BS EN 16150:2012

BSI Standards Publication

Water quality — Guidance on pro-rata Multi-Habitat sampling of benthic macro-invertebrates from wadeable rivers

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 16150:2012.

The UK participation in its preparation was entrusted to Technical Committee EH/3/5, Biological Methods.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 71890 8

ICS 13.060.70

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2012.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16150

April 2012

ICS 13.060.70

English Version

Water quality - Guidance on pro-rata Multi-Habitat sampling of benthic macro-invertebrates from wadeable rivers

Qualité de l'eau - Lignes directrices pour l'échantillonnage des macroinvertébrés benthiques en cours d'eau peu profonds au prorata des surfaces de recouvrement des habitats présents

Wasserbeschaffenheit - Anleitung für die pro-rata Multi-Habitat-Probenahme benthischer Makroinvertebraten in Flüssen geringer Tiefe (watbar)

This European Standard was approved by CEN on 16 March 2012.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 16150:2012: E

Contents

Page

Foreword

This document (EN 16150:2012) has been prepared by Technical Committee CEN/TC 230 “Water analysis”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2012, and conflicting national standards shall be withdrawn at the latest by October 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard gives guidance on procedures for the pro-rata Multi-Habitat-Sampling (MHS) of benthic macro-invertebrates in wadeable rivers and streams. The term "pro-rata" reflects the intention to sample adequate proportions of riverine habitats with reference to their percentage occurrence.

The pro-rata MHS technique does not replace other techniques, but is rather, alongside other applications, a fundamental requisite of some multi-metric assessment approaches used to evaluate the ecological status of running waters. The method described in this document is one of the possible techniques among the existing pro-rata MHS techniques.

The MHS methodology is based on Rapid Bioassessment Protocols [1], the procedures of the Environment Agency for England and Wales [2], the Austrian Guidelines for the Assessment of the Saprobiological Water Quality of Rivers and Streams [3], the AQEM sampling manual [4], the AQEM & STAR site protocol [5], EN 27828, the Austrian Standards M 6232 and M 6119-2 [6], [7], the German Standard DIN 38410-1 [8] and the French Standard XP T90-333 [9].

This European Standard also describes in a detailed manner how to sample different habitats that might be suitable for sampling approaches other than Multi-Habitat-Sampling.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 27828, *Water quality — Methods of biological sampling — Guidance on handnet sampling of aquatic benthic macro-invertebrates (ISO 7828)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
akal
fine to medium-sized gravel; grain diameter > 0,2 cm to 2 cm

3.2
argyllal
silt, loam, clay

3.3
debris
organic and inorganic matter deposited within the splash zone area by wave-motion and changing water levels

3.4
hygropetric sites
thin water layer on solid (rocky) substrates

3.5
investigation site
specific area of an investigated river reach for sampling benthic organisms

3.6
macro-algae
strands of filamentous algae and algal tufts

3.7
macrolithal
coarse blocks, cobbles, gravel and sand; grain diameter > 20 cm to 40 cm

3.8
megalithal
upper sizes of large cobbles, boulders, blocks and bedrock; grain diameter > 40 cm

3.9
mesolithal
fist to hand-sized cobbles with a variable percentage of gravel and sand; grain diameter > 6 cm to 20 cm

3.10
micro-algae
algal films

3.11
microlithal
coarse gravel (size of a pigeon egg to a child's fist) with variable percentages of medium to fine gravel; grain diameter > 2 cm to 6 cm

3.12
pelal
mud and sludge; grain diameter < 0,06 mm

3.13
psammal
sand; grain diameter 0,06 mm to 2 mm

3.14
psammopelal
sand and mud

3.15
sampling unit
benthic sample of a specific habitat

Note 1 to entry: One Multi-Habitat sample usually consists of a fixed number of sampling units.

3.16
sewage bacteria and fungi
filaments, tufts or coverage of bacteria and fungi, to be seen with the naked eye

EXAMPLE Sphaerotilus, Leptomitus, Beggiatoa, Thiothrix.

3.17
xylal
tree trunks (dead wood), branches, roots

3.18
technolithal
solid material (usually stones) or geotextiles inserted into a river for the purposes of river engineering

4 Description of the sampling approach

The method focuses on a multi-habitat approach, designed for sampling major habitats in proportion to their presence within a sampling reach. A sample consists of a number of sampling units (SU) taken from habitat types in relation to their spatial percentage cover. The AQEM and STAR projects [5] identified 20 "sampling units" taken from all habitat types at an investigation site, each with a share of at least 5 % spatial coverage, to be the optimum approach for ecological status assessment of wadeable rivers. Where habitat diversity is very low or taxa diversity within habitats is low and using 20 units would be an excessive repetitive sampling burden, fewer than 20 “sampling units” may be required to gain a good assessment of the ecological status. Where fewer than 20 units are used, the minimum spatial coverage should be adjusted accordingly: for example, 10 sampling units would have a minimum of 10 % spatial coverage. Throughout the rest of this document, the example of 20 “sampling units” is used to describe the approach; users should adjust numbers of unit accordingly in cases of low habitat or taxa diversity.

A "sampling unit" is a sample performed by positioning the net and disturbing the substrate in a quadratic area that equals the frame-size upstream of the net (EN 27828). Sediments are disturbed to an adequate depth that ensures capture of all species present depending on substrate diameter, compactness and ‘shape’ (organic substrata). For example, sediments should be disturbed to a depth of approximately

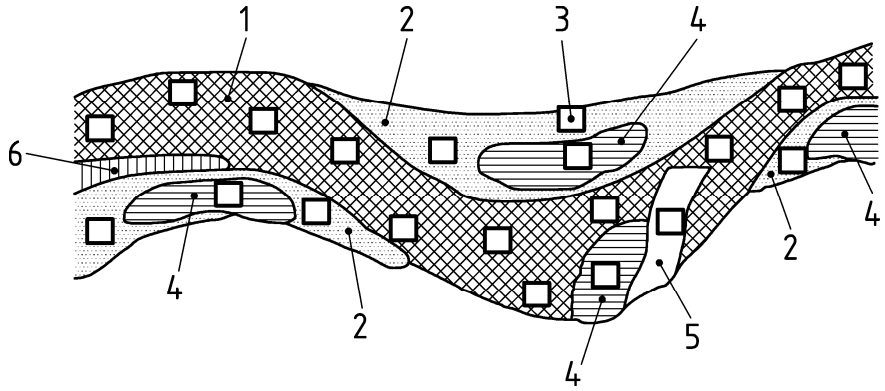
— 5 cm to 10 cm for finer substrates (psammal, pelal, fine particulate organic matter (FPOM)),

— 10 cm to 15 cm for intermediate sized substrates (akal, microlithal, coarse particulate organic matter (CPOM)), or

— 15 cm to 20 cm for larger substrates (macrolithal; living parts of terrestrial plants).

A distribution of 20 sampling units proportional to the share of habitats means if the total habitat in the sampling area consists of 50 % psammal (sand), then 10 "sampling units" are withdrawn from this substrate. The categories of habitat composition follow the descriptions given in Clause 3.

If a square net of 25 cm $\times$ 25 cm is used, the sampling procedure equals a sampled area of approximately 1,25 m^2 of the stream bed (Figure 1).



Key

1 lithal (55 % = 11 replicates)
2 psammal (25 % = 5 replicates)
3 replicate
4 CPOM (15 % = 3 replicates)
5 xylal (5 % = 1 replicate)
6 akal (< 5 % = 0 replicates)

Figure 1 — Example of sampling unit position in a theoretical investigation site according to the "Multi-Habitat-Sampling" method [1]

5 Field sampling procedures

5.1 Factors limiting effective Multi-Habitat-Sampling (MHS)

The effective use of the MHS procedure may be impaired under the following conditions which should be avoided and from which samples should not be taken (if possible):

— during or shortly after floods; consider allowing a recovery period of four to six weeks after a spate;

— during or shortly after droughts (completely dry river sections);

— during any other natural or man-induced disturbances, e.g. if unnatural turbidity prevents a proper estimation of the habitat composition or sampling of the stream bed.

The Multi-Habitat-Sampling procedure includes several steps which are described in 5.2 and 5.3.

5.2 Estimation of habitat composition

Before initiating sampling, complete the sampling protocol (see Annex A for an example), especially the estimation of the percentage coverage of the different habitats. Whenever possible, the sampling area should not be disturbed by physical contact. If the estimation of the coverage of habitats needs to be corrected, e.g. due to low visibility of parts of the river bed, this can be done during the sampling procedure. After sampling, the estimated coverage of substrates should be reviewed for accuracy and completeness.

With 20 sampling units (for example) and based on the habitats listed in Clause 4 or Table A.1, the coverage of all habitats in the river channel (including margins) with at least 5 % cover is recorded to the nearest 5 %. The presence of other habitats (< 5 % cover) is indicated by a cross.

NOTE It is advisable to divide the sampling reach into 20 m to 25 m segments, thus easing the habitat estimation.

Estimate habitat composition by referring to a suitable pro forma (for example Table A.1) and take into account the following steps:

a) Estimation of the cover of mineral habitats: the sum of the coverage of the individual mineral habitat should be 100 % (column 1, upper part in Table A.1).

b) Estimation of the cover of biotic habitats (seen as an additional layer on the mineral substrates, e.g. macrophytes, macro-algae, woody material, roots, or CPOM): the sum of the coverage of the individual biotic habitats is variable (0 % to 100 %).

c) Depending on the objectives of the sampling, do not sample habitats with a cover of less than 5 % but rather indicate these with a cross.

5.3 Allocation of sampling units

Complete a survey specific pro forma (for example, Sampling Protocol II, Table A.2) in order to define the number and the allocation of sampling units (see Annex A).

To allocate the sampling units, consider the mineral (3.1) and the biotic (3.2) habitats as one layer, thus combining the biotic habitat estimation with the mineral substrate estimation. This ensures that samples taken from biotic habitats include the underlying (subjacent) mineral substrates. The sum of the cover of all habitats (mineral and biotic) should be 100 %. If the conditions allow, estimate the cover of mineral and biotic habitats in one step. This procedure may be helpful if a high proportion of biotic habitats are present in the river and if consequently problems in assessing the percentage of the underlying mineral substrates arise.

The allocation of the 20 sampling units (for example) follows the combined (mineral and biotic) habitat estimation (5 % coverage equals 1 sampling unit) using a suitable pro forma (see Table A.2).

a) Copy the portion (percentage) of mineral habitats (5 % steps) from Table A.1 to row “mineral habitats” in Table A.2.

b) Copy the portion (percentage) of biotic habitats (5 % steps) from Table A.1 to column “biotic habitats” in Table A.2.

c) If bare mineral habitats exist exclusively, enter the percentage of these habitats in the corresponding cell of the row “bare mineral substrate” (column "%") in Table A.2.

d) If mineral and biotic habitats are combined (e.g. FPOM on psammal or macro-algae on mesolithal), enter the percentages in the corresponding cells of the column "%" in Table A.2.

e) If biotic habitats cannot be properly allocated to an underlying mineral habitat (bottom or margins, e.g. roots or macrophytes), enter their percentage of cover in the column “not allocable” in Table A.2. In such a case, subtract this number of sampling units from the nearest adjacent mineral habitat. If this procedure leads to a non-representative result, subtract the number of sampling units from the most frequent mineral habitat.

f) As a last step, enter the final number of sampling units in the different columns "SU", converting the percentages of the "%"-columns into sampling units (5 % coverage equals 1 sampling unit).

EXAMPLE If the overall cover of mesolithal is 40 % (8 sampling units) and macro-algae are attached to 10 % of the mesolithal, take 6 sampling units from the bare mesolithal, and 2 sampling units from mesolithal with attached macro-algae.

The final allocation of sampling units of a given habitat represents the overall structure of an investigation site.

Sampling units should also be adequately distributed between bed and banks and lentic and lotic sites as well as riffles and pools. It is particularly important that samples from biotic layers reflect the distribution of the underlying mineral substrates. The column “comments" in the Table A.1 can be used, for example, to indicate the proportion of lentic or lotic areas within the substrate coverage and the near-margin or in-stream situation, respectively.

Indicate man made substrates (e.g. technolithal = rip-rap) in the column "man-made" (see Annex A).

6 Detailed description of sampling procedures

6.1 General recommendations for sampling

The investigation site should be representative of the river section and be suited to the purpose of the study.

Sampling starts at the downstream end of the reach and proceeds upstream.

When sampling the "sampling units", use the hand-net either as a kick-net, or for "jabbing", "dipping" or "sweeping", or a combination of these. Controlled sampling by hand is the preferred method (see details in Clause 7). If kick-sampling is necessary (e.g. in deep sections), hold the net vertically with the frame at a right angle to the current, downstream of the sampler’s feet (sampling area), and disturb the stream bed vigorously by kicking or rotating the heel of the boot to dislodge the substratum and the fauna.

After every three sampling units (or more frequently if necessary), rinse the collected material by running clean water through the net two to three times as clogging may prevent the collection of a representative sample. In such cases, discard the material in the net and choose another sampling unit in the same habitat type but at a different location. The final Multi-Habitat sample consists of the pooled 20 sampling units. If the scope of the study is based on different sampling designs, the sampling units can be treated separately or pooled according to other characteristics (e.g. riffles-pools, habitat types, etc.).

6.2 Megalithal (bedrock and boulders)

The sampling strategies for boulders depends on area and number of sampling units allocated. As only the surface can be sampled, lifting is not applicable. Large stones are sampled by brushing and scraping the surface and then sweeping the animals into the net.

Individual samples of boulder substrates should be allocated to different positions (front, side, etc.) for different sampling units. If only one sampling unit in boulders is allocated, three positions (front, right side and left side) may be combined for this single sampling unit. However, the sampling should also consider the extent of algal cover on the boulders.

6.3 Macrolithal and mesolithal (cobbles, stones, pebbles)

Sampling starts by gently sweeping the surface within the targeted area by hand to dislocate surface-dwelling animals and sweep them into the net. Move cobbles and large stones by hand and sweep, brush or scrape the surfaces to dislodge clinging and sessile organisms. It is recommended that cobbles and bigger stones be collected in a bucket to dislocate attached animals by hand-picking and controlled sweeping.

The remaining substrate is disturbed in the 0,25 m $\times$ 0,25 m area upstream of the net. To dislodge the animals from the interstices of the sediments, the substrate should be disturbed with a screwdriver or similar device up to a depth of about 15 cm to 20 cm. A frame of 625 cm^2 placed on the substrate surface in front of the hand net is recommended for more precise sampling.

In shallow waters with a strong current, an enclosed piece of equipment (such as a Hess- or Surber sampler with an appropriate sampling area) may be used instead of a hand-net. This is helpful in defining the sampling area and preventing too many animals drifting into the net from upstream areas. In lentic areas, the sediment within the sampling area may be disturbed by hand and water may be forced through the net to trap the animals. It is possible to use different devices for different microhabitats, as long as the same required area is sampled.

6.4 Microlithal and smaller mineral substrates

Disturb the substrate in the 0,25 m $\times$ 0,25 m area upstream of the net. To dislodge the animals from the interstices of the sediments, disturb the substrate with a screwdriver or similar tool up to a depth of about 5 cm to 15 cm. Hold the net close enough for the invertebrates to flow into the net with the current, but far enough away for most of the sand and gravel to sink in front of the net. Take care to minimise the quantity of sand in the samples.

Sample areas of un-vegetated or soft substrate by "bumping" the net along the surface of the substrate rather than dragging the net through soft substrates. Alternatively, kick the area to dislodge sediment and organisms into the water column and then sweep the net through the suspended cloud of sediment to capture the dislodged animals. This reduces the amount of sediment and debris in the sample.

In shallow waters with a strong current, an enclosed apparatus (such as a Hess- or Surber-Sampler) may be used instead of a hand-net.

In lentic areas, disturb the sediment within the sampling area by hand in the normal fashion; then create a current by pushing water through the net with the hands to trap the animals. Again, it is possible to use different devices for different microhabitats, as long as the same required area is sampled.

6.5 Xylal (woody debris)

Avoid sampling relatively new ‘deadfall’ that lacks microbial conditioning. Washing the samples into a bucket is the most effective method. Alternatively, take the woody debris out, spray onto a net and pick the animals off using forceps.

6.6 Roots

Sweeping followed by vigorous shaking can be effective.

6.7 Coarse Particulate Organic Matter (CPOM/leaf litter)

Wash carefully in the field and avoid taking large amounts of leaves back to the laboratory.

6.8 Macrophytes (emergent and submerged)

Macrophytes should be taken to the laboratory for further examinations because organisms such as *Simuliidae* and some chironomid tubes (e.g. *Rheotanytarsus*) cannot be washed off completely in the field. The quantitative sampling of an adequate area of the macrophyte stand with adequate portions of roots, stems and leaves is recommended instead of taking some sweeps with the hand net.

6.9 Technolithal

A variety of techniques may be required depending on the nature of the man-made substrate.

7 Sample treatment

7.1 Removal of large material and sorting

Branches, sticks and stones may be removed after being rinsed and inspected for clinging or sessile organisms. Any organisms found should be placed into the sample container. It is not recommended to spend time inspecting small debris in the field. However, larger and more fragile organisms (e.g. *Ephemeroptera*) or species of groups that cannot be preserved (e.g. *Tricladida*, *Oligochaeta*) should be sorted initially in the field (maximum 50 representative organisms). These organisms should then be stored in small separate containers with no substrate.

7.2 Removal of large organisms

Large and rare organisms which are easily identifiable on-site (such as large mussels or crayfish) should be recorded in the field, removed from the sample and returned to the stream.

7.3 Storage

Immediately after collection, transfer the sample from the net to the sample container(s) and preserve with formalin (4 % final concentration of formaldehyde) or in sufficient ethanol (95 %) to cover the sample completely. The final ethanol concentration should be about 70 %. When using ethanol, water in the sample should be decanted before adding the fixation liquid. Fixation is important to prevent carnivores, particularly stoneflies (*Setipalpia* [=*Systellognatha*]), beetles (*Adephaga*), caddis larvae (e.g. *Rhyacophilidae*), *Sialidae* and certain *Gammaridae* from eating other organisms. Forceps may be needed to remove organisms from the dip net. Tightly close the sample container and store the samples in cooled conditions.

7.4 Labelling

Place a label (written in pencil, printed on a laser printer or photocopied) inside the sample container indicating the following information: project (optional); stream name; site name and location; site code (optional); date of sampling; habitat, riffle or pool section; sampling gear, fraction; sampler’s name (optional).

The outside of the container should include the same information and the words "preservative: formalin 10 %" or "95 % ethanol", respectively. If more than one container is needed for a sample, label with all the necessary information and number each container (e.g. 1 of 2, 2 of 2). If rare taxa (e.g. crayfish, large mussels) have been identified in the field and returned to the river, record their presence and abundance on the label placed

in the sample containers as well as in the sample pro forma. If possible, label and place the container with the rare and fragile organisms into the main sample container and note their existence in the sampling protocol.

For health and safety reasons, formalin is often not used. However, it is known to be the most effective fixative for fresh water macro-invertebrate samples [2]. If a laboratory cannot use formalin and the sample has been preserved with 95 % ethanol, it should be re-preserved in the laboratory in fresh alcohol. The sample can then be stored for several months before analysis.

7.5 Refining the site-protocol

Refine the sampling protocol, particularly the portion of microhabitats after the sampling has been completed. After having sampled the various microhabitats, walking the reach helps to ensure a more accurate assessment. Note the sampling gear used and comment on the conditions during sampling, e.g. high flows, treacherous rocks, difficult access to stream, or anything else that could indicate an influence on the sample composition.

Annex A
(informative)

Sampling protocols

Table A.1 — Sampling protocol I[1)]

Site name	Date	Investigator	
	1	2	**3**
MINERAL HABITATS 5% steps; indicate microhabitats < 5 % with 'X', indicate artificial microhabitats with 'X' in column 'man-made'	% coverage - 5 % steps	Comments	**'man-made"**
Hygropetric Sites water layer on solid substrates			☐
Megalithal > 40 cm large cobbles, bolders and blocks, bedrock			☐
Macrolithal > 20 cm to 40 cm coarse blocks, head-sized cobbles (with variable percentages of cobbles, gravel and sand)			☐
Mesolithal > 6 cm to 20 cm fist to hand-sized cobbles (with variable percentages of gravel and sand)			☐
Microlithal > 2 cm to 6 cm coarse gravel (size of a pigeon egg to child's fist) (with variable percentages of medium to fine gravel)			☐
Akal > 0,2 cm to 2 cm fine to medium-sized gravel			☐
Psammal > 6 µm to 2 mm sand			☐
Psammopelal mixture of sand with mud			☐
Pelal < 6 µm mud (including organic mud and sludge)			☐
Argyllal silt, loam, clay (inorganic)			☐
Sum	**100 %**		
BIOTIC HABITATS			
5 % steps; indicate microhabitats < 5 % with 'X', indicate artificial microhabitats with 'X' in column 'man-made'	only biotic habitats		
Micro-algae diatoms and other algae			☐
Macro-algae filamentous algae, algal tufts			☐
Submerged macrophytes macrophytes, including moss and *Characeae*			☐
Emergent macrophytes e. g. *Thypha*, *Carex*, *Phragmites*			☐
Living parts of terrestrial plants fine roots, floating riparian vegetation			☐
Xylal (wood) tree trunks (dead wood), branches, roots			☐
CPOM deposits of coarse particulate organic matter, as e. g. fallen leaves			☐
FPOM deposits of fine particulate organic matter			☐
Debris organic and inorganic matter deposited within the splash zone area by wave motion and changing water levels, e. g. mussel shells, snail shells			☐
Sewage bacteria and –fungi e. g. *Sphaerotilus*, *Leptomitus*, sulfur bacteria (e. g. *Beggiatoa*, *Thiothrix*), sludge			☐
Sum	variable		

1) The user of this form is allowed to copy this present form.

Table A.2 — Sampling protocol II[2)]

			MINERAL HABITATS – percent coverage (sum: 100 %)																					
			hygropetric sites		megalithal > 40 cm		macrolithal > 20 cm to 40 cm		mesolithal > 6 cm to 20 cm		microlithal > 2 cm to 6 cm		akal > 0,2 cm to 2 cm		psammal > 6 µm to 2 mm		psammopelal		pelal < 6 µm		Argyllal < 6 µm		not allocable	
			%	SU	%	SU	%	SU	%	SU	%	SU	%	SU	%	SU	%	SU	%	SU	%	SU	%	SU
		bare mineral substrate																						
BIOTIC HABITATS - percent coverage (sum variable)		micro-algae																						
		macro-algae																						
		submerged macrophytes																						
		emergent macrophytes																						
		living parts of terrestial plants																						
		xylal																						
		CPOM																						
		FPOM																						
		debris																						
		sewage, bacteria and –fungi																						

2) The user of this form is allowed to copy this present form.

Bibliography

[1] BARBOUR, M.T., GERRITSEN, J., SNYDER, B.D. & STRIBLING, J.B. (1999): *Rapid bioassessment protocols for use in streams and wadable rivers: periphyton, benthic macroinvertebrates and fish*. (2nd Ed.) EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

[2] MURRAY-BLIGH, J.A.D. (1999): *Procedures for collecting and analysing macro-invertebrate samples. Quality Management Systems for Environmental Monitoring: Biological Techniques, BT001*. (Version 2.0, 30 July 1999) - Environment Agency, Bristol, UK.

[3] MOOG, O., CHOVANEC, A., HINTEREGGER, J. & RÖMER, A. (1999): *Austrian Guidelines for the assessment of the saprobiological water quality of rivers and streams (in German: Richtlinie zur Bestimmung der saprobiologischen Gewässergüte von Fließgewässern).*- Bundesministerium für Land- und Forstwirtschaft. Wasserwirtschaftskataster, Wien, 144 pp.

[4] AQEM consortium (2002): *Manual for the application of the AQEM system. A comprehensive method to assess European streams using benthic macroinvertebrates, developed for the purpose of the Water Framework Directive. Version 1.0.* (www.aqem.de).

[5] AQEM & STAR Site Protocol (2002): www.eu-star.at. Protocols.

[6] OENORM M 6119-2 (draft), *Guidelines for the ecological study and assessment of rivers – Macrozoobenthos. Part 2: A Standardized Procedure for prorate Multi-Habitat-Sampling.*

[7] OENORM M 6232, *Guidelines for the ecological study and assessment of rivers* (bilingual edition)

[8] DIN 38410-1, *German standard methods for the examination of water, waste water and sludge — Biological-ecological analysis of water (group M) — Part 1: Determination of the saprobic index in running waters (M 1)*

[9] XP T90-333, *Water quality — Sampling of aquatic macro-invertebrates in shallow freshwaters*

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™