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Water quality — Guidance on marine biological surveys of hard-substrate communities

Qualité de l'eau — Lignes directrices pour les études biologiques marines des peuplements du substrat dur

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 19493 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 230, *Water analysis*, in collaboration with Technical Committee ISO/TC 147, *Water quality*, Subcommittee SC 5, *Biological methods*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Introduction

Surveys of benthic marine algae and fauna on hard substrates represent an important part of marine environmental surveys. The species composition, both in terms of the species present and their relative abundances, is a result of the natural and anthropogenic environmental factors at the survey site. Natural factors that influence species composition include wave exposure, depth, salinity, nutrient level, type of substrate, slope, orientation, turbidity, current, temperature and grazing. Anthropogenic factors include pollution (e.g. oil, contaminants, particles), physical disturbance, elevated nutrient levels and effects from fisheries.

A number of different methods are being used to investigate flora and fauna on hard substrate according to the survey aim and the type of biotope surveyed. To allow environmental authorities and others to make use of this knowledge, it is essential that surveys are intercomparable in time and space, as well as between operators, and that the data are of a high quality. This International Standard is based on a limited selection of methods that allow precise documentation, that are replicable and which have been tested over many years. In choosing methods for this standard, semi-quantitative and quantitative techniques have been emphasized, such that species and quantities can be related to a known area of sea floor.

For the purposes of this International Standard, hard substrate is defined as bedrock, stable rocks and fixed marine constructions (e.g. pipelines and quays). The main focus is on biological surveys based on species that can be recorded in the field (i.e. that are visible to the naked eye).

The guidelines are applicable to seagrass communities and their epiflora and epifauna. They can also be used for surveys of stable substrates comprising loose pebbles/boulders, stone blocks, coarse gravel and other loose material as well as bedrock covered with loose sediment, but in general, such substrates require specially adapted techniques. Additional methods are usually required for surveys in depths greater than approximately 30 m.

For sediment sampling in marine areas, refer to ISO 5667-19. For surveys of sublittoral soft-bottom fauna, see ISO 16665.

Water quality — Guidance on marine biological surveys of hard-substrate communities

1 Scope

This International Standard provides guidance for marine biological surveys of supralittoral, eulittoral and sublittoral hard substrate for environmental impact assessment and monitoring in coastal areas.

This International Standard comprises

— development of the sampling programme,

— survey methods,

— species identification, and

— storage of data and collected material.

This International Standard specifies the minimum requirements for environmental monitoring.

The methods are limited to surveys and semi-quantitative and quantitative recording techniques that cause little destruction of the fauna and flora. In practice, this refers to direct recording in the field and photography. Sampling by scraping off organisms, use of a suction sampler, etc. are not covered in this International Standard, but such techniques can be used as a supplement to obtain information on small-sized species or those that live hidden.

2 Terms and definitions

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

2.1
area of influence
area influenced or expected to be influenced, based on the available information

2.2
biotope
area of uniform environmental conditions (habitat) and its characteristic assemblage of plant and/or animal species

EXAMPLE *Laminaria hyperborea* community (cuvie or tangleweed), knotted wrack community, blue mussel belt.

2.3
macroscopic organisms
algae and animals that are visible without magnification equipment ($\geqslant$ 1 mm) and which can be recorded in the field

NOTE Certain macroscopic organisms can require microscopic inspection for identification. For microscopy of collected material, the lower size limit is set to 1 mm.

2.4
hard substrate
substrate consisting of bedrock, larger rocks/stones or fixed marine constructions such as wharfs, quays and pipelines

NOTE For the purpose of this International Standard, hard substrate can also include other substrates that are not likely to be moved or turned over during a reasonable time period so that perennial species communities are likely to develop (e.g. pebbles and stones in sheltered environments).

2.5
hard substrate flora and fauna
attached algae and animals, together with relatively stationary animals living on or in close association with hard substrate

EXAMPLE Attached: kelp, seaweeds, sponges, bryozoans, corals, mussels, barnacles, ascidians. Relatively stationary: snails, sea-urchins, crabs.

2.6
supralittoral zone
zone above the eulittoral zone, which is reached by spray water

NOTE Its upper limit is normally determined by the upper limit of *Verrucaria* (black lichen belt), blue-green algae (usually *Calothrix scopulorum*) or littorinid snails.

2.7
eulittoral zone
marine intertidal zone which is submersed and emerged, either periodically due to tides or aperiodically due to irregularly occurring factors, as in the enclosed seas of the Baltic or the Mediterranean

NOTE Biologically, this zone is defined as the zone between the upper limit of barnacles and the upper limit of laminarians. In the Baltic where there is no tide, the eulittoral zone is the zone of short-lived annual algae.

2.8
sublittoral zone
zone below the eulittoral zone, which is submersed with the upper part at extreme low water levels occasionally emerging

NOTE 1 In this International Standard, the lower limit is set by the deepest occurring algae.

NOTE 2 This is also referred to as the subtidal zone.

NOTE 3 Biologically, this zone is defined as the zone between the upper limit of laminarians and the lower limit of algal vegetation (see Annex C).

2.9
level of exposure
level of wave and current exposure at a site

2.10
receiving water body
water body which receives an input of material, of either natural or anthropogenic origin

NOTE The term often appears in the context of contamination (for example effluent from municipal waste water outlets or industrial processed water). Receiving water body surveys describe the state of contamination in a given area.

2.11
sampling station
precise location where recording is carried out and any samples collected

NOTE A sampling station is defined by its geographical position (OS National Grid Reference, latitude, longitude), its depth (relative to chart datum and normalized to mean low water as given in tide tables) and any other information on physical conditions (e.g. substrate type, slope and orientation).

2.12
reference station
one or more sampling stations chosen to represent environmental conditions in a given area, i.e. free from direct anthropogenic influences

2.13
baseline survey
survey with emphasis on characterization and description of biotic and abiotic conditions in the survey area, and which forms the basis for future monitoring and/or follow-up surveys

2.14
temporal trend monitoring
surveys of the hard substrate community in response to temporal changes in chemical and/or physical conditions in the surrounding waters to document either pollution or natural variation over time

2.15
ROV
Remotely Operated Vehicle
remote-controlled underwater vehicle with video camera and often the possibility for mounting additional equipment such as sonar, manipulator arm, etc.

3 Quality and safety

3.1 Health and safety requirements

3.1.1 General

All phases of hard substrate field work and sample processing should adhere strictly to national and international health and safety regulations. The main points are listed below.

3.1.2 Laboratory safety facilities

A valid health and safety manual should be freely available in the institute or laboratory and the appropriate first aid supplies and emergency facilities (such as an eyewash station and a shower) should be installed. The laboratory and storage areas should further be equipped with point-ventilation outlets and preferably have a monitor for chemical levels in the air.

3.1.3 Requirements for diving

For surveys that require diving, this should be carried out in accordance with the appropriate rules and regulations. The diver and others participating in the diving work are required to follow the national or international regulations implemented for the prevention of accidents and health risks. Diving and communication equipment should fulfil the relevant requirements. A guide to planning and carrying out scientific diving operations is given in Reference [2]. Persons participating in diving should have the necessary certificates and official approval from the national authorities.

NOTE See also European Standards for Scientific Diving (European Scientific Diver and Advanced European Scientific Diver) http://www.soc.soton.ac.uk/OTHERS/SDSC/ESD_AESD%20Standards.pdf.

3.1.4 Field safety

Work should not be undertaken alone. Risk assessments should be addressed for the specific locations where a survey is being undertaken.

All personnel collecting and handling samples should be given training in the appropriate health and safety procedures and, where in force, have attained certification status. Refresher training should be carried out regularly. Staff should be trained in assessing risk to personnel or equipment and should follow any documented procedures.

3.1.5 Handling of chemicals

Chemicals used for fixing or preserving samples should be stored and handled with proper precautions according to health and safety regulations. Non-drip dispensers should be used for liquid chemicals.

Common chemicals used in hard substrate samples include the fixative formalin or substitutes, the preservative ethanol and biological stains.

WARNING — Formalin is particularly hazardous to health, and prolonged or intense exposure can cause long-term allergies. A number of less hazardous, but expensive, alternatives to formalin are available and should be used where possible, especially when dealing with small sample volumes.

3.2 Quality assurance and quality control

3.2.1 General

Quality assurance and quality control measures should be incorporated during all stages of marine biological surveys and sample processing programmes. These principles help to guarantee that all data produced are of a specific quality and that all parts of the work are carried out in a standardized and intercomparable manner. All procedures should therefore be clearly described and carried out openly, such that all of the laboratory's activities can be audited internally and externally at any time (see EN 14996).

NOTE The overall aim is to assure traceability and full documentation of field registration procedures, samples and equipment from beginning to end.

National and/or international accreditation should be sought if appropriate; this is required for most commercially operated laboratories. Guidance from relevant accreditation bodies should be sought in developing specific in-house quality systems, work procedures and protocols. It is recommended that the laboratories participate in intercomparative tests or learning schemes to develop expertise and maintain appropriate skills. This ensures continued standardization and reproducibility of results.

3.2.2 Scientific requirements for personnel

The surveys should be carried out by appropriately qualified personnel (marine zoologists/marine botanists). They should be able to document competence in their specialist field and regular structured training and participate in ring-testing. For surveys spanning several years, priority should be given to continuity in personnel carrying out the recordings.

4 Strategies and objectives for hard-substrate surveys

4.1 Sampling programme and plan

The sampling programme should be developed according to the individual aims of the survey, the required precision of the results, local topographical and hydrographical conditions in the survey area, information about local pollution sources, knowledge from previous surveys and any other conditions that can be of importance for the survey. For guidance on the design of sampling programme, see ISO 5667-1. The sampling programme should be determined before the survey is initiated, but appropriate adjustments may be made in the field, particularly for a pilot survey (see 4.3.2).

Surveys in partly eulittoral and sublittoral zones require different equipment and techniques. Eulittoral zone surveys are the easiest to carry out and require the least resources since surveys can normally be undertaken at low tide. Surveys in the sublittoral zone usually involve SCUBA-diving or different ROV-techniques. This International Standard describes a limited variety of different eulittoral and sublittoral survey methods. A detailed description of the recording methods is given in Annex A.

NOTE Detailed guidance on sampling programmes and methods is also given in the Marine Monitoring Handbook (http://www.jncc.gov.uk) and the Swedish EPA (http://www.naturvardsverket.se/upload/02_tillstandet_i_miljon/Miljoovervakning/undersokn_typ/hav/vegbotos.pdf).

4.2 Positioning of sampling stations

4.2.1 General

Sampling stations should be positioned according to the particular aims of the individual survey, previous surveys in the area and local topographical and hydrographical conditions. The hard-substrate community structure depends on wave exposure, type of substrate, compass direction, bottom slope, water depth and salinity. This shall be taken into account when locating the sampling and reference stations and when comparing different areas and localities.

The sampling stations should preferably be placed in areas of hard rock or other stable substrate. Areas with heterogeneous bottom conditions are difficult to record accurately and should be avoided. Particular attention should be given to station positioning in areas exposed to fresh water seeps, desiccation, ice scouring or other factors providing highly unstable conditions.

When surveys are made over time, the stratum (or strata) of the observations should be kept constant (fixed site and depth) to minimize structural variation as the temporal variation is the only one of interest. Biotopes that have little natural variation in species composition over time are best suited for temporal trend monitoring [e.g. perennial communities like the knotted wrack community (*Ascophyllum nodosum*)].

For environmental descriptions and temporal trend monitoring, a pilot survey should be carried out before sampling station positioning.

4.2.2 Strategies for locating sampling stations

Sampling stations can be located according to one or a combination of the following strategies.

— **Random sampling**. In special circumstances, sampling stations may be positioned randomly or scattered. For example, random sampling is used when no previous knowledge of the area is available as a guide to appropriate stratification, or when an unbiased value for a whole area is desired.

— **Stratified random sampling**. Based on *a priori* subdivision of the study area. The subdivisions may be delineated according to depth, substrate type, wave exposure or other factors. This ensures that all the main habitat types present on a site will be sampled and is the recommended strategy in most cases.

— **Systematic/grid sampling**. Sample stations are arranged in a regular grid-like pattern. This arrangement is appropriate for pilot surveys and for estimations of spatial pattern/extent, for instance, the zone of influence around point source discharges. The survey area should be of topographic homogeneity.

— **Gradient sampling**. Sampling stations are arranged along a known or anticipated gradient of interest. This is applicable, for instance, to trace the influence of a known pollution source.

4.2.3 Fixed sampling points

To reduce random variability when temporal changes are to be monitored, fixed sampling points can provide an effective approach.

