
**Soil quality — Sampling of soil
invertebrates —**

Part 6:

**Guidance for the design of sampling
programmes with soil invertebrates**

Qualité du sol — Prélèvement des invertébrés du sol —

*Partie 6: Lignes directrices pour la conception de programmes
d'échantillonnage des invertébrés du sol*



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Published in Switzerland

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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 23611-6 was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 4, *Biological methods*.

ISO 23611 consists of the following parts, under the general title *Soil quality — Sampling of soil invertebrates*:

- *Part 1: Hand-sorting and formalin extraction of earthworms*
- *Part 2: Sampling and extraction of micro-arthropods (Collembola and Acarina)*
- *Part 3: Sampling and soil extraction of enchytraeids*
- *Part 4: Sampling extraction and identification of soil-inhabiting nematodes*
- *Part 5: Sampling and extraction of soil macro-invertebrates*
- *Part 6: Guidance for the design of sampling programmes with soil invertebrates*

Introduction

The biodiversity of soil fauna is tremendous. Soil harbours species-rich communities, which regulate ecosystem processes such as organic matter decomposition, nutrient flows or soil fertility in general, References [40], [45]. All terrestrial animal phyla can be found in soils, Reference [16]. In addition to thousands of bacterial and fungal “species”, more than 1 000 species of invertebrates in abundances of up to 1,5 million individuals can be found within a square metre of soil, References [3], [5]. This diversity can only be reliably estimated by investigation of the soil community itself, since other parameters like climate are not or only weakly correlated with species richness, Reference [24].

The composition of this community, as well as the abundance and biomass of the individual species and groups is a valuable source of information, since they integrate various abiotic and biotic effects such as soil properties and conditions, climate, competition or biogeographical influences, Reference [68]. For this reason, the evaluation of the biodiversity of soil invertebrate communities becomes more and more important for the classification and assessment of biological soil quality, Reference [51]. However, this work is only possible if data collection (i.e. sampling of the soil fauna) is carried out according to standardized methods. For this reason, a number of ISO guidelines have been prepared covering the sampling of the most important soil organism groups.

In the individual parts of ISO 23611, the practical work concerning the respective animal group is described in detail. However, (nearly) nothing is said about how to plan the use of such methods or how to evaluate the results. Despite the fact that sampling for any field study can be different depending on the individual purpose, guidance is needed for monitoring studies in a legal context. Such studies can include the following:

- site-specific risk assessment of contaminated land;
- study of potential side effects of anthropogenic impacts (e.g. the application of chemicals or the building of roads);
- the biological classification and assessment of soils in order to determine the biological quality of soils;
- long-term biogeographical monitoring in the context of nature protection or restoration, including global change [e.g. as in the long-term ecological research project (LTER)].

Spatial studies focusing on environmental and ecological questions require a carefully designed strategy for collecting data (References [31], [65]). Before identifying the optimal design, two issues have to be clarified: what is the objective of the study and what is already known about the survey area? Afterwards, one may select one of the well-known design patterns (e.g. grid sampling, random sampling, clustered sampling or random transects) or prepare a study-specific design. In any case, the field sampling design has to be practical, e.g. the volume of soil to be sampled, depending on the size and distribution of the organisms, has to be manageable (i.e. the smaller the individual animal, the smaller the size), and cost effective.

In studies focusing on soil invertebrates, it is not possible to observe the entire population. Therefore, sampling is done only at a limited number of locations. The main reason for using statistical sound sampling schemes is that such sampling guarantees scientific objectivity and avoids forms of bias such as those caused by judgement sampling. This is especially valuable if the objective is to obtain data that are representative for the whole area. At the same time, statistics-based sampling schemes ensure standardized sampling methods over time, i.e., if the same area is to be re-sampled in the future, the results will be comparable.

The rationale for this guidance on the design of field sampling methods for soil invertebrates takes into consideration the guidance provided in ISO 10381-1 describing soil sampling in general.

The design of microbiological studies is already covered by ISO 10381-6, ISO 14240-1 and ISO 14240-2.

Soil quality — Sampling of soil invertebrates —

Part 6: Guidance for the design of sampling programmes with soil invertebrates

1 Scope

This part of ISO 23611 provides guidance for the design of field studies with soil invertebrates (e.g. for the monitoring of the quality of a soil as a habitat for organisms). Detailed information on the sampling of the most important soil organisms is provided in the other parts of this International Standard (ISO 23611-1 to ISO 23611-5).

This part of ISO 23611 is used for all terrestrial biotopes in which soil invertebrates occur. Basic information on the design of field studies in general is already laid down in ISO 10381-1. This information can vary according to the national requirements or the climatic/regional conditions of the site to be sampled.

NOTE While this part of ISO 23611 aims to be applicable globally for all terrestrial sites that are inhabited by soil invertebrates, the existing information refers mostly to temperate regions. However, the (few) studies from other (tropical and boreal) regions, as well as theoretical considerations, allow the conclusion that the principles laid down in this part of ISO 23611 are generally valid, References [4], [6], [40], [21].

This part of ISO 23611 gives information on site-specific risk assessment of contaminated land, study of potential side effects of anthropogenic impacts (e.g. the application of chemicals or the building of roads), the biological classification and assessment of soils in order to determine the biological quality of soils, and long-term biogeographical monitoring in the context of nature protection or restoration, including global change (e.g. as in long-term ecological research projects).

2 Normative references

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

ISO 10381-1:2002, *Soil quality — Sampling — Part 1: Guidance on the design of sampling programmes*

ISO 10381-2, *Soil quality — Sampling — Part 2: Guidance on sampling techniques*

ISO 10381-3, *Soil quality — Sampling — Part 3: Guidance on safety*

ISO 10381-4, *Soil quality — Sampling — Part 4: Guidance on the procedure for investigation of natural, near-natural and cultivated sites*

ISO 10381-5, *Soil quality — Sampling — Part 5: Guidance on the procedure for the investigation of urban and industrial sites with regard to soil contamination*

ISO 10381-6, *Soil quality — Sampling — Part 6: Guidance on the collection, handling and storage of soil under aerobic conditions for the assessment of microbiological processes, biomass and diversity in the laboratory*

ISO 10390, *Soil quality — Determination of pH*

ISO 10694, *Soil quality — Determination of organic and total carbon after dry combustion (elementary analysis)*

ISO 11074, *Soil quality — Vocabulary*

ISO 11260, *Soil quality — Determination of effective cation exchange capacity and base saturation level using barium chloride solution*

ISO 11272, *Soil quality — Determination of dry bulk density*

ISO 11274, *Soil quality — Determination of the water-retention characteristic — Laboratory methods*

ISO 11277, *Soil quality — Determination of particle size distribution in mineral soil material — Method by sieving and sedimentation*

ISO 11461, *Soil quality — Determination of soil water content as a volume fraction using coring sleeves — Gravimetric method*

ISO 11465, *Soil quality — Determination of dry matter and water content on a mass basis — Gravimetric method*

ISO 11466, *Soil quality — Extraction of trace elements soluble in aqua regia*

ISO 13878, *Soil quality — Determination of total nitrogen content by dry combustion (“elemental analysis“)*

ISO 14869-1, *Soil quality — Dissolution for the determination of total element content — Part 1: Dissolution with hydrofluoric and perchloric acids*

ISO 15709, *Soil quality — Soil water and the unsaturated zone — Definitions, symbols and theory*

ISO 15799, *Soil quality — Guidance on the ecotoxicological characterization of soils and soil materials*

ISO 17616, *Soil quality — Guidance on the choice and evaluation of bioassays for ecotoxicological characterization of soils and soil materials*

ISO 23611-1:2006, *Soil quality — Sampling of soil invertebrates — Part 1: Hand-sorting and formalin extraction of earthworms*

ISO 23611-2, *Soil quality — Sampling of soil invertebrates — Part 2: Sampling and extraction of microarthropods (Collembola and Acarina)*

ISO 23611-3, *Soil quality — Sampling of soil invertebrates — Part 3: Sampling and soil extraction of enchytraeids*

ISO 23611-4, *Soil quality — Sampling of soil invertebrates — Part 4: Sampling, extraction and identification of free-living stages of nematodes*

ISO 23611-5, *Soil quality — Sampling of soil invertebrates — Part 5: Sampling and extraction of soil macro-invertebrates*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11074 and the following apply.

3.1 Soil biology

3.1.1

biodiversity

variability among living organisms on the earth, including the variability within and between species, and within and between ecosystems

NOTE Also often used as the number and variety of organisms found within a specified geographic region.

3.1.2

community

association of organisms, belonging to different species, families, etc. living at the same time at the same place, i.e. the living portion of an ecosystem

See Reference [42].