria capucina Desm.	1
Fragilaria capucina var. *amphicephala* Grun) Lange-Bert.	1
Fragilaria capucina var. *austriaca* (Grun) Lange-Bertalot	4
Fragilaria capucina var. *distans* (Grunow) Lange-Bertalot	3
Fragilaria capucina var. *mesolepta* (Rabenh.) Rabenh.	3
Fragilaria capucina var. *rumpens* (Kutz.) Lange-Bertalot	2
Fragilaria construens var. *exigua* (W. Sm.) Schulz	1
Fragilaria construens var. *pumila* Grun. in Van Heurck	2
Fragilaria incognita Reichardt 1988	1
Fragilaria karelica Molder	2
Fragilaria lapponica Grun. in Van Heurck	2
Fragilaria nitzschioides Grun. in Van Heurck	2
Fragilaria perminuta (Grunow) Lange-Bert.	3
Fragilaria pseudoconstruens Marciniak	3
Fragilaria sp. H.C. Lyngb.	4
Fragilaria vaucheriae (Kutz.) J.B. Petersen	4
Fragilaria vaucheriae var. *capitellata* (Grun. in Van Heurck) R. Ross	2
Fragilariforma virescens (Ralfs) Williams & Round	3
Fragilariforma virescens var. *exigua* (Grunow) Poulin	3
Frustulia rhomboides (Ehrenb.) De Toni	1
Gomphonema acuminatum Ehrenb.	3
Gomphonema affine Kutz.	2
Gomphonema angustatum (Kutz.) Rabenh.	4
Gomphonema anoenum Lange-Bertalot	1
Gomphonema augur Ehr.	4
Gomphonema clavatum Ehr.	3
Gomphonema exiguum var. *minutissimum* Grun in Van Heurck	2
Gomphonema gracile Ehrenb.	2
Gomphonema hebridense Gregory	1
Gomphonema lateripunctatum Reichardt & Lange-Bertalot	1

Table 1: List of diatom taxa and associated nutrient sensitivity scores for the purposes of calculating the value of the parameter, lake trophic diatom index

Column 1	Column 2
Diatom taxa	**Nutrient sensitivity score**
Gomphonema minutum (Ag.) Ag.	3
Gomphonema olivaceoides Hust.	2
Gomphonema olivaceum (Hornemann) Breb.	5
Gomphonema parvulum (Kutz.) Kutz.	4
Gomphonema parvulum var. *exilissimum* Grun. in Van Heurck	3
Gomphonema procerum Reichardt & Lange-Bertalot	1
Gomphonema pseudoaugur Lange-Bertalot	1
Gomphonema pseudotenellum Lange Bertalot	3
Gomphonema sp. Ehrenb.	3
Gomphonema subtile Ehrenb.	1
Gomphonema tergestinum (Grun. in Van Heurck) Fricke in A. Schmidt	3
Gomphonema truncatum Ehrenb.	4
Gomphonema vibrio Ehrenb.	1
Gyrosigma acuminatum (Kutz.) Rabenh.	4
Gyrosigma attenuatum (Kutz.) Rabenh.	4
Hannaea arcus (Ehrenb.) Patr. in Patr. & Reimer	1
Karayevia clevei (Grunow) Round et L. Bukhtiyarova	4
Karayevia laterostrata (Hust.) Round et L. Bukhtiyarova	4
Lemnicola hungarica (Grunow) Round et P.W. Basson	3
Luticola mutica (Kutz.) Mann	5
Mastogloia smithii Thwaites ex W. Sm.	2
Mastogloia smithii var. *amphicephala* Grun. in Van Heurck	1
Mastogloia sp. Thwaites ex W. Sm.	1
Melosira varians Ag.	5
Meridion circulare (Grev.) Ag.	1
Navicula seminulum	4
Navicula agrestis Hust.	5
Navicula angusta Grun.	5
Navicula aquaedurae Lange-Bertalot	1
Navicula arcus Ehrenb.	2
Navicula arvensis Hust.	1
Navicula atomus (Kutz.) Grun.	5
Navicula bryophila J.B. Petersen	3
Navicula capitata Ehrenb.	5
Navicula capitatoradiata Germain	4
Navicula cari Ehrenb.	4
Navicula caterva Hohn & Hellermann	2
Navicula cincta (Ehrenb.) Ralfs in Pritch.	3
Navicula cryptocephala Kutz.	4
Navicula cryptotenella Lange-Bertalot	5
Navicula cuspidata (Kutz.) Kutz.	4
Navicula decussis Ostr.	5

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Diatom taxa	**Nutrient sensitivity score**
Navicula dicephala Ehrenb.	4
Navicula difficillima Hust.	3
Navicula digitoradiata var. *digito-radiata* (Greg.) Ralfs in Pritch.	4
Navicula gallica var. *perpusilla* (Grun) Lange-Bertalot	2
Navicula gastrum (Ehrenb.) Kutz.	3
Navicula graciloides A. Mayer	3
Navicula gregaria Donk.	5
Navicula hungarica Grun.	5
Navicula ignota var. *acceptata* (Hustedt) Lange-Bertalot	2
Navicula ignota var. *palustris* (Hust.) J.W.G. Lund	5
Navicula jaernefeltii Hust.	3
Navicula lanceolata (Agardh) Kutz.	4
Navicula leptostriata Jorgensen	2
Navicula libonensis Schoeman	4
Navicula mediocris Krasske	1
Navicula menisculus Schum.	5
Navicula mimima Grun. In Van Heurck	3
Navicula minuscula Grun. in Van Heurck	5
Navicula phyllepta Kutz.	2
Navicula placenta Ehrenb.	3
Navicula porifera var. *opportuna* (Hust.) Lange-Bertalot	2
Navicula pseudoanglica Lange-Bertalot	3
Navicula pseudolanceolata Lange-Bertalot	4
Navicula pseudoscutiformis Hust.	2
Navicula pseudotuscula Hust.	3
Navicula pygmaea Kutz.	3
Navicula radiosa Kutz.	2
Navicula radiosafallax Lange-Bertalot	3
Navicula reichardtiana Lange-Bertalot	5
Navicula reinhardtii Grun. in Van Heurck	5
Navicula rhynchocephala Kutz.	4
Navicula rotunda Hust.	5
Navicula salinarum Grun. in Cleve & Grun.	5
Navicula saprophila Lange-Bertalot & Bonik	4
Navicula saxophila Brock ex Hust	5
Navicula schoenfeldii Hust.	2
Navicula scutelloides W. Sm. ex Greg.	4
Navicula seminuloides Hust.	5
Navicula slesvicensis Grun. in Van Heurck	5
Navicula soehrensis Krasske	1
Navicula soehrensis var. *hassiaca* (Krasske)Lange-Bertalot	1
Navicula sp. Bory	4

Table 1: List of diatom taxa and associated nutrient sensitivity scores for the purposes of calculating the value of the parameter, lake trophic diatom index

Column 1	Column 2
Diatom taxa	**Nutrient sensitivity score**
Navicula stroemii Hust.	4
Navicula subatomoides Hust. ex Patr.	5
Navicula subminuscula Manguin	5
Navicula submuralis Hust.	5
Navicula subrotundata Hust.	4
Navicula subtilissima Cleve	1
Navicula tenelloides Hust.	5
Navicula tenuicephala Hust.	1
Navicula tripunctata (O.F. Mull.) Bory	5
Navicula trivialis Lange-Bertalot	3
Navicula veneta Kutz.	5
Navicula vixvisibilis Hust.	3
Neidium affine (Ehrenb.) Pfitz.	1
Neidium ampliatum (Ehren) Krammer	1
Neidium bisulcatum (Lagerst.) Cleve	1
Neidium hercynicum A. Mayer	1
Neidium sp. Pfitzer	2
Nitzschia acicularis (Kutz.) W. Sm.	3
Nitzschia acidoclinata Lange Bertalot	2
Nitzschia amphibia Grun.	5
Nitzschia angustatula Lange-Bertalot	4
Nitzschia angustiforaminata Lange-Bertalot	5
Nitzschia archibaldii Lange-Bertalot	1
Nitzschia bacillum Hustedt in A.Schmidt et al	2
Nitzschia capitellata Hust.	5
Nitzschia commutata Grun. in Cleve & Grun.	4
Nitzschia dissipata (Kutz.) Grun.	5
Nitzschia flexa Schum.	1
Nitzschia fonticola Grun. in Van Heurck	4
Nitzschia frustulum (Kutz.) Grun. in Cleve & Grun.	5
Nitzschia gracilis Hantzsch	3
Nitzschia hantzschiana Rabenh.	3
Nitzschia heufleriana Grun.	2
Nitzschia incognita Legler & Krasske	1
Nitzschia inconspicua Grun.	5
Nitzschia intermedia Hantzsch ex Cleve & Grun.	1
Nitzschia lacuum Lange-Bertalot	3
Nitzschia linearis W. Sm.	3
Nitzschia microcephala Grun. in Cleve & Grun.	3
Nitzschia obtusa var. *scalpelliformis* Grun. in Van Heurck	3
Nitzschia palea (Kutz.) W. Sm.	4
Nitzschia paleacea (Grun. in Cleve & Grun.) Grun. in Van Heurck	4

Table 1: List of diatom taxa and associated nutrient sensitivity scores for the purposes of calculating the value of the parameter, lake trophic diatom index

Column 1	Column 2
Diatom taxa	**Nutrient sensitivity score**
Nitzschia paleaeformis Hust.	1
Nitzschia pumila Hust.	3
Nitzschia pura Hustedt	4
Nitzschia pusilla Grun.	4
Nitzschia recta Hantzsch ex Rabenh.	3
Nitzschia sigma (Kutz.) W. Sm.	1
Nitzschia sigmoidea (Nitzsch) W. Sm.	1
Nitzschia sinuata var. *delognei* (Grun. in Van Heurck) Lange-Bertalot	5
Nitzschia sinuata var. *tabellaria* (Grun.) Grun. ex Van Heurck	1
Nitzschia sociabilis Hust.	5
Nitzschia solita Hustedt	5
Nitzschia sp. Hassall	4
Nitzschia sublinearis Hust.	2
Nitzschia supralitorea Lange-Bertalot	5
Nitzschia valdestriata Aleem & Hust.	1
Nitzschia vermicularis (Kutz.) Hantzsch. in Rabenh.	2
Opephora sp. Petit	2
Pennate undifferentiated	2
Peronia fibula (Breb. ex Kutz.) R. Ross	2
Pinnularia appendiculata (Ag.) Cleve	1
Pinnularia borealis Ehrenb.	4
Pinnularia brebissonii (Kutz.) Rabenh.	2
Pinnularia gibba (Ehrenb.) Ehrenb.	1
Pinnularia intermedia (Lagerst.) Cleve	2
Pinnularia interrupta W. Smith	1
Pinnularia major (Kutz.) W. Sm.	3
Pinnularia microstauron (Ehrenb.) Cleve	2
Pinnularia rupestris Hantzsch in Rabenh.	2
Pinnularia sp. Ehrenb.	3
Pinnularia subcapitata Greg.	2
Pinnularia viridis (Nitzsch) Ehrenb.	1
Placoneis clementis (Grunow) E.J. Cox	4
Placoneis elginensis (Greg.) E.J. Cox	5
Placoneis placentula (Ehrenb.) Heinzerl.	4
Planothidium daui (Foged) Lange-Bert.	2
Planothidium delicatulum (Kütz.) Round et L. Bukhtiyarova	5
Planothidium granum (Hohn et Hellerman) Lange-Bert.	5
Planothidium haukianum (Grunow) Round et L. Bukhtiyarova	5
Planothidium lanceolatum (Bréb.) Round et L. Bukhtiyarova	4
Planothidium peragalli (Brun et Hérib.) Round et L. Bukhtiyarova	3
Psammothidium bioretii (Germain) L. Bukhtiyarova et Round	2
Psammothidium chlidanos (Hohn et Hellerman) Lange-Bert.	2

Table 1: List of diatom taxa and associated nutrient sensitivity scores for the purposes of calculating the value of the parameter, lake trophic diatom index

Column 1	Column 2
Diatom taxa	**Nutrient sensitivity score**
Psammothidium didymum (Hust.) L. Bukhtiyarova et Round	5
Psammothidium grishunun fo. *daonensis* (Lange-Bert.) L. Bukhtiyarova et Round	2
Psammothidium lauenburgianum (Hust.) L. Bukhtiyarova et Round	5
Psammothidium levanderi (Hust.) L. Bukhtiyarova et Round	2
Psammothidium marginulatum (Grunow) L. Bukhtiyarova et Round	3
Psammothidium rossii (Hust.) L. Bukhtiyarova et Round	3
Pseudostaurosira brevistriata (Grun. in Van Heurck) Williams & Round	4
Pseudostaurosira robusta (Fusey) Williams & Round	3
Rhopalodia brebissonii Krammer	2
Rhopalodia gibba (Ehrenb.) O. Mull.	2
Rhopalodia gibberula var. *rupestris* (W. Sm.) O. Mull.	1
Rossithidium linearis (W. Sm.) Round et L. Bukhtiyarova	2
Rossithidium petersenii (Hust.) Round et L. Bukhtiyarova	1
Rossithidium pusillum (Grunow) Round et L. Bukhtiyarova	2
Sellaphora bacillum (Ehenb.) Mann	4
Sellaphora pupula (Kutz.) Mereschkowsky	3
Sellaphora seminulum (Grun.) Mann	4
Simonsenia delognei (Grun. in Van Heurck) Lange-Bertalot	5
Skeletonema sp. Grev.	4
Stauroneis kriegeri Patr.	4
Stauroneis palustris Hust.	2
Stauroneis sp. Ehrenb.	4
Staurosira construens Ehrenb.	4
Staurosira elliptica (Schumann) Williams & Round	4
Staurosirella pinnata (Ehrenb.) Williams & Round	4
Stenopterobia curvula (W Smith) Krammer	1
Surirella angusta Kutz.	4
Surirella brebissonii Krammer & Lange-Bertalot	5
Surirella elegans Ehrenb.	5
Surirella minuta Breb. ex Kutz.	5
Surirella roba Leclercq	1
Surirella sp. Turpin	1
Synedra acus Kutz.	3
Synedra acus var. *delicatissima* (W. Sm.) Grun.	1
Synedra delicatissima W. Sm.	2
Synedra fasciculata (Ag.) Kutz.	5
Synedra parasitica (W. Sm.) Hust.	3
Synedra parasitica var. *subconstricta* (Grun. in Van Heurck) Hust.	4
Synedra sp. Ehrenb.	2
Synedra tenera W. Sm.	1
Tabellaria binalis (Ehrenb.) Grun. in Van Heurck	1
Tabellaria fenestrata (Lyngb.) Kutz.	1

Table 1: List of diatom taxa and associated nutrient sensitivity scores for the purposes of calculating the value of the parameter, lake trophic diatom index	
Column 1	**Column 2**
Diatom taxa	**Nutrient sensitivity score**
Tabellaria flocculosa (Roth) Kutz.	2
Tabellaria quadriseptata Knudson	1
Tabellaria ventricosa Kütz.	1
Tabularia fasciculata (Ag.) Williams & Round	4
Tetracyclus lacustris Ralfs	1
Thalassiosira pseudonana (Hust.) Hasle & Heimdal	5
Tryblionella acuminata W. Sm.	4
Tryblionella hungarica (Grun) Mann	5
Tryblionella levidensis W. Sm.	4

Table 2: Reference values for the parameter, lake trophic diatom index	
Column 1	Column 2
Annual mean alkalinity of lake (mg/l $CaCO_3$)	Reference value for the parameter, lake trophic diatom index
< 10	20
≥ 10	25

Annex 1: Worked example

The following taxon list was obtained from an analysis of a sample collected from a lake in northern England in July 2006.

The first column has the taxon name, the second column shows the abundance (a, = number of valves) of that taxon in the sample; the third column has the nutrient sensitivity score for that taxon and the final column shows the product of a × s.

Taxon	**a**	**s**	**as**
Achnanthidium minutissimum type	187	2	374
Brachysira styriaca	2	1	2
Brachysira vitrea	48	1	48
Caloneis silicula	1	2	2
Cyclotella sp.	3	0	0
Cymbella affinis	7	1	7
Cymbella cistula	1	2	2
Cymbella delicatula	1	1	1
Cymbella microcephala fo. *microcephala*	7	1	7
Denticula tenuis	13	1	13
Encyonema gracile	1	2	2
Eucocconeis flexella	3	1	3
Eunotia pectinalis	5	1	5
Eunotia sp.	3	1	3
Fragilaria perminuta	8	3	24
Gomphonema acuminatum	1	3	3
Gomphonema gracile	4	2	8
Gomphonema parvulum	1	4	4
Gomphonema sp	1	3	3
Nitzschia frustulum	1	5	5
Nitzschia gracilis	1	3	3
Nitzschia sp.	2	4	8
Rossithidium linearis	1	2	2
Sellaphora pupula	1	3	3
Synedra tenera	3	1	3
Tabellaria flocculosa	2	2	4
Tryblionella acuminata	4	4	16

The observed value of lake trophic diatom index for this sample is calculated as follows:

1. sum as for all taxa in sample = 555

2. sum a for all taxa in sample = 312

3. Calculate W = sum as / sum a = 1.78

4. Calculate the observed value of lake trophic diatom index for the sample using the equation in Section 3.1:

$$(W \times 25) - 25 = (1.78 \times 25) - 25 = 19.5$$

The mean total alkalinity for the lake in 2006 was 3.1 mg/l $CaCO_3$. This means that the lake is in the 'low alkalinity' type. Using Table 2, the reference value for lake trophic diatom index in the lake is 20.

Applying the equation in Section 3.3, the ecological quality ratio for the sample is:

$$(100 - 19.5) / (100 - 20) = 80.5 / 80 = 1.01$$

Therefore, $EQR_{DARLEQ} = 1$

Annex 2: Further Reading

Kelly, M.G., Juggins, S., Bennion, H., Burgess, A., Yallop, M., Hirst, H., King, L., Jamieson, J., Guthrie, R., and Rippey, B. (2007) *Use of Diatoms for Evaluating Ecological Status in UK Freshwaters*. Environment Agency Science Report SCO301030.