Guidance to facilitate the development of Regional Environmental Management Plans (REMPs)

Updated as of November 2019
International Seabed Authority Secretariat

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I. Purpose and scope of the document

1. This document was prepared by the secretariat of the International Seabed Authority (ISA) to facilitate the process of developing regional environmental management plans under the auspices of the ISA, in line with the United Nations Convention on the Law of the Sea (the Convention), the 1994 Agreement relating to the Implementation of Part XI of the Convention, and ISA rules, regulations and procedures, by :

- clarifying the roles and responsibilities of ISA organs (Legal and Technical Commission and Council) within ISA policy processes of developing regional environmental management plans (REMPs), and a series of workshops to be convened by ISA secretariat, as scientific and technical process to prepare draft elements for inclusion in the REMPs, including pre-, during- and post-workshop activities;
- clarifying the relationship of the REMPs with the Mining Code and highlighting how the REMPs can facilitate achieving environmental management objectives and implementing overall environmental management measures, including the environmental management system of the contractors, as articulated in the draft regulations of exploitation of mineral resources in the Area and other relevant regulations of the ISA;
- discussing possible scientific and technical approaches of spatial planning required to develop draft REMPs;
- laying out a range of scientific data and information that are collected by contractors and compiled through ISA database (*DeepData*) as well as from other possible sources to be compiled, analyzed and synthesized in the form of various data products to support the planning processes of the REMP development; and
- identifying possible elements to be considered for inclusion in the REMPs.

2. **Section II** clarifies the roles and responsibilities of ISA organs in leading policy processes of developing REMPs, which will be supported by a series of workshops to be convened by ISA secretariat as scientific and technical processes, drawing on documents ISBA/17/LTC/7 (Environmental Management Plan for the Clarion-Clipperton Zone), in particular its detailed account of the legislative basis for the CCZ-EMP, ISBA/24/C/3 (Preliminary strategy for the development of regional environmental management plans for the Area), ISBA/25/C/4 (Relationship between the draft regulations on exploitation of mineral resources in the Area and regional environmental management plans), IBSA/25/C/13 (Implementation of the ISA's strategy for the development of regional environmental management plans for the Area), and ISBA/25/C/8 (Implementing the precautionary approach to activities in the Area).

3. **Section III** provides a clarification on the relationship between the REMPs and the draft regulations on exploitation of mineral resources in the Area and other relevant ISA regulations, and discusses potential ways and means that the REMP can facilitate and provide guidance on environmental management system of the Mining Code.

4. **Section IV** provides a review of possible spatial planning tools and approaches, not in an exhaustive

manner, which can be applied to describe potential areas, through workshop discussion, for designation of areas of particular environmental interest (APEIs) or sites requiring enhanced protection measures as part of regional environmental management planning process. This section is further elaborated by annex on a compilation of relevant scientific criteria for applying area-based management tools, including their relevance to the activities in the Area. This section draws on document ISBA/17/LTC/7 (Environmental Management Plan for the Clarion-Clipperton Zone) as well as reports of ISA workshops held on REMPs in Qingdao (China) in May 2018, and Szczecin (Poland) in June 2018.

5. **Section V** lays out a range of scientific data and information to be compiled, analyzed and synthesized from ISA database as well as other global and regional databases and sources. It also highlights possible data products that can be produced through expert processes, in order to provide a robust scientific and technical basis for planning processes for REMP development, including the application of area-based management tools as well as other environmental management measures.

6. **Section VI** attempts to identify possible elements to be considered for inclusion in the draft REMP document, building on the powers of the ISA on the protection of the marine environment, as stipulated in the Convention, the 1994 Agreement relating to the Implementation of Part XI of the Convention and ISA rules, regulations and procedures.

II. ISA process of developing regional environmental management plans (REMPs)

What are the objectives of developing REMPs?

- to provide the relevant organs of the ISA, as well as contractors and their sponsoring States, with proactive environmental management measures and tools, including area-based management tools, to support informed decision-making that balances resource development with the protection of marine environment at regional scale;
- to provide the ISA with a clear and consistent mechanism to identify particular areas thought to be representative of the full range of habitats, biodiversity and ecosystem structures and functions within the relevant management area and/or sites in need for protection to preserve ecological balance of the marine environment in the Area;
- to provide those areas with appropriate levels of protection;
- to help the ISA to meet internationally agreed goals and targets (e.g. Sustainable Development Goals and Aichi Biodiversity Targets).

United Nations Convention on the Law of the Sea of 10 December 1982, art. 157 (1), art 145

The International Seabed Authority, on behalf of the States Parties to the Convention, is responsible for administering the mineral resources of the Area, including prospecting, exploration and exploitation activities for those resources. As part of its responsibility, the Authority is charged with taking the measures necessary **to ensure effective protection of the marine environment from the harmful effects that may arise from such activities**. For that purpose, the Authority must adopt appropriate rules, regulations and procedures designed to accomplish the following:
(a) Prevent, reduce and control pollution and other hazards to the marine environment, including the coastline, that have the **potential to interfere with the ecological balance of the marine environment**. In doing this, its mandate calls for particular attention to be paid to the need for **protection from the harmful effects of such activities** as drilling, dredging, excavating, disposing of waste, and constructing and operating or maintaining installations, pipelines and other devices related to such activities;
(b) Protect and conserve the natural resources of the Area, **preventing damage to the flora and fauna of the marine environment.**

Part XII of the Convention (Protection and preservation of the marine environment) art. 194 (5)
The measures taken in accordance with this Part shall include those necessary to **protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life.**

Strategic plan of the International Seabed Authority for the period 2019–2023 (ISBA/24/A/10)
Strategic direction 3 Protect the marine environment
The Authority will implement the following strategic directions:
Strategic direction 3.1. Progressively develop, implement and keep under review an **adaptive, practical and technically feasible regulatory framework,** based on best environmental practices, for the protection of the marine environment from harmful effects which may arise from activities in the Area.

Strategic direction 3.2. Develop, implement and keep under review regional environmental assessments and management plans for all mineral provinces in the Area where exploration or exploitation is taking place to ensure sufficient protection of the marine environment as required by, inter alia, article 145 and Part XII of the Convention.
Strategic direction 3.3. Ensure **public access to environmental information,** including environmental information from contractors, and participation by stakeholders, as appropriate.
Strategic direction 3.4. Develop **scientifically and statistically robust monitoring programmes** and **methodologies to assess the potential risk** for activities in the Area to interfere with the ecological balance of the marine environment.
Strategic direction 3.5 Develop **appropriate regulations, procedures, monitoring programmes and methodologies to prevent, reduce and control pollution and other hazards to the marine environment**, as well as interference with the ecological balance of the marine environment, prevent damage to the flora and fauna of the marine environment and implement the relevant requirements relating to the protection of the marine environment as contained in Part XII of the Convention.

How should the REMPs be designed to contribute to achieving the overall mandates of the ISA regarding the protection of the marine environment?

- Building on the overall mandates of the ISA regarding the protection of the marine environment (as articulated in the Convention, the 1994 Agreement relating to the Implementation of Part XI of the Convention, and ISA rules, regulations and procedures), **regional-scale environmental management objectives for REMPs,** which transcends the contract areas, will need to be determined, based on the best available scientific information and taking into account relevant aspects of the SDGs and other international environmental targets.
- In view of scientific uncertainties and limited data availability in the Area, particular considerations need to be made on setting in place **adaptive planning and management frameworks and processes within the implementation framework of REMPs, in terms of regular scientific assessment, review of implementation, and updating of the plan** (see section VI), thereby promoting informed decision-making, in order to achieve overall mandates of ISA to ensure the effective protection of the marine environment, including biological diversity and ecological integrity, from the harmful effects of activities in the Area, as articulated in the Convention.

Relevant provisions in Part XI of the UNCLOS

- Activities in the Area shall, as specifically provided for in this Part, be carried out for **the benefit of mankind as a whole**, irrespective of the geographical location of States, whether coastal or land-locked, and taking into particular consideration the interests and needs of developing States and of peoples who have not attained full independence or other self-governing status recognized by the United Nations in accordance with General Assembly resolution 1514 (XV) and other relevant General Assembly resolutions (Article 140(1)).
- The Authority may carry out **marine scientific research concerning the Area and its resources**, and may enter into contracts for that purpose. The Authority shall promote and encourage the conduct of marine scientific research in the Area, and shall coordinate and disseminate the results of such research and analysis when available (Article 143(2)).

- The **effective participation of developing States** in activities in the Area shall be promoted as specifically provided for in this Part, having due regard to their special interests and needs, and in particular to the special need of the land-locked and geographically disadvantaged among them to overcome obstacles arising from their disadvantaged location, including remoteness from the Area and difficulty of access to and from it (Article 148).
- Activities in the Area shall be carried out in a such manner as to foster **healthy development of the world economy and balanced growth of international trade**, and to **promote international cooperation** for the over-all development of all countries, especially developing states (Article 150)

Draft regulations on exploitation of mineral resources in the Area (ISBA/25/C/WP.1) Regulation 2 (e)

Provide, pursuant to article 145 of the Convention, for the effective protection for the Marine Environment from the harmful effects that may arise from Exploitation, in accordance with the Authority's environmental policy, including **regional environmental management plans,** based on the following principles:

(i) a fundamental consideration for the **development of environmental objectives** shall be the **effective protection for the marine environment**, including biological diversity and ecological integrity;
(ii) the application of the **precautionary approach**, as reflected in principle 15 of the Rio Declaration on Environment and Development;
(iii) the application of an **ecosystem approach**;
(iv) the application of the **polluter pays principle** through market-based instruments, mechanisms and other relevant measures;
(v) **access to data and information** relating to the protection and preservation of the marine environment; and
(vi) **accountability and transparency** in decision-making

Guiding principles of the Environmental Management Plan for the Clarion-Clipperton Zone (ISBA/17/LTC/7)

(i) **Common heritage of mankind**. The Area and its resources are the common heritage of mankind. All rights to the resources of the Area are vested in mankind as a whole on whose behalf the Authority shall act;
(ii) **Precautionary approach**. Principle 15 of the Rio Declaration on Environment and Development specifies that where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation;
(iii) **Protection and preservation of the marine environment**. All States have a duty to protect and preserve the marine environment;
(iv) **Prior environmental impact assessment**. The prior assessment of activities that may have significant adverse impacts on the environment;
(v) **Conservation and sustainable use of biodiversity**. All States have a duty to conserve and sustainably use marine biodiversity;
(vi) **Transparency.** The Authority shall enable public participation in environmental decision-making procedures in accordance with the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, 1998, and its own rules and procedures.

Sustainable Development Goals (SDGs), in particular SDG 14 – Conserve and Sustainable Use the Oceans, Seas and Marine Resources, related targets include:
- Target 14.2 By 2020, **sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts**, including by strengthening their resilience, and take action for their restoration in order to achieve

healthy and productive oceans

- Target 14.5 By 2020, **conserve at least 10 per cent of coastal and marine areas**, consistent with national and international law and based on the best available scientific information
- Target 14.A **Increase scientific knowledge, develop research capacity and transfer marine technology**, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries
- Target 14.C Enhance the conservation and sustainable use of oceans and their resources by **implementing international law as reflected in UNCLOS**, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want

Who is developing and approving the REMPs?

- The **Legal and Technical Commission** of the ISA is responsible for preparing draft REMPs (see section VI for indicative elements of REMPs) and making recommendations to the Council for approval.

United Nations Convention on the Law of the Sea of 10 December 1982, art. 165 (below are summarized from art. 165)

The Legal and Technical Commission of the Authority is responsible for **making recommendations to the Council on the protection of the marine environment, taking into account the views of recognized experts in that field.** In addition, the Commission must:
(a) Formulate and submit to the Council rules, regulations and procedures on prospecting, exploration and exploitation in the Area, taking into account all relevant factors, including **assessments of the environmental implications of activities in the Area;**
(b) Keep such rules, regulations and procedures **under review;**
(c) Make recommendations to the Council regarding the establishment of a **monitoring programme** to observe, measure, evaluate and analyse, by recognized scientific methods, on a regular basis, **the risks or effects of pollution of the marine environment** resulting from activities in the Area;
(d) **Coordinate the implementation of the monitoring programme** approved by the Council.

The Legal and Technical Commission may also make recommendations to the Council for:
(a) The issue of **emergency orders to prevent serious harm to the marine environment** arising out of activities in the Area. Such recommendations shall be taken up by the Council on a priority basis;
(b) The **disapproval of areas for exploitation** by contractors or the Enterprise in cases where **substantial evidence indicates the risk of serious harm to the marine environment;**
(c) The **direction and supervision of a staff of inspectors** who shall inspect activities in the Area to determine whether the provisions of the Convention and the regulations and procedures are being met

- The **Council** shall consider the draft REMPs (see section VI for indicative elements of REMPs), as recommended by the Legal and Technical Commission, for approval, as was the case for the decision of the Council relating to an environmental management plan for the Clarion-Clipperton Zone (ISBA/18/C/22).

United Nations Convention on the Law of the Sea of 10 December 1982, art. 162

1. The **Council** is the executive organ of the Authority. The Council shall have the power to establish, in conformity with the Convention and the general policies established by the Assembly, **the specific policies to be pursued by the Authority on any question or matter within the competence of the Authority.**

2. In addition, the Council shall:
…….
(w) issue emergency orders which may include orders for the suspension or adjustment of operations, to **prevent serious harm to the marine environment arising out of activities in the Area**;
(x) disapprove areas for exploitation by contractors or the Enterprise in cases where **substantial evidence indicates the risk of serious harm to the marine environment**;
…..

What are the actions and priorities envisaged to develop REMPs under the auspices of the ISA?

- By decision adopted at its 25th Session (ISBA/24/A/10), the ISA Assembly adopted the Strategic Plan of the Organization for the period 2019–2023, and invited members of the Authority and observers, as well as the organs of the Authority, to support the implementation of the strategic plan.
- Strategic Direction 3.2 articulates that ISA is to "*develop, implement and keep under review regional environmental assessments and management plans for all mineral provinces in the Area where exploration or exploitation is taking place to ensure sufficient protection of the marine environment as required by, inter alia, article 145 and part XII of the Convention*".
- In its 25th Session (July 2019), the ISA Assembly adopted the High-level Action Plan (ISBA/25/A/15) that identifies the actions necessary to achieve the objectives in the Strategic Plan, as well as the priorities for the period 2019-2023. In order to address the objectives set out in Strategic Direction 3.2 the following high-level actions and outputs have been identified:

High-level action	*Outputs for 2019–2023*				
	Description	*Timeframe for completion*	*Organs responsible*	*Associated organs*	*Coordinating organs*
3.2.1 Develop regional environmental assessments and management plans for all mineral provinces in the Area where exploration or exploitation is taking place	(i) Implementation of the Authority's strategy for the development of regional environmental management plans	2020	Council	Secretariat	
	(ii) Develop and implement a standardized approach for the design and development of regional environmental management plans	2020	Secretariat	Council	
	(iii) Report on progress with the implementation of the Authority's programme for regional environmental management plans	Annual	Secretariat	Council	Legal and Technical Commission
	(iv) Prepare regional environmental assessments compiling relevant scientific information in support of the development of regional environmental management plans	2020	Legal and Technical Commission	Council	
	(v) Adopt regional environmental management plans for all mineral provinces where exploration and exploitation are taking place	2023	Council	Legal and Technical Commission	
3.2.2 Facilitate the implementation, in cooperation with contractors, sponsoring States and other relevant stakeholders, of regional environmental management plans for all mineral provinces in the Area where exploration or exploitation is taking or will take place	No output against this action	2023	Council	Assembly	Legal and Technical Commission and secretariat
3.2.3 Keep under review the implementation of the regional environmental management plans, including with regard to the challenges and constraints identified therein, for all mineral provinces in the Area where exploration or exploitation is taking or will take place	(i) Review the implementation of the environmental management plans for the Clarion-Clipperton Fracture Zone	2023	Council	Legal and Technical Commission	Secretariat
	(ii) Recommend specific measures to address issues identified in the review of regional environmental management plans	2023	Legal and Technical Commission	Council	Secretariat
	(iii) Review the effectiveness of existing areas of particular environmental interest and consider the designation of additional areas	2020	Legal and Technical Commission	Council	Secretariat
3.2.4 Encourage and facilitate strategic partnerships to support the work of the Authority in developing, implementing and keeping under review regional environmental assessment and management plans	No output against this action	Continuous	Assembly	Council	

What are the expected roles and outputs of the ISA workshops on REMPs?

- **Workshops on REMPs** to be convened by the secretariat under the auspices of the ISA, in line with relevant decisions of the Council, will :
    - identify possible elements to be considered for inclusion in the draft REMPs, including a description of potential network of areas of particular environmental interest (APEIs) and/or sites in need for protection to maintain ecological balance of the marine environment; and
    - in doing so, 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, including the peer-review of workshop results, as appropriate.
- **Participants for the workshops** are invited through ISA's official nomination/selection process, through a set of selection criteria, considering also geographic factors and gender balance and ensuring the **effective participation of relevant stakeholders** (such as member States, in particular developing countries, contractors, sponsoring States, representatives of industry sectors and non-governmental organizations) and experts in relevant fields.
- Workshop processes in general will be undertaken, subject to availability of financial resources, in **two phased approaches**, depending on the availability of relevant scientific data/information as well as data products.
- **First workshop** will focus on **scientific synthesis and description**, in particular with objectives to:
    - review and analyze ecosystem data
    - synthesize environmental data, faunal distribution, faunal dispersal capabilities and distances, genetic connectivity, patterns of biodiversity, community structure, ecosystem function, and ecological proxy variables
    - review current exploration activity within contract areas and distribution of resources
    - define the planning area, drawing on information on mineral provinces and biogeography
    - describe potential areas that could be protected from exploitation in order to achieve effective protection of the marine environment, through the designation of areas of particular environmental interests (APEIs) and/or potential sites in need for protection to maintain ecological balance of the marine environment from harmful effects of mining activities, as a means to ensure effective protection for the marine environment under Article 145 of the Convention, which is further informed by Article 194 (5).
- **Second workshop** will focus on identifying specific management measures and implementation framework for developing draft elements for inclusion in the REMP. Indicative elements for the REMPS are described in section VI, which is subject to change, depending on future workshop outputs and region-specific context and circumstances. In particular, the workshop will focus on :
    - management goals and objectives at regional scale, including environmental performance outcomes
    - area-based management measures
    - application of environmental standards and guidelines
    - development of environmental monitoring at the regional scale, through collaboration among contractors, sponsoring States and other stakeholders

- strategic framework for assessment of cumulative impacts at the regional scales measures for enhancing ecosystem recovery, if applicable
- implementation measures including data gathering, analysis and synthesis; communication and reporting; monitoring, review and updating; knowledge gaps and priorities for future research; capacity building and technology transfer; collaboration and cooperation; financing mechanisms

- **Post-workshop process** will focus on preparing draft REMP documents, drawing on the results of the above-noted two workshop processes, and making the draft REMP documents available for peer-review of stakeholders for comments and suggestions, as necessary. This draft document will then be considered by the LTC with a view to making recommendation to the Council.

III. REMPs and the draft regulations on exploitation of mineral resources in the Area and other relevant ISA regulations

Relationship between the REMPs and the draft regulations on exploitation of mineral resources in the Area and other relevant ISA rules, regulations and procedures

- As clarified in document ISBA/25/C/4, the REMPs are not themselves legal instruments but rather instruments of environmental policy. For instance, it is by the decision of the Council stemming from the powers and functions allocated to it by the Convention that a representative network of nine areas of particular environmental interest (APEIs) were established in the Clarion-Clipperton Zone (CCZ), where no exploration or exploitation should be conducted for five years or until further review by the LTC. Those provisions do not supersede the specific legal rights and obligations established under the Convention, nor do they supersede the rules, regulations and procedures of the ISA. Rather, they clarify how the Council intends to apply those rules, regulations and procedures in the light of the need to take a precautionary approach to the development of activities in the Area. Likewise, various measures that have been identified in the environmental management plan of the CCZ to be undertaken by different entities, including the secretariat, contractors, sponsoring States and scientific researchers, are not expressed in the form of binding legal obligations.
- As such, it would be critical to ensure consistency and close linkages with the Convention and ISA rules, regulations and procedures, when the environmental management measures of the REMPs are developed. This will enable the effective implementation of the REMPs as a powerful policy instrument to facilitate the implementation of the overall environmental management system of draft regulations on exploitation of mineral resources and the associated environmental standards and guidelines being developed under the draft regulations.

How can the REMP facilitate and provide guidance on environmental management system of the draft regulations on exploitation of mineral resources in the Area and other relevant ISA regulations?

- There are number of possible ways through which the REMP could facilitate and provide guidance on environmental management within contract areas, *inter alia*:
    - **setting the objectives for environmental management** at the regional scale, based on the biophysical characteristics of the regional marine environment and the environmental impacts that may rise from deep sea mining activities, which provides the regional context for environmental management at individual contract areas;
    - **compiling, analyzing, synthesizing, disseminating and updating of environmental data** at the regional scale, including in the form of regional environmental assessment and a GIS database compiling geo-reference data, as a way to facilitate the conduct of environmental baseline studies, development and implementation of environmental monitoring programme, application of environmental impact assessments and other tools for environmental management in contract areas, and to identifying knowledge gaps as key areas for future research efforts;

- providing guidance on the identification of **potential sites in need for protection** to maintain ecological balance of the marine environment from harmful effects of mining activities, as means to ensure effective protection for the marine environment under Article 145 of the Convention, which is further informed by Article 194 (5);
- **providing guidance on the relinquishment** of exploration areas in a way that may best advance environmental objectives;
- providing guidance to **enhance the recovery** of habitats and ecosystems;
- **facilitating collaboration** among contractors, and between contractors and other stakeholders, in the areas of environmental impact assessment, environmental management and monitoring, marine scientific research and capacity building; and
- **providing a process for review** of the effectiveness of environmental measures in meeting the objectives of the REMP, including the application of Best Environmental Practices and Best Available Techniques.

- A REMP can complement/facilitate the development and implementation of environmental Standards and Guidelines under the Draft Regulations by providing, *inter alia*:
  - **regional-scale objectives** for the development of environmental Standards and Guidelines;
  - **mechanisms for the collection, synthesis, and review of scientific data** to ensure the use of Best Available Scientific Evidence in the development and implementation of environmental Standards and Guidelines;
  - **opportunities for cooperation** among contractors in implementing environmental Standards and Guidelines; and
  - **processes for the implementation and review of environment management** at a regional scale, including the review of the application of environmental standards and guidelines**.**

Draft regulations on exploitation of mineral resources in the Area
ISBA/25/C/WP.1

Regulation 47
Environmental Impact Statement
3. The Environmental Impact Statement shall be in the form prescribed by the Authority in annex IV to these regulations and shall be:
(a) Inclusive of a prior environmental risk assessment;
(b) Based on the results of the environmental impact assessment;
(c) **In accordance with the objectives and measures of the relevant regional environmental management plan**; and
(d) Prepared in accordance with the applicable Guidelines, Good Industry Practice, Best Available Scientific Evidence, Best Environmental Practices and Best Available Techniques.

Regulation 48
Environmental Management and Monitoring Plan
3. The Environmental Management and Monitoring Plan shall cover the main aspects prescribed by the Authority in annex VII to these regulations and shall be:
(a) Based on the environmental impact assessment and the Environmental Impact Statement;
(b) **In accordance with the relevant regional environmental management plan**; and
(c) Prepared in accordance with the applicable Guidelines, Good Industry Practice, Best Available Scientific Evidence and Best Available Techniques, and consistent with other plans in these regulations, including the Closure Plan and

the Emergency Response and Contingency Plan.

Annex VIII
Closure Plan

1. The Closure Plan shall be prepared and implemented in accordance with the Guidelines and **the relevant regional environmental management plan** and shall include the following information:

……

(f) Data and information relating to baseline conditions for monitoring measures;

(g) An updated environmental impact assessment for the activities that will be undertaken during closure, if any, together with details of the identifiable residual Environmental Effects, including any relevant technical documents or reports;

(h) Details of monitoring to be undertaken during and after closure that specify the sampling design (spatial and temporal sampling), the methods to be used and the duration of the post-closure activities;

(i) Details of the management measures to Mitigate the residual Environmental Effects;

(j) Details of any restoration objectives and activities, where applicable;

…….

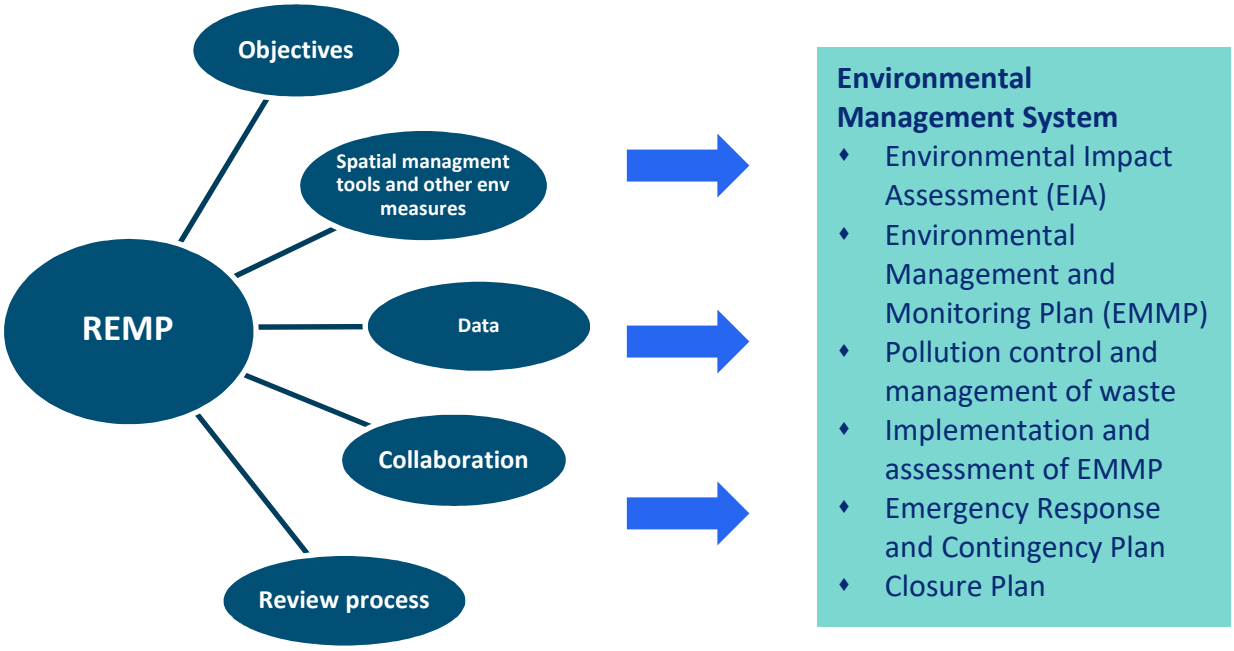

Figure 1. Possible ways in which the REMP can facilitate the implementation of Environmental Management System as provided in the draft regulations on exploitation of mineral resources in the Area (ISBA/25/C/WP.1)

Table 1. Possible aspects in which the REMP may facilitate or guide the implementation of the Mining Code[1]

Legal document	Plans and measures For environmental management	Possible aspects in which the REMP may facilitate/guide the implementation of plans/tools/measures
Draft Regulations on Exploitation of Mineral Resources in the Area (ISBA/25/C/WP.1)	Environmental Impact Statement (Draft Regulation 47 and Annex IV of the Draft regulations)	• Provision of regional environmental management objectives and policy context • Compilation, analysis and synthesis of environmental data for describing existing physicochemical and biological environment • Overview of key environment features and their vulnerability to mining impacts to support environmental risk assessment at smaller spatial scales • Provision of data and spatial planning tools to describe/ identify sites in need of protection to maintain ecological balance of the marine environment • Provision of guidance on the design of monitoring, and management and mitigation measures
	Environmental Management and Monitoring Plan (Draft Regulation 48 and Annex VII of the Draft regulations)	• Provision of regional environmental management objectives and the policy context • Compilation, analysis and synthesis of environmental data for designing environmental management and monitoring programs • Provision of guidance on spatial management tools to describe/ identify sites in need of protection to maintain ecological balance of the marine environment • Provision of strategic directions and collaborative framework for future research and studies • Facilitating collaboration in the areas of environmental management and monitoring, marine scientific research and capacity training
	Closure Plan (Draft Regulation 48 and Annex VIII of the Draft regulations)	• Provision of regional environmental objectives for closure activities • Provision of environmental data on baseline conditions for monitoring measures • Provision of data and spatial tools describe/ identify sites in need of protection to maintain ecological balance of the marine environment, and impact and preservation reference zones for assessment of environmental impacts of closure activities, including cumulative impacts, and management and mitigation measures • Provision of data and spatial tools for the design of

[1] **"**The Mining Code" refers to the whole of the comprehensive set of rules, regulations and procedures issued by the International Seabed Authority to regulate prospecting, exploration and exploitation of marine minerals in the international seabed Area (defined as the seabed and subsoil beyond the limits of national jurisdiction).

		monitoring programs • Provision of information for setting restoration objectives and activities • Provision of mechanisms for the management of data and information post-closure
Regulations on Prospecting and Explorations (ISBA/19/A/9, ISBA19/C/17 and ISBA 18/A/11)	Environmental monitoring and evaluation (Regulations 5 and 31 in ISBA/19/C/17, Regulations 5 and 33 in ISBA/16/A/12/Rev.1 and ISBA/18/A/11)	• Compilation, analysis and synthesis of environmental data for describing existing physicochemical and biological environment • Overview of key environment features and their vulnerability to mining impacts • Identification of knowledge gaps for prioritizing future research efforts
	Determination of serious harmful effects on vulnerable marine ecosystems (Regulation 31 in in ISBA/19/C/17, Regulation 33 in ISBA/16/A/12/Rev.1 and ISBA/18/A/11)	• Compilation, analysis and synthesis of environmental data for describing existing physicochemical and biological environment • Identification of sites in need of protection to maintain ecological balance of the marine environment • Identification of approaches for assessing serious harmful effects
	Environmental baselines and monitoring (Regulation 32 in ISBA/19/C/17, Regulation 34 in ISBA/16/A/12/Rev.1 and ISBA/18/A/11)	• Compilation, analysis and synthesis of environmental data for describing existing physicochemical and biological environment • Overview of key environment features and their vulnerability to mining impacts
	Emergency orders	• Provision of data and spatial planning tools for assessing threat of serious harm to the marine environment
	Relinquishment (Regulation 35 in ISBA/19/C/17, Regulation 27 in ISBA/16/A/12/Rev.1 and ISBA/18/A/11)	• Provision of guidance and spatial planning tools to enable contractors to proceed with relinquishment in a way that maximizes environmental benefits

IV. Scientific and technical approaches for developing REMPs

Spatial planning considerations of REMPs

- Evidence-based regional environmental management in the Area will require objective and transparent spatial planning. The ISA is developing regional environmental management plans (REMPs) as a best practice for regions within the Area in which future mining is contemplated. A REMP will describe the goals, guidelines, and specific management measures particular to a specific region where mining could occur. REMPs are expected to include both area-based management tools (ABMTs) as well as other management measures as guided by the Convention and ISA rules, regulations and procedures. The ABMTs considered for REMPs will likely vary between regions and mineral types. Different biogeographic regions and habitats may require different approaches and thresholds to ensure effective management. REMPs will need to be tailored to the ecosystem structure and function for the specific area in question, as well as the different habitats, community structure, biodiversity, connectivity, and resilience of the area.
- The development of a REMP will require proactive area-based planning, building on the identification of both large regional-scale management areas as well as the identification of individual sites in need of special consideration. REMPs are expected to primarily protect regional areas of the seabed through a network of areas of particular environmental interest (APEIs). APEIs are expected to cover the full range of habitats, biodiversity, and ecosystem functions within the overall management area. Development of the APEI network should be based on scientific principles. Placement of such networks is typically based on spatial analyses of physical, geochemical, ecological, and social datasets (Wedding et al. 2013).
- APEIs are generally described as: "Large areas with self-sustaining populations and a broad range of habitat variability. Those should not be affected directly by physical activity or indirectly by mining effects such as plumes, although the degree of impacts raised by potential deep-sea mining is still unknown." (ISBA/17/LTC/7)

Comparison of planning approaches: "coarse filter" versus "fine filter" planning approaches

- At the time of designing the initial area of particular environmental interest network in the Clarion-Clipperton Zone (CCZ), the scientific criteria adopted by the Convention on Biological Diversity and Food and Agriculture Organization of the United Nations (FAO) for identifying and managing habitats and faunal communities vulnerable to human activities were not fully developed. In particular, the CBD's scientific criteria for ecologically or biologically significant marine areas (EBSAs) are focusing more on the inherent ecological or biological value of the marine environment, rather than addressing any specific impacts from human activities. As such, EBSAs are not management measures *per se*. FAO's criteria for vulnerable marine ecosystems (VMEs) are focusing on preventing significant adverse impacts of bottom fisheries on vulnerable marine ecosystems.
- Building on the experience and lessons learned from CCZ-EMP as well as the long-term experience from CBD and FAO in applying their respective scientific criteria in the past decade, it would be worthwhile to examine how their experience can be applicable and contribute to the future development of REMPs. This would to enable ISA with the necessary spatial planning tools to scientifically describe and identify sites, at a finer scale, in need for protection to preserve ecological balance of the marine environment, as stipulated in article 145 of the Convention, in addition to ISA's experience on designating APEIs in CCZ-EMP. As FAO's VMEs focus on addressing impacts of human activities, the analysis in this section will focus on comparing the FAO's VMEs (as an example of finer

scale spatial planning) with APEIs (building on CCZ-EMP experience), with regard to their generic planning approaches.

- As noted above, VMEs of FAO have been used, within the context of managing deep sea fisheries[2], as identifier for specific habitats and ecosystems that are particularly vulnerable due to their uniqueness or rarity, their structure forming characteristics and/or also for potential fragility or slow recovery from disturbance, being defined as areas that meet one or more of the following criteria (see the table in the Annex I)
  - ✓ Uniqueness or rarity
  - ✓ Functional significance of the habitat
  - ✓ Fragility
  - ✓ Life-history traits of component species that make recovery difficult
  - ✓ Structural complexity

- APEIs and VMEs would be expected to be selected for distinctly different reasons and to serve distinctly different purposes. The selection of APEIs in a region is meant to preserve large, representative and self-sustaining areas of the ecosystem, while the selection of VMEs is meant to preserve specific examples of ecosystems and habitats that are vulnerable to disruption or impact from human activities (e.g. for FAO, bottom fisheries). In the terms used in conservation planning, APEIs would be generally selected on "coarse filter" criteria such as representation of broad ecosystem features and gradients (Hunter et al. 1988, Hunter 1991). VMEs would generally be selected on "fine filter" criteria such as the occurrence of unique species combinations or examples of fragile habitat structures. This general combination of coarse and fine scale approaches is commonly used in both marine spatial and conservation planning in numerous national and international processes.
- A dual "coarse-filter" and "fine-filter" spatial planning approach provides for :(i) regional approach(seascape scale) targeting broad ecosystem features and gradients, and (ii) special sites that may be of particularly high values or at particularly high risk. A coarse filter approach will generally focus on levels of ecological organization above the homogeneous community type to include seascape level ecological phenomena (including disturbance regimes) and heterogeneity. Ecological communities may not be sufficiently independent to be considered as separate components of biodiversity. Therefore, it has been recommended that maintenance of a diverse representation of physical environments should be used to maintain a majority of species diversity as a coarse filter approach to conservation of biological diversity (Hunter et al. 1988). It has also been also suggested that maintaining areas of high physical and ecological heterogeneity through a coarse filter approach offers increased resilience under changing climatic conditions (Halpin 1997). As such, in the context of the REMP development, APEIs may be best suited to perform this coarse scale function of protecting broad gradients of habitats and physical conditions.
- The complementary fine filter approach (e.g. VMEs) focuses on conserving individual rare or specialized species that may slip through the coarse filter and are not necessarily protected in the reserves (e.g. APEIs). An illustration of this point using hydrothermal vents as an example suggests

[2] http://www.fao.org/in-action/vulnerable-marine-ecosystems/en/

that "APEIs are expected to work for broadly distributed organisms, but are likely inadequate for small, rare, and isolated habitats with idiosyncratic physico-chemical environments and with faunal assemblages endemic to and dependent on those environments" (Van Dover et al. 2018). Under this example coarse filter planning approach (e.g. APEIs) would need to be supplemented with fine-filter planning approach (e.g. VMEs) in order to capture these isolated and rare (at a global scale) hydrothermal vent features.

- Due to the very different scale and purpose of these two different area-based planning approaches, the process for describing and identifying a broad collection of representative APEIs areas ("coarse filter planning") will focus on different objectives, different criteria and different analytical methods than the identification of potential VME sites, in other words sites in need for protection to preserve ecological balance of the marine environment ("fine filter planning").

Spatial Planning Criteria and Methods

- Evidence based spatial analysis to support the development APEIs within the REMP planning process should adhere to the standards of "Best Available Scientific Evidence," "Best Available Techniques," and/or "Best Environmental Practices" as described in the draft regulations on exploitation of mineral resources in the Area (ISBA/25/C/WP.1). There is an extensive and growing scientific literature on the best practices and methods for conducting spatial planning for conservation and management. Current best environmental practices include systematic conservation planning (SCP) approaches that allow for objective, multi-criteria analysis in the site selection process (Ban et al. 2013) Key components—and benefits—of systematic conservation planning, compared to sector-specific or *ad hoc* approaches, include transparency (e.g., defined goals, explicit analyses of data, quantitative objectives), inclusiveness (e.g., engaged stakeholders, consideration of known elements of biodiversity), integration (e.g., complementarity of selected areas and actions, spatial connectivity), and efficiency (e.g., costs to users and implementers are minimized) (Margules & Pressey 2000; Pressey 2007; Pressey & Bottrill 2009; Ban et al. 2013).

- Where possible, more sophisticated spatial planning approaches now also suggest the use of multi-criteria trade-off analyses to allow for more transparent and objective analysis of potential siting and potential outcomes (White et al. 2012, Lester et al. 2013, Best and Halpin 2019). The contrasting tradeoffs between habitat conservation and resource use can be explicitly modeled in terms of an efficiency frontier (White et al. 2012). Originally developed as portfolio analysis to weigh financial investment in terms of risk versus return over time (Markowitz 1952), tradeoff analysis provides a useful view for evaluating across many sites the risk to environmental protection versus the profitable return to industry. Ideally, alternative sites can be chosen that maintain profitability while also maximizing conservation benefit. Plotting the value of each site along two axes (i.e. profitability versus conservation) readily yields a relationship, which for the ideal scenario of interacting services is concave across the range of values (Lester et al. 2013).

- Systematic conservation planning (SCP) and trade-off analysis are best-practice standards that should be implemented where possible in the development of REMPs. These approaches benefit from a growing set of tools and techniques in both the terrestrial as well as marine spatial planning fields. A very important caveat is that both systematic conservation planning (SCP) and trade-off analysis require significant data coverage and precision in order to be fully implemented.

Better data can provide increased spatial precision

- To date, the development of proposed APEIs to support REMPs has been conducted using very coarsely defined areas using simple geometric features. In the case of the CCZ region, the size, shape and configuration of individual APEIs were based on simple criteria stating that each APEI:
  - ✓ should take into account biophysical gradients which affect the biogeography of marine biodiversity in the planning region;
  - ✓ should protect a full range of habitat types found within each subregion;
  - ✓ should be large enough to maintain minimum viable population sizes for species potentially restricted to a subregion;
  - ✓ should 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 APEIs; and
  - ✓ The boundaries should be straight lines to facilitate rapid recognition and compliance.

- This process resulted in final selection and approval of 9 rectangular APEIs composed of 200km x 200km core areas surrounded by an addition 100km buffer zones providing 400km x 400km final APEI units. The simple spatial design of these APEIs reflects both a desire to use parsimonious criteria, but also reflect the matching the limits of spatial precision to the data and knowledge limitations in the region (Wedding et al. 2013, Wedding et al. 2015).
- In data poor situations, spatial planning will necessarily rely on broad assumptions concerning species distributions, expected larval connectivity, and geophysical gradients to develop guidance on the size, shape and spatial configuration of proposed APEI sites (Wedding et al. 2013, Wedding et al. 2015, Dunn et al. 2018.
- With increased coverage and density of appropriate data and information, the ability to propose and justify more precise, finer-scale and potentially more complex shapes and configurations become more possible. This potential for increased precision in the future could be beneficial to the development of more detailed REMP planning that could provide for targeted selection of representative APEIs. It is hoped that new data aggregated and shared under the emerging ISA *DeepData* information system (see section V) will directly help provide more information and precision in the REMP development process.

Site versus Regional Network Analyses

- In general, spatial planning requires two types of criteria and scales of analysis: (1) individual site criteria that provide guidance on the priority, size, shape, and orientation of individual sites; and (2) 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. Table 1 presents general APEI selection criteria with general assessment approaches.

Table 1. APEI criteria and general assessment approaches

APEI Criteria	Assessment Approach
large areas	spatial analysis of ecosystem extent vs. relative areas
self-sustaining populations	Metapopulation, dispersal distance and connectivity analysis
broad range of habitat variability	Habitat models & representativity analysis
no direct mining effects	disturbance & recovery models
no indirect mining effects	physical models (plumes)
unknown impacts	precautionary approach

Timing of spatial planning in the REMP process

- The best practices of systematic conservation planning are based on the expectation that all areas in a planning region are evaluated in the process. The timing and sequencing of when areas are considered in the planning process can contribute to the number and types of alternatives that are available for consideration and the completeness of the planning process. Trade-off analyses are optimized when decisions can be made that provide positive outcomes for both resource extraction value and conservation value simultaneously.
- In general, there are more possibilities for identifying the least conflicting outcomes when all areas can be considered simultaneously. Early, regional scale scoping of both areas of high mineral value as well as areas of high conservation value can increase the probability of identifying spatial configurations that support win/win outcomes. If areas are locked out of consideration in initial scoping, the possibilities for finding spatial solutions that optimize both mineral value and conservation value may be limited. Best practices in systematic conservation planning and multi-sector marine spatial planning suggest that conducting REMP analysis prior to any area allocations would provide the most options for spatial consideration and lower the likelihood for conflicts at later stages of the process.
- Development of a REMP and associated APEIs will not be the end of a process; instead, ongoing evaluation and monitoring and the ability to adjust the REMP upon receipt of new data will be necessary.

How do we define the geographic scope of REMP?

- Defining the scope or spatial extent of REMPs is a fundamental step in the REMP development process. Defining the appropriate spatial extent of a REMP region is closely linked to the first three criteria required to implement APEIs for a region: (1) large area of similar habitat coverage; (2) self-sustaining populations and (3) a broad range of habitats (see table 1 above). The spatial extent can generally be defined taking into account mineral provinces in the Area where exploration or exploitation is taking place as well as biogeographic regions. Because the regions need to be defined specifically to set the geographic extent for REMP, criteria to define the extent will be relative to the type of area under planning, including the following considerations:

Geophysical features

- The definition of a REMP region through geophysical features will differ between types of geological regions. So, the regional scope may be defined with different types of geophysical features of areas located on the seafloor in abyssal plains, versus oceanic spreading ridges or clusters of seamounts. Analysis of bathymetric trends, geomorphological features and sediment structures can help to identify general inflection points or sharp changes that can be used to help define limits between broad geophysical regions. In other cases, the transition between geophysical features may be gradual and mid-points between features may need to be estimated. Regional areas may be defined as a contiguous area or gradient (e.g. a spreading ridge region) or may need to include clusters of discontiguous areas (e.g. clusters of separate seamount areas).

Biogeographic Areas

- The definition of a REMP regional scope may also be defined by the biogeographic ranges of characteristic species and communities. It can start with broad "province level" biogeographic classifications, as discussed in the literature. This approach can then incorporate finer-scale habitat or abundance models derived from species occurrence data. Analysis of species communities through ordination approaches or other techniques (e.g. non-metric multidimensional scaling) may be used to assess emergent species groupings. The identification of representative archetypical species (i.e. umbrella species) or species functional types may be used to infer general grouping to a regional context. In general, both geophysical and biogeographic information and approaches will be considered in the development of the REMPs.

Summary of spatial considerations

- In summary, spatial planning will play a fundamental role in the development of REMPs. The current best practices from systematic conservation planning, marine spatial planning and emerging trade-off analyses provide a wealth of new tools and techniques that can inform the REMP process. Spatial planning process have shown that multi-scale approaches to identify both coarse ecosystem features (coarse-filter approaches) combined with more targeted identification of vulnerable habitats and species (fine-filter approaches) can also be implemented in the REMP process. APEIs can be appropriately scaled to target many of the regional ecosystem gradients and properties while the approach for sites in need for protection can be appropriately scaled to target finer scale examples of vulnerable habitats and features. In the REMP planning process, different criteria will need to be considered in the identifications of individual sites (uniqueness, rarity, fragility etc.) (see annex I) versus the criteria (representativity, adequacy, spatial configuration, connectivity etc.) used to develop a network of sites. In addition, both geophysical and biogeographic considerations, in addition to legal consideration to begin with, will need to be used to develop the spatial extent of the REMP planning regions. And finally, the best practices of systematic conservation planning and trade-off analysis suggest that the earlier spatial issues can be considered in the planning process, the more potential spatial configurations and options can be available for decision making.

V. Compilation of scientific data/information as inputs to the development of REMPs

LTC guidance for the collection of environmental baseline data and the environmental impact assessment, which can inform the development of REMPs

- The LTC periodically reviews a set of recommendations to guide the contractors to collect data for the purpose of establishing baseline conditions of physical oceanography, chemical oceanography and geological, biological and other parameters that characterize the benthic and pelagic environments, against which environmental impact assessments can be undertaken. The data/information collected by contractors are compiled through the ISA database (*DeepData*, see the next section), which will become critical sources of information for the REMP planning process.

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15. Data to be addressed should include:
(a) **Physical oceanography**:
(i) The measurement programme should be adapted to the geomorphology of the seabed and the regional hydrodynamic processes at the sea surface, in the water column and at the sea floor;
(ii) Collect information on the oceanographic conditions, including pressure, current direction and velocity, temperature, salinity and turbidity regimes, at intervals down the entire water column and, in particular, near the sea floor;
(iii) Measure the physical oceanographic parameters at the depths likely to be impacted by plumes caused by the processing discharge and seabed-disturbance plumes;
(iv) Physical parameters need to be measured with sufficient temporal and spatial resolution to adequately characterize the oceanographic environment;
(v) Measure natural particle concentrations and composition to record distribution throughout the water column;
(b) **Chemical oceanography**:
(i) Collect information on water column chemistry, including water overlying the resource, in particular on metals and other elements that may be released during the mining process, including interactions that may occur through crushing processes, leaks in the riser pipe, dewatering on the surface vessel and the consequent discharge plume;
(ii) Provide information on potential additional chemicals that may be released, if any, in the discharge plume following dewatering and/or processing of the ore, if it is to occur offshore; (iii) Measure oxygen concentration, generating profiles in the water column, as far as possible near and across the sediment-water interface into the sediment column;
(iv) Measure pH and other components of the carbonate system where appropriate (e.g. carbon dioxide, alkalinity);
(c) **Geological properties**:
(i) Produce Geographic Information System regional maps with highresolution bathymetry and sea floor bottom type showing major geological and geomorphological features to reflect the heterogeneity of the environment. These maps should be produced at a scale appropriate to the resource and habitat variability;
(ii) Record baseline levels of heavy metal and trace element content of the resource that may be released during the activity of test-mining or testing of mining components;
(iii) Determine the basic properties of the substrata to characterize the surficial deposits which are the potential source of seabed-disturbance plumes;

(iv) Sample the substratum taking into account the variability of the seabed and the nature of each resource category;
(d) **Biological communities**:
(i) Use high-resolution bathymetric maps to plan the biological sampling strategy, taking into account variability in the environment:
(ii) Gather data on biological communities, taking samples of fauna representative of variability of habitats, bottom topography, depth, seabed and sediment characteristics, the water column and mineral resource being targeted;
(iii) Collect data on the near-bottom and sea-floor protozoan and metazoan communities specifically relating to megafauna, macrofauna, meiofauna, microbial communities, demersal fishes and scavengers and biota associated directly with the resource, both in the exploration area and in areas that may be impacted by operations (e.g. the areas affected by discharge and seabed disturbance plumes); (iv) Assess pelagic communities in the water column and near-bottom (in the benthic boundary layer) that may be impacted by operations (e.g. noise and discharge plumes);
(v) Record sightings of marine mammals, other near-surface large animals (such as turtles and fish schools) and bird aggregations, identifying the relevant species where possible. Details should be recorded in transit to and from areas of exploration and on passage between stations;
(vi) Establish time series stations to evaluate temporal variations in water column and seabed communities;
(vii) Assess regional distribution of species and communities/assemblages as well as genetic connectivity of key and representative species;
(viii) Where possible, collections should be photo-documented (and indexed to video imaging) in situ to provide an archive of context/setting information for each sample;
(e) Record and describe bioturbation activity and mixing of sediments;
(f) Evaluate linkages between pelagic and benthic habitats, including fluxes to the sediment: gather time series data on the sinking flux and composition of materials (including particulate organic matter) from the upper water column to the seabed;
(g) Measure sediment community oxygen consumption as a metric of whole community (largely microbial) function;
(h) Evaluate the food web structure of the pelagic and benthic habitats.

17. In addition to the information provided above, the following information is **specific to polymetallic sulphides**:
(a) Any modification of fluid discharge in hydrothermal settings and associated fauna (using photo documentation, temperature measurements and other metrics, as appropriate) should be recorded;
(b) For active sulphide deposits, temperature-fauna relationships should be analysed (e.g. 5 to 10 discrete, video-documented temperature measures within each subhabitat);
(c) The distribution, abundance, species structure and diversity of the dominant taxa in each subhabitat (active, inactive vent areas, non-vent habitats) should be determined. This includes the assessment of specialist localized chemosynthetic communities relative to potential mining locations;
(d) Meiofaunal and microbial community structure and biomass associated with the polymetallic sulphide deposits should be obtained from remotely operated vehicle/submersible sampling, where possible, or be examined from rock dredge and rock drill samples. A statistically defensible number of samples should be taken from polymetallic sulphides, where possible. Species that live on the rock or in crevices and pits in the deposit should be identified, where possible;
(e) Biological samples from active hydrothermal vent systems should only be collected using precision sampling by remotely operated vehicle/submersible technology according to subhabitat and placed into discrete sample boxes.

18. In addition to the information provided above, the following information is **specific to cobalt-rich ferromanganese crusts**:
(a) Biological communities associated with cobalt-rich ferromanganese crusts may have a highly localized distribution. Biological sampling within the contractor's area must therefore be stratified by habitat type, which will be defined by topography (e.g. summit, slope and base for seamounts), hydrography, currents regime, predominant megafauna (e.g. coral mounds, sponge and octocoral fields), oxygen content of the water (if the oxygen minimum layer intersects the feature) and, potentially, depth. Both spatial and temporal replicate biological samples should be obtained using appropriate sampling tools in each subhabitat. A statistically defensible number of replicate samples per stratum is recommended for collection of specimens and to assess species richness;
(b) Photographic or video transects should be undertaken to determine habitat type, community structure and associations of megafauna with specific types of substrata. Abundance, percentage cover and diversity of megafauna should be based initially on at least four transects. These transects should include flat sea floor at the base of the seamount, the slope of the seamount and its summit. Further transects should be carried out in crust areas of potential test-mining interest;
(c) Demersal fishes and other nekton living over the sea floor should be assessed using towed photographic/video transects, benthic landers and/or submersible/remotely operated vehicle observations and photographs. Seamounts can be important ecosystems with a variety of habitats for a number of fish species that form aggregations there for spawning or feeding.

ISA database (*DeepData*) in support of the REMPs

- The ISA has developed its database (*DeepData*) which will become the repository of data/information submitted by the contractors on their prospecting and exploration (and future exploitation) activities, providing also a potential to be the repository of other relevant data on the environment and resources of the Area.
- *DeepData* includes data on mineral resource assessment and environmental parameters of the surrounding marine ecosystems, from the seafloor to the ocean surface. Contractors are required to submit the metadata and the results of their observations from geological and environmental surveys in contract areas. Data should be submitted using the templates published by the Legal and Technical Commission, as described in the recommendations for guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area[3] and for the content, format and structure of annual reports[4] .
- The reporting templates, two for each type of mineral resources (nodules, sulphides and crusts), are available on the ISA website[5]: one for *geological data*, describing the geologic, geochemical and geotechnical aspects related to the mineral resources, and one for the *environmental data* comprising biological, physical and geochemical parameters of the marine environment, regarding seabed sediments and water column. In addition to structured data (table format), the *DeepData* also hosts

[3] ISBA/19/LTC/8
[4] ISBA/21/LTC/15
[5] https://www.isa.org.jm/reporting-templates

unstructured information, including maps, photographs, videos, graphics and relevant publications published in peer-reviewed journals.

- Upon the public launching of *DeepData* in July 2019, the environmental, bibliographic and other non-confidential data will be available for open access from the ISA website. Mineral resource assessment data (submitted under *geological data* template) is confidential according to the terms of contracts for exploration. The information stored at *DeepData* will have a critical role in the assessment of environmental baseline data and gap analyses to guide contractors and other stakeholders in future sampling designs, and to foster development of environmentally sound technologies.
- *DeepData* will allow the characterization of the biotic and abiotic components of the habitats found in the Area. This information will be used to assess short, medium and long-term changes in the marine environment, contributing to design and implementation of environmental monitoring programs, environmental impact and risk assessment, and regional environmental management plans, including the application of area-based management tools at local and regional levels.

Other global and regional database as potential sources

- In many countries, a National Oceanographic Data Centre (NODC) is providing facilities to archive many data types related to marine sciences (e.g. NODC in the United States: http://www.nodc.noaa.gov. These NODCs work together in the framework of the Intergovernmental Oceanographic Commission (http://ioc-unesco.org/) of UNESCO. Specific examples of online resources for downloading oceanographic data are:

Bathymetry:

- ✓ SRTM30_Plus (see http://topex.ucsd.edu/WWW_html/srtm30_plus.html)
- ✓ ETOPO1 (see http://www.ngdc.noaa.gov/mgg/global/etopo1sources.html)
- ✓ GEBCO (see http://www.gebco.net/data_and_products/gridded_bathymetry_data/)

Sea Surface Temperature:

- ✓ AVHRR Pathfinder (see http://www.nodc.noaa.gov/SatelliteData/pathfinder4km/)

Marine biodiversity:

- ✓ Ocean Biogeographic Information System (see https://obis.org/)

Ocean Color/Primary Productivity

- ✓ NASA Ocean Color Chlorophyll (see https://oceancolor.gsfc.nasa.gov/)
- ✓ Vertically Generalized Production Model (VGPM; see http://www.science.oregonstate.edu/ocean.productivity/)

Sea Surface Height[6] :

- ✓ AVISO sea surface height (SSH) data
- ✓ AVISO geostrophic current data
- ✓ AVISO significant wave height data

[6] All available from AVISO at (http://www.aviso.oceanobs.com/en/data/products/sea-surface-heightproducts/global/index.html)

Sea Surface Wind:

- ✓ Quikscat (see http://podaac.jpl.nasa.gov/PRODUCTS/p109.html)
- ✓ AVISO Surface Wind data (http://www.aviso.oceanobs.com/en/data/products/wind-wavesproducts/mswhmwind/processing-gridded-wind-wave-products/index.html)

- Access to these data archives will be mostly useful to support predictive modeling (see below), which can be used for habitat mapping, modelling of plume impacts as well as for assessment of cumulative impacts derived from climate change and its interactions with benthic-pelagic coupling effects (see HYbrid Coordinate Ocean Model or HYCOM, https://www.hycom.org).
- Examples of metadata databases are the Global Change Master Directory of NASA (general environmental), OceanPortal of International Oceanographic Data and Information Exchange (IODE) of the Intergovernmental Oceanographic Commission (IOC; specific to marine environment), and World Conservation Monitoring Centre (WCMC; specific to conservation).
- Remote data collection and observatories can also contribute as data sources. Examples of remote data collection and observatories include the Global Ocean Observing System (GOOS, https://www.goosocean.org), together with its regional nodes, and specific programs such as the Deep Ocean Observing Strategy (DOOS, http://deepoceanobserving.org/), the European Multidisciplinary Seafloor and water column Observatory (EMSO, http://emso.eu/) and the Argo float program (http://www.argo.net/).
- 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 (ICES http://www.ices.dk/) in the Northern Atlantic and the North Pacific Marine Science Organization (PICES http://www.pices.int/) in the Pacific.
- Also the UN Food and Agriculture Organization (FAO, http://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. FAO's database on vulnerable marine ecosystems (VMEs, http://www.fao.org/in-action/vulnerable-marine-ecosystems/about-vme-database/en/) is a compilation of information on management measures taken to reduce current or potential impact on areas where VMEs are known or likely to occur, and is linked to data providers, which are mainly regional fisheries management organizations (RFMOs).
- Museums are traditionally the keepers of biodiversity information, storing physical specimens since centuries. The progress in databases and communications via Internet has prompted many museums to digitize specimen data and make this information available through the World Wide Web (e.g. Natural History Museum of London (https://data.nhm.ac.uk), Smithsonian, California Academy of Sciences, Australia, etc) following the standards of the Global Biodiversity Information Facility (GBIF) and Ocean Biogeographic Information System (OBIS).
- A number of marine laboratories, such as the Sir Alistair Hardy Foundation for Oceanographic Studies (SAHFOS, http://www.sahfos.ac.uk/) and the Scripps Institute of Oceanography (http://www.sio.ucsd.edu/), have geospatially referenced collections of plant and animal specimens, and related environmental data that span decades.
- International scientific programs generate large datasets, which are typically available online. Examples include:

- ✓ InterRidge (http://www.interridge.org/),
- ✓ A transatlantic assessment and deep-water ecosystem-based spatial plan for Europe (https://www.eu-atlas.org/)
- ✓ Integrated Assessment of Atlantic Marine Ecosystems in Space and Time (iAtlantic)
- ✓ Atlantic Ocean Research Alliance Coordination and Support Action (https://www.atlanticresource.org/aora/)
- ✓ Deep-sea Sponge Grounds Ecosystems of the North Atlantic
- ✓ Marine Ecosystem Restoration in Changing European Seas (https://www.atlanticresource.org/aora/)
- ✓ Global Ocean Biodiversity Initiative (http://gobi.org/)
- ✓ JPI Ocean (http://www.jpi-oceans.eu/)

- Conservation organizations hold species information to support their conservation programs, and often work closely together with environmental managers. Examples include UNEP-WCMC species databases (www.unep-wcmc.org/species/dbases/about.cfm), IUCN Red List (http://www.iucnredlist.org/) and the Global Marine Species Assessment (GMSA, http://sci.odu.edu/gmsa/).
- Increasingly, industries are holders of useful information based on direct observations of species occurrences from their transport systems during business operations.

Sampling and data considerations in the Area, including strategies for dealing with data paucity in the Area and the need for collaboration among contractors and relevant scientific programmes/ initiatives

- Regional environmental management planning, based on the best available scientific information, in the Area faces a number of challenges deriving from difficulty involved in monitoring extensive remote deep-sea environment, poor scientific understanding of large-scale ecological processes and interactions, uncertainty in the attribution of cumulative impacts of threats, and challenges in ensuring effectiveness management interventions.
- Setting in place adequate monitoring programme, rigorous evaluation and transparent reporting mechanisms for the activities in the Area would benefit from (i) integrating models into marine management systems to help understand, interpret and manage the environmental and socio-economic dimensions of uncertain and complex marine systems, (ii) utilizing big data sources and new technologies to collect, process , store and analyze data, and (iii) applying approaches to evaluate, account for, and report on the multiple sources of uncertainty (Addison et al. 2018 ICES).
- Sampling of variables related to deep seabed ecosystems is often technologically and financially challenged, requiring large-scale sea-going infrastructures and specialized personnel to operate sampling equipment as well as to process and analyze the samples. The vastness of the deep ocean has so far resulted in an extremely poor spatial and temporal resolution of observations.
- The information currently available on seabed regions with potential for exploitation of mineral resources varies between contract areas and mineral provinces. Several aspects account for this variation, *inter alia* the date of contract signature, the amount of information collected during exploration surveys, the frequency and spatial coverage of environmental sampling, the precision of measurements and results reported (e.g. taxonomic level of species identification). These differences

add constraints to inter-contract areas/ inter-regional comparisons. In recognition of sampling discrepancies, it is imperative to effectively use the best available information and ensure that future research efforts are aligned reflecting knowledge gaps. Towards this end, collaborative efforts and better sharing of data must be highly encouraged through the process of developing and implementing REMPs.

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28. Cooperative research may provide additional data for the protection of the marine environment and may be cost-effective for contractors.

29. Interaction between multiple oceanographic disciplines and multiple institutions can be useful in closing the gaps in knowledge (especially regional-scale environmental patterns) that result from contractors working individually.

30. Cooperative research programmes may prove especially synergistic, bringing together the expertise, research facilities, logistic capabilities and common interests of mining companies and cooperative institutions and agencies. In this way, contractors may make best use of large-scale research facilities such as vessels, autonomous underwater vehicles and remotely operated vehicles and expertise in geology, ecology, chemistry and physical oceanography of academic institutions.

- Systematic decision-making requires a solid foundation from which information and knowledge can be extracted to inform choices among a set of options. In the case of evaluating the degree to which specific areas could be vulnerable to exploitation of mineral resources in the Area and in need for protection and enhanced management measures, specific set of scientific criteria can be defined and applied, building on existing set of scientific criteria being adopted and applied in other ocean sectors (see the previous section and annex I). With the compilation, analysis, and synthesis of geo-reference environmental and physical data and information, these scientific criteria can be applied, with necessary modifications, to describe potential sites in need for protection to maintain ecological balance of the marine environment from harmful effects of mining activities, as a means to ensure effective protection for the marine environment under Article 145 of the Convention, which is further informed by Article 194 (5) (see the previous section).
- Documenting environmental baseline data is essential to monitor and predict changes in ecological or biological conditions, which may arise from exploitation activities. Many different types of data are needed for establishing baseline conditions, e.g. physical, chemical, geological, biological and other parameters that characterize the environments likely to be impacted by exploitation activities. Although these data are fundamental to any systematic analysis of the marine environment, the time and expense required to collect many of these data types (e.g. species observation data, deep-seabed physical, chemical and sediment/substrate data) greatly limit data availability.
- Given the paucity of data that are available, it is imperative that available data, including those from ISA database (*DeepData*) be analyzed and synthesized to the greatest extent possible as useful data products in support of process for developing REMPs. Existing data available through *DeepData* shall be complemented with data from other regional and global databases (as noted in the above section), as well as data generated by independent scientific projects and historical data.
- In order to describe marine ecosystems and assess ecological integrity in the Area, a range of information needs to be compiled, including but not limited to:

Ecosystem diversity

- ✓ Biodiversity: Species/taxon richness and evenness, species/OTU structure for the different components of the biota, including megafauna, macrofauna, meiofauna and microbiota, at site, area and regional scales (alpha, beta and gamma diversity).
- ✓ Community structure: species density, presence, absence, mobility types(sessile versus mobile) and functional groups (e.g., suspension feeders versus deposit feeders)
- ✓ Habitat diversity/complexity: habitat engineers and foundation species, topography, geology, hydrography

Ecosystem function

- ✓ Biomass
- ✓ Trophic structure: Trophic richness and redundancy
- ✓ Ecosystem functions and drivers: C-cycling and C-flows, rates and depths of bioturbation, carbon burial, calcium carbonate dissolution, nutrient fluxes, seafloor POC flux, ocean depth, sediment properties such as grain size, TOC, mineral resource abundance and properties

Ecosystem recovery and resilience

- ✓ Biogeography: species/OTU geographic and bathymetric distribution
- ✓ Connectivity: shared haplotypes, gene flow, dispersal distance, settlement and recruitment
- ✓ Life-history traits: growth rates, reproductive maturity, development
- ✓ Demography: population dynamics and effective population size

- Direct, or inferred, data and assessments of these aspects will vary in quantity and quality. As indicated above, insufficient data will likely hamper direct evaluation of the vulnerability of an area/site based solely on the available data itself. Under such circumstances, input from experts may be supplemented by biogeographic classifications and predictive modelling (habitat mapping) to assist in identifying similar areas. Models are not a substitute for real observations, but will be necessary and important contributions to the evaluation of habitat vulnerability if they have been adequately ground-truthed and validated. Results of modelling approaches always have uncertainty about the predicted likelihood or abundance of an ecosystem feature, but good modelling methods include the uncertainty of the prediction as well as the most likely value. Application of, and extrapolation from, the existing information will therefore benefit from addressing[7], *inter alia*:

  - ✓ **Issues related to scale of application of scientific criteria to describe sites in need for protection to preserve ecological balance of the marine environment**, from both the ecological perspective and from the implementation perspective. For instance, at the species level, an appropriate scale of study for one life history stage (e.g. larval) may be inappropriate for another (e.g. juvenile). Consequently application of the criterion regarding importance to life history stages of a species could require considering several different scales to capture the requirements of the species. In general, for any of the criteria, if specific questions can be posed, appropriate scales are usually

[7] Ardron et al 2009. Defining ecologically or biologically significant areas in the open oceans and deep seas: Analysis, tools, resources and illustrations. CBD

fairly self-evident, such as the range of an individual, the distribution of a species, or the persistence of an upwelling event.

- ✓ **Evaluation of the relative importance / significance of an area for given scientific criteria to describe sites in need for protection to preserve ecological balance of the marine environment.** The properties of marine ecosystems vary widely from region to region, so global absolute thresholds (i.e. measurement 'X' must exceed 'a' units) are not appropriate. Instead, the evaluation process must sort out the relative importance of specific features or places in a given ecological region on each of the criteria. With comprehensive quantitative data, two general approaches can be used for investigation of such patterns: identify general break point in the data and select a cut-off based on standard deviations.

- ✓ **Accounting for spatial and temporal variability**. The science advice identifying the likely vulnerable area and suggesting appropriate geographic scope should include as much information as possible about the magnitude and time-scale of these variations. How variability is incorporated into evaluations of an area is largely dependent on the type of data being analyzed. It is equally important to examine spatial and temporal (spatio-temporal) variability in survey data. Although it is tempting to aggregate data from different surveys together to better understand population level processes, it is important to first consider how the data overlap in time and space.

- ✓ **Precision, accuracy, and uncertainty**. These three properties of data are inter-related but not interchangeable. Uncertainty contributes to two types of possible errors in evaluating data relative to the scientific criteria to describe sites in need for protection to preserve ecological balance of the marine environment; "misses" – when it is erroneously concluded that an area does not meet a criterion when in reality it does, and "false positives", when it is erroneously concluded that an area does meet one of the criteria, when in reality it does not. Misses are likely when data are incomplete and/or sampling coverage at the wrong scale (generally too coarse), so features are present in an area (or ecological functions served) but they simply are not recorded in the available data. False positives also reflect incomplete knowledge of an area, such that limited sample data are treated as typical, and a model is built around them predicting a broader distribution of a feature than actually exists. Without groundtruthing, this can lead to the protection of sites that do not actually have the desired feature. Both types of errors decrease as ecological knowledge increases and sampling becomes more complete. With high uncertainty in data and information, the precautionary approach would support a relatively higher tolerance for false positives than misses. Thus, failure to find evidence of a vulnerable area in incomplete data sets should not be taken as strong evidence that the area has no special requirements for conservation.

- ♦ Over time, knowledge in understanding the marine environment of the Area will increase, as will experience with the use of the scientific criteria to describe sites in need for protection to preserve ecological balance of the marine environment. Therefore any process for application of these criteria should include periodic reviews of results.

VI. Indicative elements of REMPs

- Building on the discussion presented in the above sections, this section illustrate possible elements that can be considered for inclusion in the REMPs, which are subject to modifications taking into account regional context and circumstances, as follows:

1. ***Context***

- *Legal frameworks*
- *Guiding principles*
- *Geographic scope of the planning area*
- *Planning period*
- *Description of regional-scale ecosystem characteristics*
- *Description of mineral resources, and exploration and/or exploitation activities*
- *Potential impacts of exploitation activities on biodiversity, habitats and ecosystems at a regional scale, including cumulative impacts*
-

2. ***Management goals and objectives***

- *Environmental management goals and objectives at regional scale, which transcends the contract areas*
- *Environmental performance outcomes for the entire planning area at a regional scale, which will inform the identification of environmental performance outcomes expected of contractors active within the planning area of the REMP*
- *Environmental performance outcomes for APEIs and other sites in need for protection to preserve ecological balance of the marine environment*

3. ***Management measures***

- *Area-based management measures*

✓ *Sites in need for protection to preserve ecological balance of the marine environment in the Area*

✓ *Areas that could be protected from exploitation in the Area in order to achieve effective protection of the marine environment, through the designation of areas of particular environmental interests (APEIs).*

- *Application of environmental standards and guidelines*

- *Development of environmental monitoring at the regional scale, through collaboration among contractors, sponsoring States and other stakeholders*
- *Region-specific framework for assessment of cumulative impacts at the regional scale*
- *Measures for enhancing ecosystem recovery, if applicable*

4. ***Implementation Framework***

- *Collaboration and cooperation among ISA, contractors, sponsoring States, and other stakeholders*
- *Scientific data gathering, compilation, analysis and synthesis in support of implementation activities*
- *Communication and reporting of the implementation activities*
- *Monitoring and review of the implementation activities*
- *Knowledge gaps and priorities for future research*
- *Updating of the plan*
- *Capacity building, training and technology transfer in support of implementation activities at a regional scale*
- *Financing mechanism of the implementation activities*

Annex I. Comparison of existing scientific criteria for identifying marine areas in need of enhanced management and protection relating to: (i) their inherent ecological or biological significance (CBD EBSA criteria) or (ii) addressing the adverse impacts from specific human activities (e.g. bottom fishing (FAO), shipping (IMO)). Scientific criteria that could contribute to the environmental objectives indicated in the article 145 of the Convention are highlighted in color, in particular those that can be used to describe and identify at finer scale sites in need for protection to preserve ecological balance of the marine environment in the Area (see section IV). This table builds on analysis in annex II.

Vulnerable marine ecosystems (VMEs; FAO)	Ecologically or biologically significant marine areas (EBSAs; CBD)	Particularly sensitive sea areas (PSSA; IMO)
Uniqueness or rarity - an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by similar areas or ecosystems. These include: • habitats that contain endemic species • habitats of rare, threatened or endangered species that occur only in discrete areas • nurseries or discrete feeding, breeding, or spawning areas	**Uniqueness or rarity:** area contains either (i) unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features.	**Ecological Criteria** • Uniqueness or rarity • Critical habitat • Dependency • Representativeness • Diversity • Productivity • Spawning or breeding grounds • Naturalness • Integrity • Fragility • Biogeographical importance
Functional significance of the habitat - discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life history stages (e.g. nursery grounds or rearing areas), or of rare, threatened or endangered marine species.	**Importance for threatened, endangered or declining species and/or habitats** : area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species.	Social, cultural and economic criteria • Social or economic dependency • Human dependency • Cultural heritage
Fragility - an ecosystem that is highly susceptible to degradation by anthropogenic activities.	**Vulnerability, fragility, sensitivity or slow recovery**: areas that contain a relatively high proportion of 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.	Scientific and educational criteria • Research • Baseline for monitoring studies • Education

Life-history traits of component species that make recovery difficult - ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics: • slow growth rates • late age of maturity • low or unpredictable recruitment • long-lived	**Special importance for life history stages** of species : areas required for a population to survive and thrive.	Vulnerability (Vessel traffic characteristics) • Operational factors • Vessel types • Traffic characteristics • Harmful substances carried
Structural complexity - an ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features. In these ecosystems, ecological processes are usually highly dependent on these structured systems. Further, such ecosystems often have high diversity, which is dependent on the structuring organisms.	**Biological diversity**: area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.	Vulnerability (Natural factors) • Hydrological • Meteorological • Biophysical
	Biological productivity: area containing species, populations or communities with comparatively higher natural biological productivity.	Further information including • any history of groundings, collisions, or spills in the area and any consequences of such incidents; . • any adverse impacts to the environment outside the proposed PSSA expected to be caused by changes to international shipping activities as a result of PSSA designation; • stresses from other environmental sources; and • any measures already in effect and their actual or anticipated beneficial impact.
	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	

Sources :

IMO, 2005. Revised Guidelines for the identification and designation of particularly sensitive sea areas. IMO Resolution A.982(24).

FAO, 2008. International Guidelines for the Management of Deep-sea Fisheries in the High Seas.

CBD, 2008. Scientific criteria for ecologically or biologically significant areas (EBSAs) (annex I, decision IX/20)

Annex II. Existing scientific criteria for describing/identifying marine areas in need of enhanced management and protection, and their relevance to environmental characteristics relating to the need for protection of marine environment, as referred to in the Convention

Ecosystem characteristics referred to in UNCLOS Art 145, 194(5)	Existing scientific criteria for describing/identifying marine areas in need of enhanced management and protection	Examples of habitats/ecosystem features in the Area where these criteria may apply
Rarity	FAO VME: "**Uniqueness Or Rarity** - an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by similar areas or ecosystems. these include: • habitats that contain endemic species • habitats of rare, threatened or endangered species that occur only in discrete areas • nurseries or discrete feeding, breeding, or spawning areas"	*Reliance on obligate chemosynthetic symbioses constrains many vent species to living in environmental patches that emit hydrothermal effluents. This means they are vent "endemics", so endemic at the habitat scale. At a finer scale, some vent species are also endemic at the individual vent scale (Vrijenhoek, 2010).*
	CBD EBSA: "**Uniqueness Or Rarity**: area contains either (i) unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features".	*Hydrothermal vents contain many "rare" species. However, their "rarity" is not limited to the species they host. Globally, the active vent ecosystem is a "rare habitat", comprising an estimated 50km2, or <0.00001% of the surface area of the planet. Scarcity of the vent habitat places vent ecosystems at risk (Van dover et al, 2018).*
Fragility	FAO VME: "**Fragility** : an ecosystem that is highly susceptible to degradation by anthropogenic activities".	*Deep-water bottom trawling is particularly destructive for cold-water coral reefs, as they are "fragile" and "slow growing" (Huvenne et al, 2016).*
	CBD EBSA: "**Vulnerability, Fragility, Sensitivity Or Slow Recovery**: areas that contain a relatively high proportion of 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".	*At nodule habitats, there are many species considered "nodule-endemic". For example, in the UK Seabed Resources Ltd. exploration contract area (UK-1) in the CCZ, approximately half of the megafauna morphotypes found during the ABYSSLINE project occurred only on polymetallic nodules. These organisms were mostly sessile and therefore are particularly at risk from mining activities*

		as they are unable to seek refuge elsewhere; hard-substrate obligate i.e. those that live on polymetallic nodules will be the most at risk as the substrate they inhabit will be harvested (Amon et al, 2016).
	FAO VMES: "**Life-History Traits Of Component Species That Make Recovery Difficult** : ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics; slow growth rates; late age of maturity; low or unpredictable recruitment; long-lived".	*Cold-water corals are very "long-lived". For example, specimens of Paramuricea biscaya sampled after the Deep Water Horizon oil spill were found to be 600 years old. The extreme longevity and "slow growth-rates" of these corals highlights their difficulty to recover (Prouty et al, 2016).*
	CBD EBSAS: "**Special importance for life history stages of species**: areas required for a population to survive and thrive".	*Deep-sea cold-water coral reefs (e.g. Lophelia pertusa) act as breeding grounds for commercial species such as redfish (Sebastes spp.) to "survive and thrive". Early "life-history stages" of Sebastes spp. hide amongst the complex 3-dimensional structure (Baillon et al, 2012).*
Habitat of depleted, threatened or endangered species and other forms of marine life	CBD EBSA: "**Importance for threatened, endangered or declining species and/or habitats**: Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species".	*Some seamounts form habitat for species that are already "threatened" by human activities (e.g., sharks, deep-sea stony corals), and that can occur on seamounts in relatively high numbers (Clark et al, 2012).*
	FAO VME: "**Functional Significance Of The Habitat** : discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life history stages (e.g. nursery grounds or rearing areas), or of rare, threatened or endangered marine species".	*Cold water coral reefs are important "habitat"-forming organisms in the deep-sea. They can at times also act as "nursery grounds" and adult habitat for some fish species (Huvenne et al, 2016)*
Ecological balance	CBD EBSA: "**Biological Diversity**: area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity".	*Seamounts with varying levels of "biological diversity" are valuable where they add species or complement larger-scale biodiversity pools in the deep ocean (Clark et al, 2012).*
	CBD EBSA	*Deep-sea ecosystems such as seamounts*

	Biological productivity: area containing species, populations or communities with comparatively higher natural biological productivity.	*or cold-water corals have an increased "biological productivity" and are also known to be found within potential REMP regions (e.g. UK-1 claim area CCZ, Amon et al, 2016). Productivity can be increased through specific physical processes, such as topographic modification of currents and enhanced transport of particles and detrital matter (Ramirez-Llodra et al, 2010).*

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