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**Development of a standardized procedure for the
development, approval and review of regional
environmental management plans**

Recommendations on technical guidance for the development of regional environmental management plans in support of the standardized procedure and template

Issued by the Legal and Technical Commission*

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I. Introduction and background

1. Regional environmental management plans for the Area contribute to protecting marine environments while also enabling the responsible extraction of mineral resources. As noted in the regional environmental management plan standardized process and template document (ISBA/29/C/10), the recommendations focus on the sections of document ISBA/29/C/10 where detailed scientific and technical guidance are considered useful to underpin the development, establishment and review of regional environmental management plans. These recommendations aim to support each individual plan in achieving the required evidence level and scientific robustness to inform decision-making for appropriate levels of environmental protection on a regional scale from mining activities, by, inter alia:

(a) Providing detail on expert deliberations included in the development of the regional environmental management plan and the criteria used for selection of experts;

(b) Providing geographical and environmental context for environmental management;

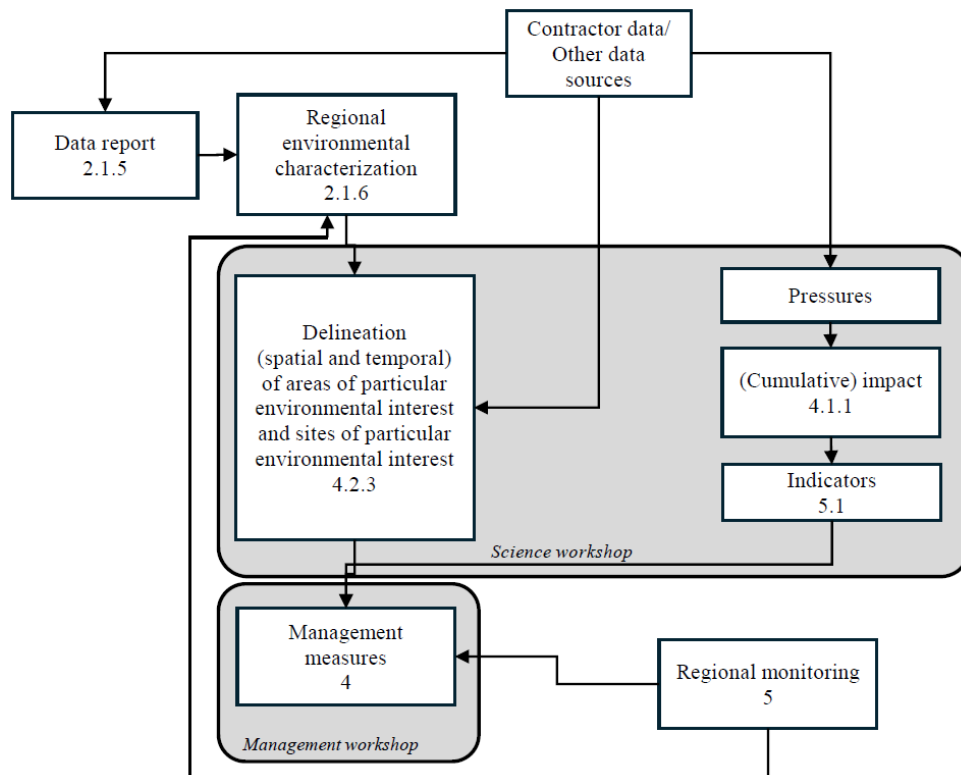
(c) Detailing criteria for a regional network of area-based management measures that are (i) representative of the full range of habitats, biodiversity, sensitive ecosystems and biological communities, within the management area; and/or (ii) important for the maintenance of ecosystem structure and function;

(d) Considering non-spatial management measures

2. By clearly outlining and elaborating on the scientific and technical approaches of the Legal and Technical Commission, the recommendations will also help external experts and other stakeholders who engage in and contribute to the regional environmental management plan process.

3. The recommendations provide more detail for the structures set out within the standardized procedure (ISBA 29/C/10), which includes the Template. Headings in bold in the present document align with the headings in the standardized procedure document. They also complement document ISBA/29/C/10 in providing broader information on the regional environmental management plan framework, comprising elements discussed in these recommendations, as shown in the figure below.

Figure
Major elements in the development of a regional environmental management plan



Note: Relevant sections in the recommendations are noted below the boxes. Boxes without sections noted contain important inputs to the process, though these are not detailed in the regional environmental management plan.

II. Standardized procedure recommendations

2.1 Compilation of available data and information

4. Environmental baseline data on the region serve as the evidence base for the regional environmental management plan. These will be compiled in the data report and will underpin the regional environmental characterization document. Potential data sources include global and regional data repositories, other public data repositories, the International Seabed Authority DeepData database¹ and supplementary data of published scientific literature. The recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area (ISBA/25/LTC/6/Rev.3) will be relevant for identifying patterns and trends at a regional scale that can inform environmental management.

2.1.1 Contractor data and information submitted to the Authority

5. DeepData hosts a large amount of contractor data on mineral resource assessment (geological data) and environmental baseline and assessment data; data types contained therein should follow the recommendations provided in document ISBA/25/LTC/6/Rev.3.

¹ <https://www.isa.org/jm/deepdata-database/>.

2.1.2 Other data and information

6. A range of non-contractor data and information may be available to inform a regional environmental management plan. These could include scientific projects, regional initiatives, peer-reviewed articles and publicly accessible databases. An indicative, non-exhaustive overview of other potentially useful public data repositories and the data types they contain is provided in annex V to the present document.

2.1.3 Traditional knowledge of Indigenous Peoples and local communities

7. References to traditional knowledge of Indigenous Peoples and communities will need to be considered once the Council finalizes the applicable references within the draft exploitation regulations. This is a placeholder.

2.1.4 Other information

8. Any other information relevant to the indicative elements for the regional environmental management plan, including other types of marine uses.

2.1.5 Data report

9. The data report provides an annotated compilation of data pertaining to the regional environmental management plan region, in particular spatial data. It will include global and regional scale data sources, as well as consider the types of information available from more localized contractor studies. It should include data sources and results on the following topics:

- (a) Bathymetry
- (b) Geography including geomorphology
- (c) Geological structures
- (d) Oceanography
- (e) Biology, including biological productivity
- (f) Biogeographic classification
- (g) Climate including climate change
- (h) Human uses
- (i) Areas defined for management and/or conservation objectives
- (j) Sociocultural data
- (k) Sites of underwater cultural heritage

2.1.6 Regional environmental characterization

10. The regional environmental characterization provides a synthesis of the environment present in the regional environmental management plan region, highlighting patterns and trends in components of the environment that will inform regional-scale discussions within the workshops.

11. The regional environmental characterization is expected to provide an overview of the following:

- (a) Background, scope and purpose of the document

- (b) Approach
 - (i) Data sources
 - (ii) Data compilation and analysis methodology where appropriate
- (c) Contract areas for exploration and exploitation of mineral resources
- (d) Bathymetry, geography and geology
- (e) Physical oceanography
- (f) Chemical oceanography
- (g) Pelagic biology and ecology
- (h) Benthic biology and ecology
- (i) Human uses and potential impacts to the marine environment, including cumulative effects
- (j) Sociocultural significance
- (k) Existing management regimes
- (l) References

2.2 Expert deliberation processes

12. Experts should be brought together, including through workshops and selected by the Commission on the basis of an expert and stakeholder mapping exercise, in accordance with the present recommendations.

13. Workshops on regional environmental management plans will be convened by the secretariat under the auspices of the Authority, in line with relevant decisions of the Council and the Commission. These will identify possible elements to be considered for inclusion in the draft regional environmental management plans to maintain ecological balance of the marine environment, including a description of a potential network of managed areas and sites comprising areas of particular environmental interest and/or sites of particular environmental interest. Workshops seek the views of recognized experts in the relevant fields and engage dialogue with all stakeholders, including through pre-workshop, workshop, and post-workshop processes.

14. Workshop processes in general will be undertaken, subject to availability of financial resources, in two phased approaches. The first phase is the undertaking of scientific workshops, the second relates to management workshops. Workshop outcomes will contribute to the first draft of the regional environmental management plan to be developed by the Commission.

15. Participants for the workshops are invited through the nomination and selection process conducted by the Authority, through a set of selection criteria for science-based and management assessment workshops, as listed below in paragraphs 17 and 19. Stakeholder mapping exercises will be conducted to ensure the effective participation of stakeholders and experts in relevant fields.

16. The selection of nominees by the Commission for each workshop is based on the expertise and experience of the nominees as relevant to the workshop objectives, taking into account equitable geographical representation, gender balance and the representation of developing States.

2.2.1 Science-based workshops

2.2.1.1 Criteria for selection of scientific workshop nominees

17. For science-focused workshops, the selection criteria usually include the following:

(a) Good scientific knowledge and research experience in the region concerned, ideally with authorship of peer-reviewed reports and publications relating to deep-sea biology, oceanography, geology and environmental impact assessment related to deep-sea mineral resources;

(b) Access to relevant unpublished environmental data, including biological, physical and chemical oceanography and geological data in the region concerned;

(c) Good experience and expertise relating to spatial planning and scientific design of area-based management tools (such as marine protected areas), as well as non-spatial management measures;

(d) Stakeholders and persons with expertise in, and relevant data for, the area concerned, including traditional knowledge, and representatives of other resource users and coastal States.

2.2.1.2 Expected focus of scientific workshops

18. Scientific assessment workshops will focus on scientific synthesis and description, in particular using data from the data report and regional environmental characterization, with objectives that will:

(a) Define the appropriate regional environmental management plan area, drawing upon information on the geology, biogeography and oceanography of the region;

(b) Review and analyse environmental data, including physico-chemical oceanographic, geological and biological data;

(c) Synthesize environmental data, especially ecological characteristics and patterns, including faunal distribution, faunal dispersal capabilities and distances, genetic connectivity, patterns of biodiversity, community structure, ecosystem function;

(d) Development of ecological proxy variables;

(e) Describe current mineral exploration activity and resource distribution;

(f) Review and describe current exploration activity within contract areas along with distribution of resources

(g) Describe potential overlaps with other legitimate users and area-based management tools established by competent bodies

(h) Develop understanding of pressures, impacts and environmental risks

(i) Evaluate effects (including cumulative and in combination) at the regional scale;

(j) Provide descriptions of areas that could be protected from exploitation in order to aid in the achievement of the effective protection of the marine environment;

(k) Identify and describe potential area-based management tools;

(l) Identify potential non-spatial management measures or options;

(m) Identify knowledge gaps and propose options to address them.

2.2.2 Management assessment workshops

2.2.2.1 Criteria for selection of management workshop nominees

19. For management-focused workshops, the selection criteria include the following:

(a) Good experience and expertise relating to spatial planning and scientific design of area-based management tools (such as marine protected areas), as well as non-spatial management measures;

(b) Good environmental knowledge of the region concerned, ideally with authorship of peer-reviewed reports and publications;

(c) Good understanding of the Authority's rules, regulations and procedures related to environmental management;

(d) Expertise in appropriate maritime agencies or organizations (such as regional fisheries management organizations) rules, regulations and procedures related to environmental management;

(e) Expertise in cumulative/in combination impacts and regional-scale environmental assessment; and

(f) Stakeholders and persons with expertise in and knowledge of the region concerned, including traditional knowledge and representatives of other resource users and coastal member States.

2.2.2.2 Expected focus of management workshops

20. Management workshops will focus on identifying specific management measures and an implementation framework for developing elements for inclusion in the regional environmental management plan. In particular, the objectives of the workshops will be to:

(a) Develop management measures at a regional scale;

(b) Develop area-based management measures;

(c) Develop environmental monitoring at the regional scale, through collaboration among contractors, sponsoring States and other stakeholders;

(d) Develop the strategic framework for assessment of cumulative impacts at the regional scales.

21. After the workshops, the report will be provided to the Commission for further consideration and subsequent development of the draft regional environmental management plan.

2.3 Formal stakeholder consultations

22. Stakeholder consultations should take place to ensure that concerns and interests of stakeholders are considered and acknowledged during the preparation and drafting of the regional environmental management plan. This can help ensure the regional environmental management plan is comprehensive, complete and takes into account various stakeholder perspectives.

23. Stakeholder consultation should be conducted in a meaningful manner. It should provide appropriate access and reasonable opportunity for those consulted to raise enquiries and to share their views. The Commission should identify stakeholders consulted, issues raised and whether and how such issues have been incorporated into the regional environmental management plan document.

2.4 Establishment of a regional environmental management plan

24. After the approval of the draft regional environmental management plan by the Council, the Commission will facilitate the implementation of the plan. The Commission, with assistance from the secretariat, may identify priority activities and a timeline for the implementation of the plan, taking into account resource availability. The Commission will explore opportunities for collaboration with existing scientific initiatives and programmes that may benefit the implementation of the plan.

25. The Commission and the secretariat will promote the participation of developing member States in the implementation of regional environmental management plans, through capacity- building activities of the Authority.

2.5 Review of the regional environmental management plan

26. A review of the regional environmental management plan will be conducted at least every five years after its approval, or earlier under certain conditions as specified in the standardized procedure. The review should focus on the following:

(a) Review of progress in the implementation of the regional environmental management plan;

(b) Review of newly available scientific information and data and implications of such information and data for regional environmental management;

(c) Identification of updates and further actions, if needed, to the management measures of the regional environmental management plan in order to advance its goals and objectives.

27. As part of the regular review process, the data report and the regional environmental characterization will be updated with new information and data. The newly available information and data will be used to validate or update the scientific assessment, such as habitat classification or risk assessment that informed the development of the regional environmental management plan. The review will also consider new contract areas, as well as areas relinquished by the contractors and assess the conservation values of such areas. Where necessary, expert deliberations will be organized to support the review.

III. Template recommendations

3.1 Geographical scope

28. Defining geographical scope (spatial extent of the regional environmental management plan area) is a fundamental, step in the regional environmental management plan development process, ensuring that the plan area has environmental and functional integrity. It further ensures that the plan is established solely in the Area and sets out the area in which area-based management tools can be developed. Deciding the scope through the workshop process encourages collaborative decision-making.

29. The regional environmental management plan geographical scope should therefore take into consideration the limits of the Area alongside the different types of large-scale geological settings for deep-sea mineral occurrence, such as abyssal plains and oceanic spreading ridges. A plan area may be defined using the position of the different types of geological settings for deep-sea minerals occurrence such as abyssal plains, oceanic spreading ridges, fracture zones and seamounts. This section will include a description of the data and information used to develop the definition of the region, including their location, depth range and the rationale for their use.

30. If appropriate, consideration should be given to fracture zones and seamounts related to ecological structure and function, such as:

- (a) Large area of similar habitat coverage;
- (b) Self-sustaining biological populations;
- (c) A broad range of habitats.

3.1.1 Geographical and geological features used for development of scope

31. The following geographical and geological features should be used for development of scope; this information should be extracted and presented in the data report where available:

- (a) Seafloor topography;
- (b) Seafloor substrate (e.g. rock, sediment);
- (c) Limits between geologically uniform regions;
- (d) Distribution of the mineral resource(s);
- (e) Distribution of geological features such as active volcanoes, hydrothermal vents and submarine mass flows;
- (f) Age of oceanic crust and seamounts.

3.1.2 Biogeographical areas

32. A regional environmental management plan area definition will also include analysis of what biogeographic regions the plan area may encompass. These are widely viewed as essential tools for oceans management in that they classify large areas into distinct (geographical) regions that contain groups of taxa and physical features that are largely distinct or unique from their surroundings at a certain scale. As such, they reflect biological units with a degree of common history and coherent response to perturbations and management actions. For the regional environmental management plan, using biogeography in the definition of scope will aid in making sure that biological gradients are not interrupted and that ecological functions are not constrained.

33. Global provincial classifications are based on combinations of environmental factors (such as oceanographic conditions and depth in the water column) and biological knowledge of distributions and abundance patterns of taxa, and include consideration of depth zones: epipelagic, mesopelagic, pelagic and benthic; and bathypelagic, abyssal and hadal. Examples of such provinces for areas of particular relevance to mineral resource management are the mesopelagic for plankton and nekton (in relation to water column discharges) and the lower bathyal and abyssal for deep-sea benthic communities (in relation to seafloor operations).

3.1.3 Oceanographic setting

34. Water masses, biological productivity and currents of the region indicate areas of similar environmental characteristics, which should be included in developing the geographic scope of the regional environmental management plan. The geographic scope could include the following:

- (a) Physical oceanography
 - Water mass distribution
 - Regional surface and mid-ocean circulation

- Bottom currents/seafloor topography driven currents (seamounts, ridges);
 - Physical water properties (pressure, temperature, salinity, turbidity).
- (b) Chemical oceanography
- Chemical water properties (nutrients, dissolved oxygen, pH, dissolved/particulate organic carbon)
 - Oxygen minimum zone depth
 - Local chemical environment.
- (c) Biological productivity
- Surface biological productivity and particulate organic carbon flux to the seafloor
 - Chlorophyll-a maximum depth.

3.2 Regional setting

35. This section should include a summary of key environmental information for the regional environmental management plan, as compiled in the data report and regional environmental characterization. This section will be supported by maps and geographic information system files. It is not intended to repeat large parts of the data report or regional environmental characterization, but to highlight the *key patterns or trends* that are important for regional-scale management.

3.2.1 Environmental characteristics

36. This section summarizes the main characteristics of the pelagic and benthic marine environment in the region. It includes descriptions of environmental baseline data and results of other data analyses in the region, gathered through the stakeholder deliberations covered in section III of the standardized procedure, and outlined further in this Guidelines document. As noted above in section 2.1, where appropriate, this should be based on the key variables and parameters included in the recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area ([ISBA/25/LTC/6/Rev.3](#)), and characteristics should be relevant to identifying patterns and trends at a regional scale.

3.2.1.1 Physico-chemical characteristics

37. The section will cover the main characteristics of meteorology and air quality, physical oceanography, and chemical oceanography, such as:

(a) Meteorology and air quality (general weather patterns and occurrence of natural climatological phenomena);

(b) Physical oceanography (e.g. thermohaline conditions, optical properties and turbidity, surface, midwater and bottom currents regime, tides, waves, turbulence, and oceanographic fronts, eddies and climate change projections, including spatial variation);

(c) Chemical oceanography (e.g. structure, depth and development of the oxygen minimum zone, nutrients, particle loads, temperature and dissolved gas profiles, vent-fluid characteristics if applicable, turbidity, salinity, density, particulate and dissolved organic matter, pH, chemical composition).

3.2.1.2 Geological characteristics

38. The section will include a description of key regional geological and topographic structures and seabed substrate characteristics.

39. The geological setting should include a general description of the geological structures and topography related to the mineral resources, observed in that region. These can include one or more of the following:

(a) For abyssal plains, the regional environmental management plan should describe the depth range and variations in topography or geomorphology that influence nodule distribution and abundance (e.g. occurrence of ridges, seamounts, characteristics of slope, submarine mass flows, etc.).

(b) For oceanic ridges, the regional environmental management plan should identify and describe any geological structures within the region, including morphology, depth range, variations in topography including slope and flank characteristics, and the geological setting of sulphide deposits.

(c) For seamounts, the regional environmental management plan should identify and describe the seamounts with their location, size, shape, slope and flank characteristics and information about sediment cover. The depth of the oxygen minimum zone should be characterized as well.

40. The characterization of seabed substrate should be focused on the type of substrate and its characteristics, related to the type and extent of deep-sea minerals. The description should include information that is important context for the distribution of the mineral resources and associated habitats. If appropriate one or more of the following substrate types should be included in the regional environmental management plan:

(a) For polymetallic nodule fields, this may include the topography and geomorphology of the seafloor, gradients and/or slopes of the abyssal plains, the type of nodules substrate such as sediments or rocks, the types of sediments and its grain size, and the description of the nodules regarding spatial distribution, abundance and size range.

(b) For polymetallic hydrothermal sulphide deposits, this may include information on depth and location of the site, distance to the ridge axis, characteristics and distribution of deposits, hosting rocks and hydrothermal vents (active or inactive), the temperature and composition of the hydrothermal fluids. The age of the oceanic crust should also be taken into account.

(c) For cobalt-rich ferromanganese crusts, this may include the range of water depth of crusts accumulations on the seamount, characteristics of the crust surface (rough – smooth) and crust location and coverage (continuous or discontinuous).

3.2.1.3 Biological characteristics

41. The description of biological characteristics for the region will emphasise information relevant to identifying patterns and trends of biological communities and ecosystems at a regional scale that are important in determining the management elements of the regional environmental management plan. These will encompass, inter alia, a description of pelagic and benthic biological and ecological properties including biodiversity, community composition, abundance, biomass, life history characteristics, relevant behaviour, including feeding rates, connectivity, trophic relationships, resilience and ecosystem functions and services.

42. The biological description should also include the following:
- Spatial (horizontal and vertical) and temporal (including seasonal and interannual) variability
 - Potential environmental drivers of spatial and temporal variability
 - Any work on ecosystem models and appropriate ecosystem indicators
 - Potential endemism (restricted to just the site, resource substrate or region);
 - Taxa known to be highly sensitive to disturbance, or are considered rare, threatened or endangered
 - Migratory and highly mobile species where foraging ranges, migration pathways, and/or management units overlap with the region.
43. The description should be structured by depth zones (at least surface (0–200 m depth, including seabirds), water column (200 m depth – ca. 50 m above the seafloor) and benthic (the seafloor including the water layer ca. 50 m above the seafloor)) and with the consideration of how these depth zones are connected.

3.2.1.4 Natural stressors

44. The section should include details of any region-scale natural stressors (e.g. volcanic activity).

3.2.2 Information on human activities in the region

45. Regional environmental management plans should consider human activities also occurring or likely to occur in the region, that would be relevant for the achievement of the plan goals and objectives.

(a) Minerals resource-related activities: details of mineral resources related activities should be described, including but not limited to:

- (i) Location of mineral exploration and exploitation contracts in the regional environmental management plan region;
- (ii) Location of reserved areas; and
- (iii) Major transit paths for vessels used in exploration and exploitation contracts in the regional environmental management plan region,

(b) Other human activities: the section should cover other legitimate marine uses in the region, including but not limited to:

- (i) Cable installation and operation;
- (ii) Pelagic and demersal fisheries;
- (iii) Other abandoned or functioning industry installations, such as telecommunications nodes or oil and gas wells;
- (iv) Marine scientific research.

(c) Other anthropogenic stressors: the section should cover other anthropogenic stressors, including but not limited to:

- (i) Climate change (including ocean acidification);
- (ii) Pollution;
- (iii) Illegitimate use of the region (e.g. illegal unreported and unregulated fishing, piracy).

3.2.3. Cultural heritage

46. Details should be provided of any cultural heritage and interests in the region. A full cultural heritage impact assessment is not expected here, but there should be consideration given to potential issues at a regional scale. The three stages that can be addressed in the regional environmental management plan process are:

(a) Describing cultural heritage assets and their settings, including cultural experience;

(b) Assessing potential impacts of future exploitation (the degree to which any change would impact on cultural significance);

(c) Identifying measures in the regional environmental management plan that would mitigate potential future impacts and protect important cultural heritage assets.

3.2.4 Summary of knowledge gaps

47. While some data gaps and uncertainties are described in the regional environmental characterization (and also above), it is recommended to include a separate summary here of the main information gaps and uncertainties (due to data quality or quantity) collectively at the level of the geographical scope of the regional environmental management plan with regard to environmental data and information.

3.2.5 Designations and management systems

48. This section should include identified descriptions, designations, management systems or standards elaborated by international organizations or agreements.

49. Identified areas of potential or particular ecological interest (e.g. ecologically or biologically significant areas, vulnerable marine ecosystems, key biodiversity areas) should be described and included on maps (or referenced to the data report).

IV. Management of the region

50. This section includes the key elements and analyses carried out in formulating management measures, as well as the management outcomes for the network of areas and sites of particular environmental interest.

51. This should include area-based management tools and other management measures to be applied across the region based on the science-oriented deliberations and management-oriented deliberations on relevant sections of the standardized procedure document and the goals and objectives in the relevant section of the template.

52. It should also include consideration of environmental risks through sequential understanding of pressures and impacts. While these details may not need to be fully elaborated in the regional environmental management plan itself, they form a set of essential processes that need to take place in order to develop management measures. These processes for developing management measures, and the conclusions of analyses needed for the development of measures, are mainly detailed in the workshop reports.

53. In the text below, the considerations are typically kept fairly general and at a high level. The environmental characteristics of each region differ, and hence the nature and extent of potential management measures (and their specific design) will depend on what is most appropriate to achieve the environmental objectives for each region.

4.1 Area-based management

4.1.1 Regional network analyses

54. Effective spatial planning requires two types of criteria and scales of analysis: (a) network or regional criteria that provide guidance on the representativity, adequacy, spatial configuration, connectivity and other broader criteria guiding the development of the entire collection of sites; and (b) criteria that provide guidance on the priority, size, shape and orientation of individual sites. The scale of benefits derived from individual protected areas will depend on their location, design, size and relationship to other forms of management. Protected area networks magnify the benefits of individual sites and protect the large-scale processes that maintain healthy populations, such as connectivity, gene flow and genetic diversity.

55. Criteria that can help to identify the ecological considerations that are central to designing protected area networks include:

- **Representativeness:** protected area networks should represent the range of diversity (from genes to ecosystems) and the associated physical environment within the given region.
- **Replication:** all habitats in each region should be replicated within the network and distributed spatially throughout the network.
- **Viability:** protected area networks should incorporate self-sustaining, geographically dispersed component sites of sufficient extent to ensure population persistence through natural cycles of variation. These sites should be independent (as far as possible) of activities in surrounding areas.
- **Precautionary design:** decisions should be based on the best information currently available, rather than delaying the process to await more and better information. Where information is limited, designers should adopt a precautionary approach.
- **Permanence:** network design must provide long-term protection to effectively conserve diversity and replenish resources.
- **Maximum connectivity:** protected area network design should seek to maximize and enhance the linkages among individual protected areas, groups of protected areas within a given region, or networks in the same and/or different regions.
- **Resilience:** protected area networks must be designed to maintain ecosystems' natural states and to absorb perturbations, particularly in the face of large-scale and long-term changes (such as climate change).
- **Size and shape:** individual protected area units within the network must be of sufficient size to minimize adverse impacts from activities outside the protected area (avoiding the "edge effect").

56. Individual site criteria include:

- **Uniqueness or rarity:** areas or ecosystems that are unique or that contain rare species whose loss could not be compensated for by similar areas or ecosystems. These include: (a) habitats that contain endemic species; (b) habitats of rare, threatened or endangered species that occur only in discrete areas; and (c) nurseries or discrete feeding, breeding or spawning areas.
- **Functional significance of the habitat:** discrete areas or habitats that are necessary for: (a) the survival, function, spawning or reproduction, or recovery of species; (b) particular life history stages (for example, nursery grounds or rearing areas); and (c) rare, threatened or endangered marine species.

- Three-dimensional structural complexity: ecosystems that are characterized by complex physical structures created by significant concentrations of biotic and abiotic features. In such ecosystems, ecological processes are usually highly dependent on these structured systems. Furthermore, such ecosystems often have high biodiversity, which is dependent on the structuring organisms.
- Special importance for connectivity: areas that are required for a population to survive and thrive.
- Vulnerability, fragility, high sensitivity or slow recovery: areas that contain a relatively high proportion of highly sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.
- Biological productivity: area containing species, populations or communities with comparatively higher natural biological productivity.
- Biological diversity: area contains comparatively higher diversity of ecosystems, habitats, communities or species or has higher genetic diversity.
- Naturalness: area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.

57. Potential individual sites will be assessed against the site criteria, using an agreed form of ranking that describes the degree to which a specific criterion is met, based on confidence levels in available scientific information.

4.1.2 Area-based management in regional environmental management plans

58. Two scales of area-based management are used for regional environmental management plans.

59. A primary area-based management tool in the regional environmental management plan is the creation and designation of a “coarse filter” network of areas of particular environmental interest, providing a regional approach targeting broad ecosystem features and gradients. The selection of such areas in a region is meant to preserve large, representative and self-sustaining areas of the ecosystem using network criteria. Given this scale of assessment, it is widely accepted that maintenance of a diverse representation of physical environments should be used to maintain the bulk of species diversity. It has also been suggested that maintaining areas of high physical and ecological heterogeneity through a coarse filter approach offers increased resilience under changing climatic conditions. Some of these are described in table 1, which contains examples of network criteria alongside large-scale parameters that will define assessment, and also suggested assessment approaches.

60. In the case of the Clarion-Clipperton Zone, the size, shape and configuration of individual areas of particular environmental interest were developed so that each area should:

- Take into account biophysical gradients which affect the biogeography of marine biodiversity in the planning region
- Protect a full range of habitat types found within each subregion
- Be large enough to maintain minimum viable population sizes for species potentially restricted to a subregion, subregions being characterized by differential environmental and biological data

- Be surrounded by a buffer zone to ensure that biota and habitats in the protected area are not affected by anthropogenic threats occurring outside the areas of particular environmental interest
- Have straight line boundaries to facilitate rapid recognition and compliance

61. Based on a detailed consideration of environmental data, faunal distribution, faunal dispersal capabilities and distances, and ecological proxy variables, in the environmental management plan for the Clarion-Clipperton Zone, it was determined that a core area of each area of particular environmental interest should be at least 200 km in length and width, surrounded by a buffer zone 100 km in width. These distances may be different for each regional environmental management plan but should fulfil the same requirements.

Table 1
Examples of criteria for areas of particular environmental interest and general assessment approaches

<i>Criteria</i>	<i>Parameters</i>	<i>Assessment approach examples</i>
Representativity	Size and shape of area	Spatial analysis of habitat, community or ecosystem components
	Spatial extents of habitats and ecosystems	
	Range of habitats and ecosystems represented	Distribution of habitat, community or ecosystem across the region
	Rare, distinctive or important species and habitats within the biogeographic region	Habitat type assessments
	Biodiversity	Biodiversity statistics (composition, abundance, etc.)
	Environmental gradients	
	Ecosystem integrity	
Replication	Size and shape of area	Number of replicates of habitats
	Position of replicates within area	Statistical analyses of variability
	Area represented related to amount of habitat in the region	
	Range of habitats or ecosystems	
Permanence	Range of habitats	Time-series analyses
	Connectivity	Physical models (e.g. plumes)
	Size and shape of area	Metapopulation, dispersal distance and connectivity analysis
Viability; maximum connectivity	Range of habitats	Metapopulation, dispersal distance and connectivity analysis
	Size and shape of area	Migration corridors
Resilience	Biodiversity	Species diversity
	Ecological significance	Functional group diversity
	Long-term protection	Ecological traits
	Ecological linkages; connectivity	Disturbance and recovery models
	Size and shape of area	

<i>Criteria</i>	<i>Parameters</i>	<i>Assessment approach examples</i>
Precautionary design	Size and shape (buffers)	Distribution of potential human impacts
Size and shape	Size and shape (buffers)	Spatial analysis of ecosystem extent compared with relative areas

62. Examples of areas of particular environmental interest include:

- Areas of representativity (e.g. multiple habitats, topography, faunal communities)
- Fracture zones
- Seamounts

63. For finer spatial scales of management, a “fine filter” approach is used that allows for the designation of sites of particular environmental interest that may be of particularly high value or at particularly high risk, and is focused on conserving individual rare or specialized taxa that are not necessarily protected in areas of particular environmental interest.

64. Some assessment approaches for these considerations are described in table 2, along with examples of site criteria.

Table 2

Examples of criteria for sites of particular environmental interest and general assessment approaches

<i>Criteria</i>	<i>Assessment approach examples</i>
Uniqueness or rarity	Species diversity; species rarity; endemism; habitat rarity
Functional significance of the habitat	Observation of nursery areas, rearing areas or spawning grounds; life history analysis
Structural complexity	Ecological traits analysis; habitat models; multibeam echo sounder; sea surface salinity
Connectivity	Metapopulation, dispersal distance and connectivity analysis
Vulnerability, fragility, high sensitivity or slow recovery	Representativity analysis; species diversity; species rarity; endemism; pressures or impacts analysis
Biological productivity	Species diversity; biomass
Biological diversity	Species diversity
Naturalness	Species diversity; pressures or impacts analysis

65. Examples of sites of particular environmental interest include:

- Hydrothermal vents
- Deep-sea coral reefs or coral gardens
- Sponge gardens or deep-sea sponge aggregations
- Sea pen fields
- Xenophyophore aggregations

66. This general combination of coarse and fine filter approaches is commonly used in both marine spatial and conservation planning in numerous national and international processes.

4.1.3 Spatial extent of the area of particular environmental interest network

67. The spatial extent of protection needed to be provided by the areas and sites of particular environmental interest to aid in the fulfilment of the goals and objectives of the regional environmental management plan will vary between plans, as well as how the nature and extent of management measures are structured. Different habitats will require different levels of protection.

68. Development of an understanding of extent of protection usually involves at least the following considerations:

(a) The spatial coverage of a habitat occurring in a particular region (the more habitat available, the smaller the proportion that needs to be protected);

(b) The regional and global conservation status of the habitat (the better the status or the better the trend, the smaller the proportion that needs to be protected);

(c) Biodiversity or ecosystem functioning of the habitat (the higher the biodiversity or ecosystem functioning, the bigger the proportion that needs to be protected);

(d) Criticality of the habitat for species of conservation concern (e.g. a critical habitat for a part of the life cycle of a red-listed species) (the greater these relationships, the bigger the proportion of the habitat that needs to be protected).

69. The ability to define protection levels will also depend upon the quality and quantity of underlying data. Ultimately, the aim would be for protected areas to be determined (or modified on the basis of new data) using spatial planning software (e.g. Marxan, Zonation) or prioritization applications (e.g. prioritizr *R* package). In the early stages of planning and implementing a regional environmental management plan, however, expert opinion is the most realistic option given a data-limited situation.

4.1.4 Assessment of cumulative or in-combination effects

70. It is important to understand not only individual impacts, but also the combined impacts that are expected to occur. Effects from these impacts should be assessed both spatially and temporally at a regional, rather than local, scale.

71. Combination of effects can occur in two ways:

(a) Cumulative effects arising from multiple mining operations in the region covered by the regional environmental management plan;

(b) In-combination effects arising from all industrial sectors operating in the region.

72. These may be the same if mining is the only expected industry in the region.

73. Some effects may act synergistically to increase the level of impact, while others may act antagonistically to reduce the overall level of impact.

74. The significance of these effects can then be evaluated, particularly using any management measures provided for the areas and sites of particular environmental interest, in terms of the impact on the selected habitats, species or community groups.

4.1.5 Conditions imposed on mineral resource-related activities by the International Seabed Authority

75. Conditions may be imposed on mineral resource-related activities, for example, under the current environmental management plan for the Clarion-Clipperton Zone, the 13 areas of particular environmental interest should not be affected directly by physical activity or indirectly by mining effects. However, this does not provide restrictions on other activities, as the protection network was designed solely for mining purposes and objectives within the mandate of the International Seabed Authority.

4.1.6 Non-spatial management

76. This section includes any management measures that are not solely area-based. These may include aspects such as requirements for equipment or operations.

4.1.7 Temporal management

77. This section comprises details of any temporal, including seasonal, measures that should be applied to seabed mineral activities (e.g. to take into account migration of marine mammals and other megafauna).

4.1.8 Other management measures, if any

78. This section should include any other management measures, or options that might need to be considered in future (e.g. areas where precaution might need to be applied given particular circumstances or conditions that could be necessary in any areas of potential mining to ensure that the regional environmental management plan is not compromised).

V. Regional monitoring

79. A robust monitoring approach based on the goals and objectives of the regional environmental management plan should be designed and implemented at the regional scale to deliver reliable information regarding the conditions observed in the region to aid in assessing the performance of management measures under the plan and providing a long-term spatial and temporal perspective on natural variability. This will allow monitoring programmes to track changes at a regional scale, whether related to natural fluctuations, exploratory and testing activities or commercial mining.

80. The scope and elements of regional monitoring under each regional environmental management plan may vary depending on regional contexts and the design of any regional-scale monitoring. The availability and mobilization of resources will have to be taken into account with regard to implementation.

81. The objectives of a regional approach to environmental monitoring can include:

(a) Observation of natural and human-induced variabilities in the region, in order to determine regional systems based on the best available scientific knowledge;

(b) Provision of a strong scientific basis for the International Seabed Authority to, as necessary, revise region-specific environmental goals, objectives, policies and thresholds, as well as direct the setting and review of individual contract-specific environmental goals, objectives, policies and thresholds;

(c) Evaluation of a cumulative regional overview of the environmental impacts of mining;

(d) Identification of major gaps in knowledge that require further sampling or investigation;

(e) Provision of feedback for regional-level environmental assessments in order to inform any required modification at the regional level;

(f) Provision of guidance on the advancement of regional environmental objectives through relinquishment of parts of the exploration contract areas;

(g) Detection of the extent of environmental impacts that arise from mining activities at a regional scale in order to inform decision-making at the International Seabed Authority.

5.1 Strategy for regional environmental monitoring

82. This section should describe measures for monitoring the state of the environment and/or potential changes in a specific region. It will include:

(a) Identification of monitoring objectives, and regional-scale indicators based on the objectives of the regional environmental management plan;

(b) Future research priorities covering survey or sampling areas, sampling methodologies and data analyses to address current data gaps;

(c) Integration of information coming from all relevant sources, such as contractors, scientific literature, DeepData, global databases and other relevant information;

(d) Measures to incentivize marine scientific research through international cooperation;

(e) Options for collaboration with and between contractors.

83. The strategy could involve three hierarchical and standardized steps, as set out below.

5.1.1 Define monitoring objectives for the regional environmental management plan

84. Objectives for the regional monitoring programme have to be agreed as a starting point for the definition of spatial and temporal monitoring efforts and have to be consistently aligned with goals and objectives previously defined and modified in the respective regional environmental management plan.

5.1.2 Define targets, indicators, metrics and thresholds

85. Indicators developed from the regional objectives can be specified by a metric and a threshold. All indicators, associated metrics and thresholds should be developed utilizing the most current, best-practice environmental information from the regional environmental characterization, and therefore updated in the light of new information.

86. In the early stages of a regional environmental management plan, before exploitation, data may be limited for defining indicators. Their development may rely on qualitative ecosystem models (better known as qualitative mathematical models or signed digraphs). Such models can be used to link ecosystem species and communities to the activities and pressures of concern. They can describe and predict impacts on ecosystem structure and identify components of high risk or uncertainty, the latter being important to monitor in order to assess the likely success of potential management options and measures. As the knowledge base grows for an individual regional environmental management plan, semi-quantitative or quantitative models may also be used.

87. Suitable indicators can start to be selected using four key questions:

- Is the indicator measurable using current technology?
- Can changes in the indicator values be interpreted?
- Will the indicator lead to improved management or policy?
- Will the indicator inform decisions for multiple objectives?

88. Selection of ecological and ecosystem indicators can be informed by variables measured through existing global observation networks. Examples of such variables include essential ocean variables and essential biological variables.

5.1.3 Define spatial and temporal scales of sampling

89. Critical elements in the selection and sampling design are the identification and quantification of appropriate temporal and spatial scales of variation, which should drive the definition of appropriate data resolution for monitoring.

5.2 Knowledge gaps and research priorities

90. This section should identify the key knowledge gaps in the implementation of the regional environmental management plan and provide information about the priorities for future research and/or monitoring to address these knowledge gaps.

5.3 Other aspects

91. This section should include:

- (a) Measures for capacity-building and training;
- (b) A communication and public information strategy.

VI. Review of the progress in the implementation of the regional environmental management plan

92. This section should outline the review process to be conducted at least every five years following the adoption of a regional environmental management plan. A comprehensive review process is essential to determine if the content of the plan provides a satisfactory assessment of the project and can contribute to the decision-making process.

93. The review will be undertaken to determine its suitability or need for amendment, on the basis of the best available data and information and in alignment with the rules, regulations and procedures of the Authority.

94. The review should be:

1. Process-specific
 - Adjustable to the specific situation without compromising the integrity of the process
 - Including criteria applicable to various steps that are appropriate for the specific situation without compromising the integrity of the process
 - Including sufficient data collection effort to characterize and prioritize residual risks
 - Including a variety of assessment and reporting efforts as appropriate for the situation
 - Including stakeholder consultation

2. Performed with scientific integrity
 - Applying best available scientific evidence
 - Using actionable information and outputs
 - Using best expert judgment and sound data collection and analysis, subject to independent verification and validation
3. Sustainability-focused
 - Supporting sustainable development
 - Including assessment, evaluation and analysis of potential consequences for socioeconomic, physiochemical and biological environments
 - Aligning with efforts, goals and standards of regional and global organizations
 - Adhering to guidance contained in regional and global instruments

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Annex I

Designations of areas of particular environmental interest

Provide a list of areas of particular environmental interest, including:

- Maps
- Coordinates (turning points)
- Description of the area of particular environmental interest, including reasons for designation (representativity, unique fauna, etc.)

Annex II

Designations of sites of particular environmental interest

Provide a list of sites of particular environmental interest, including:

- Maps
- Coordinates (turning points)
- Description of the site of particular environmental interest, including reasons for designation (representativity, unique fauna, etc.)

Annex III

Summary of knowledge gaps and research priorities

Annex IV

Outlines for the data report and regional environmental characterization

The outlines below should be used to guide the preparation of the data report and regional environmental characterization. The availability of data and information and the level of detail may vary in different regions and for different parameters. The sources of data included in the data report and regional environmental characterization will be referenced in the documents.

A. Outline for the data report

1. Background and scope of the report
2. Bathymetry
3. Geography, including geomorphology
 - Distribution of geological structures (e.g. abyssal plains, oceanic ridges, fracture zones and seamounts)
 - Topography and geomorphology of the seafloor
 - Seabed substrate (e.g. sediment types, thickness and composition)
 - Distribution of deep-sea minerals (e.g. distribution of polymetallic nodules, hydrothermal vents, polymetallic sulphides deposits, age of oceanic crust and location and coverage of crusts)
4. Oceanography
 - Meteorology and climatology (e.g. monsoon and ocean climatology)
 - Physical oceanography (e.g. physical water properties, water masses, surface, midwater and bottom currents, fluxes of particulate organic carbon)
 - Chemical oceanography (e.g. productivity, nutrients, depth of oxygen minimum zone, chemical water properties)
5. Biology, including biological productivity
 - Regional distribution of taxa (e.g. Ocean Biodiversity Information System data and DeepData)
 - Habitat suitability models (e.g. predictions of habitat suitability for cold-water octocorals)
 - Occurrence of vulnerable marine ecosystems indicator taxa in the region
 - Global and regional patterns in benthic biomass
 - Migratory connectivity for oceanic megafauna
 - Connectivity models
6. Biogeographic classification
 - Global open ocean and deep seabed biogeographic classification
 - Global mesopelagic biogeography
 - Pelagic provinces of the world
 - Longhurst marine provinces

- Bioregions
 - Global seascapes
 - Biogeography of hydrothermal vents, seamount classification, etc.
7. Climate, including climate change
 8. Human uses and potential impacts
 - International Seabed Authority contract areas for the exploration and exploitation of mineral resources
 - Demersal and pelagic fishing
 - Global and regional patterns of megafaunal fishing bycatch
 - Commercial shipping
 - Undersea cables construction and operation
 - Cumulative impacts models
 9. Areas defined for management and/or conservation objectives
 - Regional fisheries management organizations
 - Regional seas conventions
 - Particularly sensitive sea areas
 - Vulnerable marine ecosystem areas closed to bottom fishing activities
 - Ecologically or biologically significant marine areas, as defined under the Convention on Biological Diversity
 - Marine protected areas
 - Key biodiversity areas
 - Important bird areas
 - Important marine mammal areas
 10. Sociocultural
 - Archaeological sites
 - Human remains
 - Traditional navigation routes
 11. Sites of underwater cultural heritage

B. Outline for the regional environmental characterization

1. Contract areas for exploration and exploitation of mineral resources
2. Bathymetry, geography and geology
 - Bathymetry
 - Distribution of geological structures (e.g. abyssal plains, oceanic ridges, fracture zones and seamounts)
 - Topography and geomorphology of the seafloor
 - Seabed substrate (e.g. sediment types, thickness and composition)

- Distribution of deep-sea minerals (e.g. distribution of polymetallic nodules, hydrothermal vents, polymetallic sulphides deposits, age of oceanic crust, and location and coverage of crusts)
3. Physical oceanography
 - Meteorology and climatology
 - Physical oceanography at regional and local scales (e.g. physical water properties, water masses, surface, midwater and bottom currents, local flow environment, fluxes of particulate organic carbon)
 - Climate change projections
 4. Chemical oceanography
 - Chemical oceanography at the regional and local scales (e.g. primary productivity, nutrients, oxygen minimum zone, chemical water properties, local chemical environment)
 5. Pelagic biology and ecology
 - Regional and local distribution of pelagic and fauna (e.g. species composition, abundance and regional and local distribution patterns of plankton, air-breathing fauna, mid-water nekton, sharks and commercially important fishes, microorganisms)
 - Temporal variation in the distribution of pelagic fauna (e.g. seasonal and inter-annual changes in biological communities and populations)
 - Trophic relationships
 - Connectivity (e.g. migration patterns, population genetic studies)
 - Ecosystem function
 6. Benthic biology and ecology
 - Regional and local distribution of benthic fauna (e.g. species composition, abundance and regional and local distribution patterns of microorganisms, benthic meiofauna, macrofauna and megafauna)
 - Temporal variation in the distribution of benthic fauna (e.g. seasonal and inter-annual changes in biological communities and populations)
 - Trophic relationships
 - Connectivity (e.g. migration patterns, population genetic studies)
 - Ecosystem function
 7. Human uses and potential impacts to the marine environment, including cumulative impacts
 - Demersal and pelagic fishing
 - Commercial shipping
 - Undersea cables construction and operation
 - Cumulative and in combination impacts
 8. Existing management regimes
 - Regulations of different activities, including area-based management tools established by international and regional organizations

9. Sociocultural
 - Archaeological sites
 - Human remains
 - Traditional navigation routes

Annex V

Potential data sources

In addition to DeepData database of the International Seabed Authority, the data needed to substantiate the regional environmental management plans can be found in national, regional and global data repositories. Below is an overview of example data repositories and the type of data contained therein that can be consulted during the data compilation stage of the development and review of the plan.

In many countries, a National Oceanographic Data Centre provides facilities to archive data sets related to marine sciences (e.g. the National Centers for Environmental Information in the United States of America, see www.ncei.noaa.gov/). National Oceanographic Data Centres collaborate in the framework of the Intergovernmental Oceanographic Commission (see www.ioc.unesco.org/) of the United Nations Educational, Scientific and Cultural Organization.

Some other, specific examples of online resources for downloading environmental data on a global scale are:

Bathymetry

- SRTM30_Plus (see https://topex.ucsd.edu/WWW_html/srtm30_plus.html)
- ETOPO Global Relief Model (see www.ncei.noaa.gov/products/etopo-global-relief-model)
- General Bathymetric Chart of the Oceans (GEBCO, see www.gebco.net/data_and_products/gridded_bathymetry_data/)
- Other bathymetric data made available from other sources, including contractors

Sea surface temperature

- AVHRR Pathfinder SST (see <https://www.ncei.noaa.gov/products/avhrr-pathfinder-sst>)

Water column temperature and salinity

- Argo float data (see <https://argo.ucsd.edu/data/>)

Marine biodiversity

- Ocean Biodiversity Information System (see <https://obis.org/>)
- The Global Biodiversity Information Facility also hosts marine biodiversity data (see www.gbif.org/)

Phytoplankton biomass and productivity

- OceanColour-CCI (see www.oceancolour.org/)
- National Aeronautics and Space Administration (NASA) Ocean Color Web (see <https://oceancolor.gsfc.nasa.gov/>)
- Vertically Generalized Production Model

Sea surface height

- AVISO sea surface height and geostrophic current data (see www.aviso.altimetry.fr/en/data/products/sea-surface-height-products.html)
- AVISO significant wave height data (see www.aviso.altimetry.fr/en/data/products/windwave-products.html)

Sea surface wind

- Quick Scatterometer (QuikSCAT, see <https://podaac.jpl.nasa.gov/QuikSCAT>)
- AVISO surface wind data (see www.aviso.altimetry.fr/en/data/products/windwave-products.html)

Data from these repositories will be mostly useful to support predictive modelling (see below), which can be used for habitat mapping, modelling of plume impacts as well as for the assessment of cumulative impacts derived from, for example, climate change and its effects on benthic-pelagic coupling (e.g. the Hybrid Coordinate Ocean Model, see www.hycom.org/).

In addition to these global data repositories, other potential data and metadata sources include:

- Remote data collection and observatories, including the Global Ocean Observing System (see www.goosoocean.org), together with its regional nodes, and specific programmes, such as the Deep Ocean Observing Strategy (see <https://www.deepoceanobserving.org/>), the European Multidisciplinary Seafloor and Water Column Observatory (see <http://emso.eu/>) and the Argo float programme (see <https://argo.ucsd.edu/>).
- Many science and fisheries advisory organizations are national, but some are regional and encompass large areas of open ocean and deep sea, such as the International Council for the Exploration of the Sea (see <https://www.ices.dk/>) in the Northern Atlantic and the North Pacific Marine Science Organization (see <https://meetings.pices.int/>) in the Pacific. These organizations hold potentially relevant environmental data and information.
- The Food and Agriculture Organization of the United Nations (FAO, see www.fao.org/) holds large amounts of data, but often aggregated to a level of detail that becomes too coarse-grained to be used for purposes other than fisheries management. The FAO database on vulnerable marine ecosystems (see www.fao.org/in-action/vulnerable-marine-ecosystems/about-vme-database/en/) is a compilation of information on management measures taken to reduce the current or potential impact on areas where vulnerable marine ecosystems are known or likely to occur, and is linked to data providers, which are mainly regional fisheries management organizations.
- Museums are traditionally the keepers of biodiversity information, storing physical specimens for centuries. The progress in databases and communications made possible by the Internet has prompted many museums to digitize specimen data and make this information available through the World Wide Web (e.g. the Natural History Museum of London (see <https://data.nhm.ac.uk>), the Smithsonian Institution (see www.si.edu/), the California Academy of Sciences (see www.calacademy.org)) following the standards of the Global Biodiversity Information Facility, Darwin Core (see <https://dwc.tdwg.org/>) and the Ocean Biodiversity Information System.
- Scientific research programmes, especially international programmes, generate large data sets. The currently obligatory data availability statement in the

resulting scientific papers states how these data can be accessed. Data are typically available online via publicly accessible data repositories, such as Pangea (see www.pangaea.de/) or Dryad (<https://datadryad.org/stash>). In case of genetic data, Genbank (see www.ncbi.nlm.nih.gov/genbank/), the Barcode of Life Data Systems (see www.boldsystems.org/), the Sequence Read Archive (see www.ncbi.nlm.nih.gov/sra) and the European Nucleotide Archive (see www.ebi.ac.uk/ena/browser/home) are the most commonly used data archives. Alternatively, data are made available as supplementary material to the scientific papers in which the research is published or they can be requested from the authors via email. Examples of scientific research programmes include:

- InterRidge (see www.interridge.org/)
- A transatlantic assessment and deep-water ecosystem-based spatial plan for Europe (see www.eu-atlas.org/)
- Integrated Assessment of Atlantic Marine Ecosystems in Space and Time (iAtlantic, see www.iatlantic.eu/)
- Atlantic Ocean Research Alliance Coordination and Support Action (see www.atlanticresource.org/aora/)
- Deep-sea Sponge Grounds Ecosystems of the North Atlantic (see <https://allatlanticocean.org/initiatives/deep-sea-sponge-grounds-ecosystems-of-the-north-atlantic/>)
- Marine Ecosystem Restoration in Changing European Seas (see www.atlanticresource.org/aora/)
- Global Ocean Biodiversity Initiative (see <http://gobi.org/>)
- Conservation and restoration of deep-sea ecosystems in the context of deep-sea mining (DEEP REST, see <https://deep-rest.ifremer.fr/>)
- The JPIOceans Joint Action Ecological Aspects of Deep-Sea Mining (see www.jpi-oceans.eu/en/ecological-aspects-deep-sea-mining and <https://miningimpact.geomar.de/>)
- Conservation organizations hold species information to support their conservation programmes and often work closely together with environmental managers. Examples include the Species+ database developed by the United Nations Environment Programme World Conservation Monitoring Centre and the secretariat for the Convention on International Trade in Endangered Species of Wild Fauna and Flora (see https://resources.unep-wcmc.org/products/WCMC_PT003) and the International Union for Conservation of Nature Red List (see www.iucnredlist.org/)
- Increasingly, industries are holders of useful information based on direct observations of species occurrences from their transport systems during business operations