SLOVENSKI STANDARD
SIST EN 16772:2016

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Kakovost vode - Navodilo za metode vzorčenja nevretenčarjev v hiporeični coni rek

Water quality - Guidance on methods for sampling invertebrates in the hyporheic zone of rivers

Wasserbeschaffenheit - Anleitung für die Probenahme von Invertebraten (Wirbellosen) in der hyporheischen Zone von Flüssen

Qualité de l'eau - Lignes directrices relatives aux méthodes d'échantillonnage des invertébrés dans la zone hyporhéique de rivières

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English Version

Water quality - Guidance on methods for sampling invertebrates in the hyporheic zone of rivers

Qualité de l'eau - Lignes directrices relatives aux méthodes d'échantillonnage des invertébrés dans la zone hyporhéique des rivières

Wasserbeschaffenheit - Anleitung zu Methoden für die Probenahme von Invertebraten (Wirbellosen) in der hyporheischen Zone von Flüssen

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (EN 16772:2016) 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of an identical text or by endorsement, at the latest by October 2016, and conflicting national standards shall be withdrawn at the latest by October 2016.

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Introduction

WARNING — Safety issues are paramount when surveying rivers. Surveyors should conform to EU and national Health and Safety legislation, and any additional guidelines appropriate for working in or near rivers.

The term “hyporheic” is derived from two Greek words: *hypo* (under) and *rheos* (flow), and was first used by Orghidan in 1959 [1] to delineate the area of saturated subsurface sediments beneath and lateral to the wetted channel that contains a mix of surface water and groundwater. In the past 50 years, scientific understanding of the hyporheic zone has improved [2] and the term has been modified and expanded by hydrologists, hydrogeologists, chemists and biologists to reflect the importance of:

— the upwelling and downwelling of water into and out of the stream bed and the mixing ratio of surface water and groundwater;

— the nature and rate of biogeochemical processes resulting from upwelling of interstitial water or downwelling of surface water;

— the ecotonal nature of the hyporheic zone which provides important habitat for benthic taxa, specialist hyporheic organisms and groundwater fauna, including macroinvertebrates, meiofauna and microorganisms. Meiofauna includes microcrustaceans, rotifers and nematodes as well early instars of many aquatic insects.

In this standard the hyporheic zone is defined as the spatio-temporally dynamic ecotone between the surficial benthic substrate and the underlying aquifer. Within the hyporheic zone, water, solutes and biota are exchanged with the stream above, the groundwater below and the saturated sediments lateral to the channel. The term “hyporheic zone” is applied to the physical habitat while the term “hyporheos” coined by Williams and Hynes in 1974 [3] is used to describe the faunal community inhabiting it.

Over the past few decades, the importance of the hyporheic zone has been increasingly recognized, with the vertical dimension added to spatial concepts of lateral and longitudinal connectivity. Together with the temporal dimension this has created a four-dimensional understanding of river ecosystems [4, 5, 6]. As the hyporheic zone is an ecotone between surface water and groundwater, abiotic conditions may reflect a transition between the two. Table 1 provides a general comparison of the physical characteristics of each environment.

Table 1 — Physical characteristics of typical groundwater and hyporheic environments compared with surface waters

Physical characteristic	Groundwater	Hyporheic
Light	Constant darkness	Constant darkness
Current velocity	Much lower	Lower
Annual and daily temperature range	Much smaller	Smaller
Substrate stability	Much higher	Higher

Approaches to river conservation and management recognize the need for a better understanding of the interactions between surface water and groundwater when undertaking investigations in the field. As the ecotone between the two, the hyporheic zone plays a vital part in ecosystem functioning in many rivers, including a critical role in the flow of energy, cycling of nutrients and organic compounds, as well as pollution attenuation. The hyporheic zone contributes to overall river biodiversity. It also provides a nursery for young life-stages of some fish and invertebrates and a potential refuge for benthos during adverse environmental conditions, such as flooding, low flows, chemical pollution, stream-bed drying or freezing. The hyporheic zone may therefore enhance the recovery of the benthic community following disturbance.

An increased interest in the hyporheic zone has resulted, in part, from international legislation, such as EC directives: the Habitats Directive [7], the Water Framework Directive [8], the Groundwater Directive [9] and the Nitrates Directive [10]. Although investigations into the hyporheic zone are not explicit within these directives, they do require national regulatory authorities to adopt a more integrated approach to the management of river catchments as a whole. Consequently, an understanding of the hyporheic zone, including its functions and the potential threats to these, is vital in order to comply fully with the requirements of these directives.

Investigations of the hyporheic zone may also be needed more generally for catchment management, river restoration, site-based investigations or for research. Consequently, the purpose of any study should be carefully considered when selecting the most appropriate method for sampling the hyporheos, especially if the collection of water quality and associated sediment data is also required. In addition, the methods described in this standard may require modification to reflect local conditions.

1 Scope

This European Standard provides guidance on methods for sampling invertebrates in the hyporheic zone of wadable rivers. It describes each method, including details of the equipment involved and its use in the field. Guidance is given on developing a sampling strategy and selecting an appropriate survey technique for the purpose of investigation.

NOTE Benthic macroinvertebrate sampling is covered by other published standards (see Bibliography). Selected literature with references in support of this document is given in the Bibliography.

2 Terms and definitions

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

2.1
aquifer
underground zone of water-bearing permeable rock or unconsolidated material from which groundwater can be extracted

2.2
benthic
relating to the surface substrate

2.3
benthos
community inhabiting the surface substrate of rivers

2.4
biofilm
coating on a substrate composed of microorganisms, extra-cellular polysaccharides, other materials that organisms produce, and particles trapped or precipitated within the matrix

2.5
biomass
total mass of living organisms per unit surface area or volume

2.6
catchment
basin
area from which precipitation or groundwater will collect and contribute to the flow of a specific river

2.7
diversity
taxonomic richness of a community and the distribution of individuals across taxa

2.8
downwelling
movement of water in a downward direction, typically from the surface stream to the hyporheic zone or groundwater

2.9
ecotone
transition area between two adjacent ecosystems

2.10
exposed river sediments
particles, typically comprising cobbles, gravel, sand and silt, deposited by flowing water but exposed as water levels fall

2.11
groundwater
water that is within the saturated zone below the water table

2.12
hyporheic flow
flow of water through the hyporheic zone

2.13
hyporheic zone
spatio-temporally dynamic ecotone between the surficial benthic substrate and the underlying aquifer

2.14
hyporheos
faunal community inhabiting the hyporheic zone

2.15
interstitial
referring to the spaces between substrate particles

2.16
macroinvertebrate
invertebrate that is easily visible without magnification (0,5 mm)

[SOURCE: EN ISO 10870:2012, 2.8]

2.17
meiofauna
invertebrates that pass through a 500-µm or 1-mm sieve but are retained on a 45-µm- or 63-µm sieve

2.18
permeability
capacity of a porous medium, either rock or unconsolidated material, to transmit water

2.19
pool
habitat feature characterized by distinctly deeper parts of the channel that are usually no longer than one to three times the channel's bankfull width, and where the hollowed river bed profiles are sustained by scouring

[SOURCE: EN 14614:2004, 2.24]

2.20
porosity
proportion of a given volume of rock or unconsolidated material that is occupied by pores

2.21
reach
major sub-division of a river, defined by physical, hydrological, and chemical character that distinguishes it from other parts of the river system upstream and downstream

[SOURCE: EN 14614:2004, 2.25]

2.22
riffle
fast-flowing shallow water with distinctly broken or disturbed surface over gravel/pebble or cobble substrate

[SOURCE: EN 14614:2004, 2.28]

2.23
riparian zone
area of land adjoining a river channel (including the river bank) capable of directly influencing the condition of the aquatic ecosystem (e.g. by shading and leaf litter input)

[SOURCE: EN 14614:2004, 2.29, modified — the NOTE was not adopted]

2.24
stream ordering
methods for classifying rivers and streams related to the complexity of the drainage basin, generally with progressively higher order numbers usually assigned to streams with greater discharge lower down the catchment

[SOURCE: EN 14614:2004, 2.37]

2.25
substrate
material making up the bed of a river

[SOURCE: EN 14614:2004, 2.40]

2.26
upwelling
movement of water in an upward direction, typically from the groundwater or hyporheic zone to the surface stream

3 Survey objectives

The objectives of the survey should be clearly defined before selecting which method to use for sampling the hyporheic zone, because the suitability of each method varies according to the purpose of study. Table 2 summarizes each sampling method according to its suitability for particular objectives. This includes consideration of:

— attributes and variations in hyporheic fauna, substrate and the interstitial environment;

— whether the method can be applied instream and/or in the riparian zone;

— whether data collected are fully quantitative or semi-quantitative.

All methods can be used to describe diversity, taxon richness, abundance and biomass, recognizing their known limitations.

Table 2 — Overview of sampling methods described in this standard and their suitability for particular surveys

	Karaman-Chappuis pit	Bou-Rouch pump	Vacuum pump	Standpipe trap	Williams corer	Colonization devices	Freeze coring
Migration/dispersal	No	No	No	Yes	No	Yes	No
Spatial heterogeneity	No	Yes	Yes	Yes	Yes	Yes	Yes
Temporal variability	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Interstitial sediment transport	No	No	No	Yes	No	Yes	No
Substrate characteristics	No	No	No	No	No	No	Yes
Used on submerged substrate	No	Yes	Yes	Yes	Yes	Yes	Yes
Used in riparian zone	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quantitative	No	No	No	No	Yes	Yes	Yes
Semi-quantitative	No	Yes	Yes	Yes	Yes	No	No

4 Sampling strategy

The design of a sampling strategy will vary according to the purpose of the investigation. Sampling site location may be influenced by pre-existing monitoring networks or previous investigations. The following should be considered:

— sampling method;

— number and location of sampling sites;

— number of replicates per site required to characterize site heterogeneity (e.g. upwelling and downwelling, substrate characteristics);

— sampling frequency;

— sampling depth;

— seasonal variability;

— abiotic data requirements;

— spatial and temporal scale of investigation.

Scale is important when examining the hyporheic zone, as various processes occur at different spatial scales. For example, at a stream-bed (patch) scale the size, shape, sorting and stability of unconsolidated material are the primary determinants of porosity and permeability. These factors have a major influence on community composition over relatively short distances and methods have been developed to address this [11]. At a broader scale, lateral connectivity (e.g. between the riparian zone and out to the wider floodplain) is a key consideration. Hyporheic flow paths occur at multiple scales, from the stream bed to the catchment.