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Marine environmental impact assessment (MEIA) — Technical specifications for marine biotic surveys in the international seabed area — General principles

Évaluation d'impact sur le milieu marin — Spécifications techniques pour les relevés biotiques dans la zone internationale des fonds marins — Principes généraux

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Foreword

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This document was prepared by Technical Committee ISO/TC 8, *Ship and Marine technology*, Subcommittee SC 13, *Marine technology*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In accordance with the United Nations Convention on the Law of the Sea (UNCLOS)[6] and the 1994 Agreement relating to the Implementation of Part XI of the UNCLOS, the International Seabed Authority (ISA) has developed regulations such as those contained in References [7], [8] and [9]. These regulations include provisions for contractors working in mineral exploration in the area to gather oceanographic and environmental baseline data and to establish baselines. These data and baselines are then used to assess the likely effects of the programme of activities under the plan of work for exploration on the marine environment.

Since high-quality environmental baseline data are a prerequisite for the correct assessment of the environmental impacts from deep-sea mining, the ISA Legal and Technical Commission issued *Recommendations for the guidance of the contractors for the assessment of the possible environmental impacts arising from exploration for polymetallic nodules in the Area*[10] in 2001, one year after the approval of the *Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area*.[7] With the publication of two additional regulations on exploration[8,9] in 2010 and 2012, it was deemed necessary to develop an environmental guideline applicable to the exploration for various deep-sea resources.

Therefore, in 2013, ISA published *Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area*.[11] This guidance was updated in 2020[12] and 2022.[13] However, the technical specifications and recommendations for environmental baseline surveys remain unclear, especially for marine biotic surveys.

In the context described above, this document provides general provisions and technical recommendations for conducting marine biological surveys, mainly for marine biological baseline surveys in the exploration of deep-sea solid mineral resources in the international seabed area.

Marine environmental impact assessment (MEIA) — Technical specifications for marine biotic surveys in the international seabed area — General principles

1 Scope

This document provides general technical recommendations for components of marine biotic surveys in the international seabed area, including station and survey line design, sampling strategies, survey items, equipment for survey and analysis, and sample preservation and analysis.

This document is applicable to marine biotic surveys in the international seabed area.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
international seabed area
seabed, ocean floor and subsoil thereof, beyond the limits of national jurisdiction

[SOURCE: UNCLOS, 1982, Article 1.1, modified — "the" has been removed from the definition.]

3.2
environmental baseline
sufficient information collected from the exploration area to describe the natural values of environmental factors and biocompetence succession without being directly affected by intense human activities, such as exploration and exploitation of deep-sea resources

[SOURCE: ISBA/25/LTC/6/Rev.1, Annex II, 2020, modified — the definition has been shortened.]

3.3
chlorophyll *a*
pigment in the cells of autotrophic plants, the main substance that absorbs and transmits light energy during photosynthesis in plants

3.4
sediment chlorophyll *a*
chlorophyll a (3.3) in the phytoplankton debris and humus that settle on the seabed, providing indicative information on the output flux, mixing and degradation of the active components of the particulate organic component of the seafloor

3.5
primary productivity
ability of autotrophic organisms to produce organic matter through photosynthesis

Note 1 to entry: Primary productivity is usually calculated as the mass of the organic matter (usually expressed in organic carbon) per unit area (or volume) per unit time (year or day), corresponding to the primary production in the same area (or volume) over that time.

3.6
microorganism
group of tiny unicellular or multicellular primary organisms with simple structures and a variety of physiological characters,

EXAMPLE 1 Prokaryotes, such as bacteria and archaea.

EXAMPLE 2 Eukaryotes, such as fungi (yeasts and moulds), protozoa and microscopic algae.

EXAMPLE 3 Noncellular organisms, such as viruses, viroids and prions.

3.7
plankton
group of organisms lacking advanced locomotive organs, with no or weak mobility, floating in the water layer and often moving with the flow, including phytoplankton and zooplankton

Note 1 to entry: According to individual size, plankton can be divided into the following types:

— megaplankton: plankton with a diameter larger than 20 cm;

— macroplankton: plankton with a diameter of 2 cm to 20 cm;

— mesoplankton: plankton with a diameter of 200 µm to 20 mm;

— microplankton: plankton with a diameter of 20 µm to 200 µm;

— nanoplankton: plankton with a diameter of 2 µm to 20 µm;

— picoplankton: plankton with a diameter less than 2 µm, including heterotrophic bacteria and autotrophic organisms, here referring to photosynthetic picoplankton.

3.8
megafauna
fauna clearly visible in photographs of the seabed

Note 1 to entry: Since the resolution of the camera varies, the benthic fauna larger than 1 cm are generally considered megafauna.

3.9
macrofauna
animal retained on a 250-µm sieve, typically sorted and identified with a microscope

EXAMPLE Polychaetes, bivalves, isopods and tanaids.

[SOURCE: ISBA/25/LTC/6/Rev.1, Annex II, 2020]

3.10
metazoan meiofauna
small invertebrate retained on a 32-µm sieve (except foraminifera), typically sorted and identified with a microscope

EXAMPLE Nematodes, harpacticoid copepods, ostracods, kinorhynchs, tardigrades and gastrotrichs.

[SOURCE: ISBA/25/LTC/6/Rev.1, Annex II, 2020]

3.11
nodule fauna
fauna attached to the surface and crevices of polymetallic nodules

3.12
demersal scavenger
animal that eats waste products and dead remains of other animals and plants that it did not kill itself

[SOURCE: ISBA/25/LTC/6/Rev.1, Annex II, 2020, modified — the term has been made singular.]

3.13
marine mammal
viviparous vertebrate, with the characteristics of lactation, pulmonary respiration, constant body temperature, streamlining, and forelimbs specialized as fins

3.14
nekton
fish, squids, crustaceans and marine mammals that are active swimmers in the open ocean environment

[SOURCE: ISBA/25/LTC/6/Rev.1, Annex II, 2020]

3.15
environmental DNA
eDNA
DNA molecule in the environment, including water and sediment, or exfoliated tissues and excreta released from organisms into the environment, that can reflect their current and past biological activities and existence in the environment

3.16
seabird
bird that is fully adapted to the marine environment in terms of morphology and behaviour and can forage in salt water

3.17
human-occupied vehicle
HOV
self-propelled submersible with its own energy, life support and accessory system

Note 1 to entry: A HOV can carry marine scientists into the deep ocean to investigate the seabed. It also includes two manipulators that can be operated to collect samples.

3.18
remote operated vehicle
ROV
underwater vehicle that is remotely controlled by the connected cable transmitting signals and power from the support vehicle

3.19
autonomous underwater vehicle
AUV
unpiloted and cableless submersible that can operate according to predetermined procedures or adapt to environmental changes

3.20
conductivity, temperature and depth profiler
CTD profiler
system for measuring conductivity (an indicator of salinity), temperature and depth (defined from pressure measurements)

3.21
conductivity, temperature and depth rosette water sampler
CTD rosette water sampler
rosette sampler with *CTD profiler* (3.20) attached and at least 12 Niskin bottles to sample larger volumes of sea water

3.22
lander system
system equipped with camera and trap deployed to the seafloor to observe animals in situ or recover specimens to the surface

3.23
deep towed camera system
imaging system that consists of still camera and video camera within a frame and is towed over the seabed

Note 1 to entry: A deep towed camera system can be used for collecting high quality video and still images over relatively large areas from the seabed.

3.24
box-corer
sediment sampler that has a detachable, square, open-ended steel sample box attached to a weighted column with a removable spade closure for the bottom of the box

Note 1 to entry: According to whether it is guided by underwater television, it can be divided into the following two types:

— box-corer not guided with underwater television;

— box-corer guided with underwater television (TV box-corer).

3.25
multicorer
sediment sampler that consists of an outer framework and weighted collecting head of plastic core tubes hanging from a water-filled hydraulic damper

Note 1 to entry: According to whether it is guided by underwater television, it can be divided into the following two types:

— multicorer not guided with underwater television;

— multicorer guided with underwater television (TV multicorer).

3.26
epibenthic sledge
sled equipped with a camera and environmental sensor system to collect epibenthic fauna and larvae by towing on the seabed

3.27
plankton net
sampler used for collecting plankton samples, equipped with either multiple nets or single

3.28
multinet
sampler equipped with multiple nets for sampling planktons from multiple water layers by opening and closing the nets in succession

4 Specifications and recommendations

4.1 Station and survey line design

The recommendations for station and survey line design are as follows:

a) Biological sampling strategy: High-resolution bathymetric and seabed topographic maps as well as a robust statistical design should be used when preparing the biological sampling strategy, taking into account variability in the environment.

b) Representative samples: Sample collection should include fauna which is representative of the variability of habitats, such as different bottom topography, depth, seabed and sediment characteristics, targeting the water column and the mineral resource.

c) Polymetallic nodules: For each block of polymetallic nodules, at least four stations should be surveyed. Surveys of chlorophyll *a*, primary productivity and plankton should be carried out with marine chemical and hydrological surveys synchronously. In benthic surveys, the stations for box-corer and multicorer sampling should be the same. For each station, box-corer and multicorer sampling should be performed at least twice to generate replicates for the analysis of macrofauna and meiofauna. A benthic survey should be carried out with a sediment survey synchronously.

d) Cobalt-rich crust: A survey of the abundance and diversity of megafauna in each seamount of the cobalt-rich ferromanganese crust region should be initially based on at least four transects (located on different sides of the seamount), which should include the summit, slope and base of the seamounts. The box-corer and multicorer sampling stations should include the summits and bases of four different sides of the seamount. Chlorophyll *a,* primary production and plankton should also be investigated on four different sides of each seamount, and three sampling stations should be set on the summit, slope and base of each seamount.

e) Polymetallic sulfides: The sampling station should include an active hydrothermal vent area and an adjacent inactive hydrothermal vent area.[15] In the active hydrothermal area, 5-10 sampling stations should be arranged along the gradient of temperature and hydrothermal fluid. In the inactive hydrothermal vent area, the sampling sites should include mineralized sites, nonmineralized sites and hydrothermal deposition sediment areas.

f) Application of underwater vehicles: If a remote operated vehicle (ROV) or a human-occupied vehicle (HOV) is used for the investigation, a push-corer can be used to collect sediment samples, a manipulator arm can be used to collect nodule fauna and megafauna, and a pump can be used to collect demersal fish and scavengers. If an autonomous underwater vehicle (AUV) is used for the investigation, it is recommended to carry out a cruise along the survey line at a set height off the bottom (optimally up to 3 m off the bottom, with a maximum limit of up to 5 m off the bottom) and to take photographs and video.

4.2 Sampling strategy

4.2.1 Interannual variation

For most environmental baselines with interannual variability, observations at the same site during similar seasons or under similar environmental conditions should be conducted for at least three years to assess interannual variability and increase the chance of capturing periodic events, especially events that can cause periodic changes in environmental baselines, such as the El Niño-Southern Oscillation (ENSO).[16-19] Data collected in years prior to the publication of this document can be used to assess interannual variability.

4.2.2 Intra-annual variation

In each block, at least one station for time-series measurement should be established to observe the temporal variability of environmental parameters, such as chlorophyll *a*, primary productivity, particle flux and hydrodynamics, at different times of the year to cover seasonal and monthly changes. The

seasonal and monthly changes in chlorophyll *a* and primary productivity can be measured by ocean colour remote sensing.

4.2.3 Seasonal variation

For parameters that are not expected to show obvious seasonal variations, such as sediment characteristics and the biogeochemical environment of deeper sediment layers, the observation results of different seasons should be verified at least once at the same site.

4.2.4 Diurnal variation

For zooplankton and other animals with obvious diurnal movement ability,[20] samples should be collected at the same station during the day and at night.

4.3 Sample types and sampling methods

4.3.1 Water samples

Water samples for surveys of chlorophyll *a* (above a 200 m depth), microorganisms, picoplankton, microplankton, and environmental DNA (eDNA) should be collected using the conductivity, temperature and depth (CTD) rosette water sampler. The vertical sampling resolution can be followed as in Table 1. For water samples to be used for the measurement of primary productivity, the sampling depth should be set according to the recommendations for the measurement of primary productivity.

Table 1 — Water sampling depth

Dimensions in metres

Type		Sampling depth
Area for polymetallic nodule exploration		2, 25, 50, 75, 100, 125, 150, 200, 500, 800, 1 000, 2 000, 3 000, 4 000 (5 000), 100 from seabed, 50 from seabed, near-bottom layer
Area for cobalt-rich crust exploration	Depth <3 000 m	2, 25, 50, 75, 100, 125, 150, 200, 500, 800, 1 000, 2 000, 100 from seabed, 50 from seabed, near-bottom layer
	Depth ≥3 000 m	2, 25, 50, 75, 100, 125, 150, 200, 500, 800, 1 000, 2 000, 3 000, 4 000 (5 000), 100 from seabed, 50 from seabed, near-bottom layer
Area for polymetallic sulfide exploration		2, 25, 50, 75, 100, 125, 150, 200, 500, 800, 1 000, 2 000, 300 from seabed, 200 from seabed, 100 from seabed, 50 from seabed, near-bottom layer

NOTE During water sampling, the data of conductivity, temperature, depth and dissolved oxygen can be obtained synchronously. The sampling depth can be adjusted appropriately, especially for the layers of the thermocline, subsurface chlorophyll *a* maximum depth and oxygen minimum depths. For areas with water depth less than 5 000 m, the sampling depth can be adjusted accordingly.

4.3.2 Sediment samples

4.3.2.1 A box-corer or TV box-corer with an opening area of 50 cm × 50 cm should be used for sampling macrofauna to meet statistical requirements.[21,22] Polymetallic nodules on the surface of the sample are used for the analysis of nodule fauna. Before collecting biological samples from nodules, the attached organisms on the nodules should be photographed, described and preserved on site, and the overlying water and sediment samples of the whole box-corer should be used for species identification and quantitative analysis of the macrofauna. The sediment sampling procedure should follow the recommendations in ISO 23040:2021, 16.4.

4.3.2.2 Sediment samples for surveys of metazoan meiofauna, foraminifera, microorganisms, sediment chlorophyll *a* and eDNA can be collected by (TV) multicorers and push corers. (TV) multicorers should be installed with more than 8 sampling tubes, with lengths greater than 60 cm and diameters