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MARINE AND COASTAL BIODIVERSITY: REVIEW, FURTHER ELABORATION AND REFINEMENT OF THE PROGRAMME OF WORK

Study of the relationship between the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea with regard to the conservation and sustainable use of genetic resources on the deep seabed (decision II/10 of the Conference of the Parties to the Convention on Biological Diversity)

Note by the Executive Secretary

The Executive Secretary is circulating herewith, for the information of participants in the eighth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, a revised text of the study of the relationship between the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea with regard to the conservation and sustainable use of genetic resources on the deep seabed, which was prepared pursuant to paragraph 12 of decision II/10 of the Conference of the Parties. The substance of the study is summarized in a note by the Executive Secretary prepared for the meeting (UNEP/CBD/SBSTTA/8/9/Add.3), which also includes suggested recommendations on the subject for the consideration of the Subsidiary Body.

* UNEP/CBD/SBSTTA/8/1.

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I. INTRODUCTION

1. Marine biodiversity is a vast reserve of economically, scientifically and environmentally valuable materials, compounds and other organisms. 1/ So far, the attention of scientists and policy makers has focused on coastal ecosystems. Deep ocean areas are very little known and were considered as a desert in terms of species diversity. Because the deep seabed is below the level of light penetration and therefore devoid of photosynthetic activity, it used to be believed that sources of productivity were limited to material sinking from above. 2/ Owing to the physical characteristics of deep oceans 3/ and the resulting high financial costs encountered by any exploratory activities, very few States, including multinationals from those States, have the technical, financial and human resources to access and exploit deep marine areas. Indeed, deep-ocean scientific expeditions can cost up to $30,000 per day, and usually last for one to two weeks. 4/

2. However, it is now estimated that the deep sea may be home to 10 million species of organisms. 5/ In 1977, a unique ecosystem was discovered at sites where high-temperature fluids rich in reduced compounds pour out into the water column. There are now two discovered benthic ecosystems characterized by energy sources other than light: sediment communities and seep communities (including hydrothermal vents, petroleum seeps and sediment-pore water seeps). Vent communities are rich in population density and high endemism and are rich sources of macro- and micro-organisms. Thus far, micro-organisms, fish, crustacea, polychaetes, echinoderms, coelenterates and mollusks have been discovered in vent areas. Approximately 450 invertebrates have been identified to generic level although many more are currently being studied. Three phyla dominate the vent fauna described to date: mollusks, arthropods and anellidis. Octopus and fish species have also been observed in and around the vents. Over 75 per cent of vent species occur at only one site. No single species occurs at all sites. Life is concentrated in the zone of mixing between the hydrothermal vent fluid and seawater. In this zone envieonmental conditions are extremely variable with temperatures as high as 50 C. There have been reports of polycaete worms (*Alvinella pompejana*) enduring hot water venting at temperatures in excess of 80 C. 6/ Examples of deep seabed ecosystems and the threats posed to them are provided in the annex to the present document.

3. In paragraph 12 of its decision II/10, the Conference of the Parties to the Convention on Biological Diversity requested the Executive Secretary of the Convention, in consultation with the Division for Ocean Affairs and the Law of the Sea of the Office of Legal Affairs of the United Nations, to undertake a study of the relationship between the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea (UNCLOS) with regard to the conservation and sustainable use of genetic resources on the deep seabed, with a view to enabling the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the Convention on Biological Diversity to address at future meetings the scientific, technical, and technological issues relating to bioprospecting of genetic resources on the deep seabed. The present study has been prepared in response to this request.

4. In parallel to the process under the Convention on Biological Diversity, the Secretary-General of the United Nations drew the attention of the General Assembly to the issue at its fiftieth session and

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1/ See UNEP/CBD/SBSTTA/2/15 and UNEP/CBD/COP/5/INF/7.

2/ Only one per cent of the photosynthetically produced carbon in offshore surface waters reaches the deep ocean-floor, see H.W. Jannasch, "Deep Sea Hot Vents as Sources of Biotechnology Relevant Microorganisms", cited by L. Glowka, "The Deepest of Ironies: Genetic Resources, Marine Scientific Research and the International Deep Sea-bed Area", 1995, p.2.

3/ 97 to 98% of the ocean floor is below 6500 metres from the ocean surface. As of 1995, only one remotely-piloted vehicle in the world, from Japan, could access the area. See L. Glowka, 1995, p.8.

4/ See UNEP/CBD/SBSTTA/2/15 and UNEP/CBD/COP/5/INF/7.

5/ L. Glowka, 1995, p. 2.

6/ WWF/IUCN (2001), The status of natural resources on the high-seas, WWF/IUCN, Gland, Switzerland

referred to the process under the Convention on Biological Diversity. 7/ In 1996, reporting to the 5th Meeting of the Parties to UNCLOS, he urged "States Parties to the Law of the Sea Convention which are also Parties to the Convention on Biological Diversity, to coordinate their activities particularly with respect to the conduct of reviews of the relationship between the two conventions, the identification of additional measures that may need to be taken, including the possible development of new or additional international rules". 8/

5. In his annual report to the General Assembly at its fifty-first session, he particularly drew the attention of Member States to the fact that:

> "[t]he topic [i.e. the issue of access to the genetic resources of the deep seabed] touches not only on the protection and preservation of the marine environment, including that of the international seabed area, but also on such matters as the operation of the consent regime for marine scientific research, (…), the duties of conservation and management of the living resources of the high seas, the sustainable development of the living resources of the high seas and the sustainable development of living marine resources generally. The specific issue of access points to the need for the rational and orderly development of activities relating to the utilization of genetic resources derived from the deep seabed area *beyond the limits of national jurisdiction*." 9/ (emphasis added).

6. In recent years, increasing awareness of the rich biological diversity both of the high seas and that of the deep seabed beyond the limits of national jurisdiction and concerns regarding the threat posed to them by human activities have led to closer examination of the existing conservation and management arrangements for marine biodiversity beyond the limits of national jurisdiction and their adequacy. Developments within the past year include the discussions at the third meeting of the United Nations Open-ended Informal Consultative Process, held in April 2002, at which it was proposed that the General Assembly should invite the Food and Agriculture Organization (FAO), the International Hydrographic Organization (IHO), the International Maritime Organization (IMO), the Intergovernmental Oceanographic Commission (IOC), the International Seabed Authority, the Secretariat of the Convention on Biological Diversity, the United Nations Secretariat (Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs), United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) and, with the assistance of regional and sub-regional fisheries bodies and other organizations in regions and sub-regions where the fauna and flora of sea-mounts and certain other underwater features may be under threat, to consider urgently how to integrate and improve on a scientific basis the management of risks to such fauna and flora within the framework of the United Nations Convention on the Law of the Sea, and to make suggestions, for this purpose, on appropriate management action.

7. As regards the protection of ecosystems around deep-sea hydrothermal vents, it was proposed that the General Assembly should reiterate the importance of the ongoing elaboration by the International Seabed Authority, pursuant to Article 145 of the United Nations Convention on the Law of the Sea, of recommendations to ensure the effective protection of the marine environment from harmful effects that may arise from activities in the Area. It was further proposed that the General Assembly should invite FAO, IHO, IMO, IOC, ISA, the Secretariat of the Convention on Biological Diversity, the United Nations Secretariat (Division for Ocean Affairs and Law of the Sea, Office of Legal Affairs; and the Division for Sustainable Development, Department of Economic and Social Affairs), UNEP and WMO, to consider, with any other United Nations agencies or regional organizations that may be involved, what action, consistent with the United Nations Convention on the Law of the Sea, should be suggested to address

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7/ 1995 annual report by the Secretary General on oceans and the law of the sea (A/50/713).

8/ United Nations document SPLOS/6.

9/ A/51/645.

priority problems in the marine environment, in particular any highlighted by future global marine assessments.10/

8. Pursuant to the recommendations of the Consultative Process, the General Assembly at its fifty-seventh session encouraged relevant international organizations, including FAO, IHO, IMO, the International Seabed Authority, UNEP, WMO, the Secretariat of the Convention on Biological Diversity and the United Nations Secretariat (Division for Ocean Affairs and the Law of the Sea), with the assistance of regional and subregional fisheries organizations, to consider urgently ways to integrate and improve, on a scientific basis, the management of risks to marine biodiversity of seamounts and certain other underwater features within the framework of the Convention. 11/ The General Assembly also decided that one of the areas of focus of the Consultative Process at its fourth meeting should be "the protection of vulnerable marine ecosystems". 12/

9. Both the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity have been widely ratified or acceded to. As of 15 January 2003, 141 States, including the European Community, were parties to the United Nations Convention on the Law of the Sea. On the other hand, the Convention on Biological Diversity currently has 187 Parties. As stated in its preamble, the main objective of the United Nations Convention on the Law of the Sea is the establishment of a legal order for the seas and oceans of the world with a view to facilitating international communication and promoting the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment. The objectives of the Convention on Biological Diversity are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies. 13/

10. Because the concept was not used at the time of its adoption, the United Nations Convention on the Law of the Sea does not specifically refer to "marine genetic resources". Article 2 of the Convention on Biobgical Diversity defines "genetic resources" as genetic material of actual or potential value, and defines "genetic material" as any material of plant, animal, microbial or other origin containing functional units of heredity. In the same Article, in defining "biological diversity", the Convention on Biological Diversity mentions living organisms from all sources including, *inter alia,* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part.

11. The term "deep seabed" occurs neither in the United Nations Convention on the Law of the Sea nor in the Convention on Biological Diversity. The United Nations Convention on the Law of the Sea mainly addresses the jurisdiction of the coastal State over maritime spaces in terms of the distance-from-baseline criterion rather than the depth criterion. Although the term "deep seabed" can apply to maritime areas either within national jurisdiction or beyond national jurisdiction, because a legal regime for biological resources under national jurisdiction already exists, the present document uses the term "deep seabed" only to refer to the ocean floor beyond the limits of national jurisdiction.

12. Chapter II below provides an overview of the provisions of the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity and explores in what manner and to what extent they are applicable to the conservation and sustainable use of genetic resources on the deep seabed. Moreover, the study covers the aspects of scientific knowledge and economic value regarding genetic

10/ Report on the work of the United Nations Open-ended Informal Consultative Process established by the General Assembly in its resolution 54/33 in order to facilitate the annual review by the Assembly of developments in ocean affairs at its third meeting - A/57/80, paras. 20, 23 and 24.

11/ General Assembly resolution 57/141, para 56.

12/ Ibid., para 62.

13/ Article 1 of the Convention on Biological Diversity.

resources on the deep seabed. The study concludes in chapter III with an identification of gaps in the legal regime and a presentation of possible options for addressing these gaps and recent developments.

II. ANALYSIS OF THE PROVISIONS OF THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA AND THE CONVENTION ON BIOLOGICAL DIVERSITY RELEVANT TO THE CONSERVATION AND SUSTAINABLE USE OF GENETIC RESOURCES ON THE DEEP SEABED

A. General relationship between the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity

13. In its resolution 54/33, the General Assembly recalled that the United Nations Convention on the Law of the Sea sets out the legal framework within which all activities in the oceans and seas must be carried out, and with which these activities should be consistent. 14/ The United Nations Convention on the Law of the Sea thus applies to all activities carried out in the oceans and seas, including those relating to genetic resources on the deep seabed, whether within areas under national jurisdiction or beyond.

14. The Convention on Biological Diversity applies to components of biological diversity in areas within the limits of national jurisdiction of a Party; and to all processes and activities carried out under the jurisdiction or control of a Party within the area of its national jurisdiction or beyond the limits of national jurisdiction. 15/ The Convention on Biological Diversity requires its Contracting Parties to cooperate directly, or through competent international organizations, in respect of areas beyond national jurisdiction, for the conservation and sustainable use of biological diversity, 16/ including marine genetic resources.

15. Although the United Nations Convention on the Law of the Sea does not explicitly refer to the notion of sustainability, since the concept only became current after the adoption of the Convention, the text of article 119 in particular emphasizes the need to conserve natural resources while exploiting them, in order to ensure that populations of harvested and associated species are maintained at a continuously viable level. The Convention on Biological Diversity complements UNCLOS in explicitly providing for the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of the use of genetic resources.

16. The two instruments are mutually supportive in encouraging an ecosystem approach requiring the protection of marine habitats and marine resources. Part XII of the United Nations Convention on the Law of the Sea imposes a general obligation on all States to preserve and protect the marine environment everywhere from all sources of degradation, as well as a specific obligation to protect fragile ecosystems and habitats of endangered species and other forms of marine life. 17/

17. Article 311 of the United Nations Convention on the Law of the Sea and Article 22 of the Convention on Biological Diversity address the relationship between the two conventions. Article 311 provides that the United Nations Convention on the Law of the Sea shall not alter the rights and obligations of States Parties which arise from other agreements compatible with it and which do not affect the enjoyment by other States Parties of their rights or the performance of their obligations under it. 18/ The Convention on Biological Diversity establishes in Article 22 that its provisions do not affect the rights and obligations of the Contracting Parties deriving from any existing international agreements (such as the United Nations Convention on the Law of the Sea), except where the exercise of those rights

14/ General Assembly resolution 54/33 of 24 November 1999.

15/ Convention on Biological Diversity, Article 4.

16/ Ibid, Article 5.

17/ UNCLOS, Articles 192-196.

18/ UNCLOS, Article 311 (2).

and obligations would cause a serious damage or threat to biological diversity. With particular reference to the marine environment, Parties are required to implement the Convention on Biological Diversity consistently with the rights and obligations of States under the law of the sea. 19/

18. It results from those provisions that actions implemented under the Convention on Biological Diversity framework for the conservation and sustainable uses of biodiversity must be compatible with the provisions of the United Nations Convention on the Law of the Sea. However, since the Convention on Biological Diversity is an elaboration of some of the general principles of the United Nations Convention on the Law of the Sea, this requirement may easily be met. In this connection, Article 237, paragraph 1 of the United Nations Convention on the Law of the Sea provides that:

> "The provisions of this Part [i.e., Part XII, on protection of the marine environment] are without prejudice (…) to agreements which may be concluded in furtherance of the general principles set forth in this Convention."

B. Overview of the legal regime in the United Nations Convention on the Law of the Sea

19. The United Nations Convention on the Law of the Sea establishes a legal framework for all activities in the oceans. In setting out a complex and comprehensive set of rules governing these activities, it adopts both a spatial and a functional approach. It divides marine space into a number of zones divided both horizontally and vertically. Vertically, the sea is divided into the seabed or ocean floor and the superjacent water column. Horizontally, space is measured from baselines extending along the coast. Regular or normal baselines coincide with the low water mark along the coast, following its sinuousities. However, straight baselines may be used where the coast is deeply indented or fringed with islands. The sea area between the baseline and the coast is called "internal waters". Because the coastal State enjoys absolute sovereignty therein, no ship may enter without permission. Extending seawards from the baselines for up to 12 nautical miles is the territorial sea, where the coastal State also enjoys sovereignty, with the exception of a right to innocent passage by foreign ships. The coastal State has almost total control over activities within its territorial sea and certainly has the authority to prevent or control both marine scientific research and all economic activity therein. In the exclusive economic zone, which may extend up to 200 miles from the coast, coastal States enjoy sovereign rights over natural resources, both living and non living as well as jurisdiction for the protection of the marine environment and over marine scientific research. Although in most cases, the seabed beyond the territorial sea, termed "the continental shelf", is subsumed within the regime of the exclusive economic zone, where the physical shelf extends beyond the 200-mile limit, the rights of the coastal State over the mineral resources of the shelf and the living "sedentary species" attached to it will continue up to a limit set out in Article 76 of the Convention.

20. The water column beyond the exclusive economic zone or beyond the territorial sea where no exclusive economic zone has been declared is termed the "high seas". Beyond the limits of the continental shelf, the seabed below the waters of the high seas has been designated in the United Nations Convention on the Law of the Sea as "the Area". The present paper is concerned only with the seabed area beyond the limits of national jurisdiction and in particular to the biological resources of the Area, since there already exists a legal regime governing the resources of the seabed within the national jurisdiction of coastal states. The Area is sometimes referred to as the "deep seabed" because the ocean floor is usually deeper than that of the continental shelf. Furthermore, since the Conference of the Parties to the Convention on Biological Diversity requested a study on the "genetic resources of the deep seabed", this paper addresses only the biological resources attached to the ocean floor and not the free-swimming fish above, which fall within the regime of fisheries on the high seas, covered by Articles 116-119 of the Convention, as well as by the United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating

19/ Convention on Biological Diversity, Article 22 (2).

to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (the 1995 Fish Stocks Agreement) , where appropriate.

21. The United Nations Convention on the Law of the Sea does not specifically address marine genetic resources. However, since such resources are biological resources, the jurisdictional framework set forth in the United Nations Convention on the Law of the Sea that governs marine living resources applies to them. The Convention on Biological Diversity recognizes the legal regime provided for in the United Nations Convention on the Law of the Sea and has in accordance therewith established the rights and obligations of States in respect of marine genetic resources within areas under national jurisdiction. 20/ With respect to areas beyond the limits of national jurisdiction, both the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity, *inter alia*, recognize the importance of cooperation among States in respect of the conservation and sustainable use of living resources.

22. The United Nations Convention on the Law of the Sea grants coastal States sovereign rights for the purpose of exploring and exploiting their natural resources within areas under national jurisdiction and calls for cooperation with regard to the conservation and management of living resources beyond the limits of national jurisdiction. The legal regime for the exploration and exploitation of mineral resources on the seabed beyond the limits of national jurisdiction is established in Part XI of the United Nations Convention on the Law of the Sea and in the 1994 Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (the Part XI Agreement). The legal regime under the United Nations Convention on the Law of the Sea applicable to marine natural resources is outlined in section 1 below.

23. The United Nations Convention on the Law of the Sea distinguishes between two categories of activities in relation to marine resources on the seabed: marine scientific research and commercially oriented activities, including prospecting, exploration and exploitation. Although "bioprospecting", which has been defined as "the exploration of biodiversity for commercially valuable genetic and biochemical resources", 21/ is not expressly addressed in the United Nations Convention on the Law of the Sea, it may be compared with prospecting activities directed at mineral research, which are regulated by the Convention.

24. Because at present marine scientific research is the activity that most affects genetic resources on the deep seabed, section 2 below discusses the legal regime for marine scientific research as set out in the United Nations Convention on the Law of the Sea.

25. Close consideration will also be given in this section to such issues as the protection and preservation of the marine environment and the development and transfer of marine technology as they are relevant to the activities pertaining to the conservation and sustainable use of marine genetic resources. These issues will be dealt with in section 3 below.

1. Regime applicable to resources

26. Under the United Nations Convention on the Law of the Sea, the areas beyond the limits of national jurisdiction are the high seas and the international seabed area ("the Area"); those within national jurisdiction are internal waters, archipelagic waters, territorial sea, exclusive economic zone (EEZ) and continental shelf.

20/ Ibid., Article 15.

21/ See UNEP/CBD/COP/5/INF/7, para. 6.

(a) Maritime areas within national jurisdiction

27. Coastal States have sovereignty over their internal waters, archipelagic waters and territorial sea—which can extend up to a limit of 12 nautical miles measured from the baselines—as well as over the natural resources found therein, and may adopt laws and regulations relating to the conservation and sustainable use of such resources.

28. In the exclusive economic zone, which can extend up to a limit of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, the coastal State has sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone. 22/

29. The coastal State has the obligation to prevent over-exploitation of the living resources in its exclusive economic zone and to restore populations of over-exploited species at levels that can produce the maximum sustainable yield. 23/ The coastal State is also under an obligation to give access to the surplus of the living resources to other States through agreements or other arrangements. 24/ The rights and obligations of States to conserve and manage straddling fish stocks and highly migratory fish stocks 25/ have been further developed in the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (the 1995 United Nations Fish Stocks Agreement). In addition, the United Nations Convention on the Law of the Sea provides that the coastal State has the right and obligation to conserve and manage other marine living resources in its exclusive economic zone, including marine mammals 26/ and anadromous stocks. 27/

30. On the continental shelf, the outer limit of which can extend beyond 200 nautical miles, 28/ a coastal State has sovereign rights for the purpose of exploring and exploiting the natural resources consisting of the mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species. 29/ The rights of the coastal State in its continental shelf are exclusive in the sense that if it does not explore its continental shelf or exploit its natural resources, no other States may undertake these activities without the express consent of the coastal State. 30/

31. If a coastal State exploits the non-living resources of the extended continental shelf beyond 200 nautical miles, it is obliged to make payments or contributions in kind to States Parties to the United Nations Convention on the Law of the Sea, through the International Seabed Authority. 31/ However, this provision does not apply to the coastal State's exploitation of living organisms belonging to sedentary species on its extended continental shelf. On the other hand, the general provisions on the protection of the marine environment in Part XII do apply to such species.

22/ UNCLOS, Article 56.

23/ Ibid., Article 61(2) and (3).

24/ Ibid., Article 62(2).

25/ Ibid., Articles 63(2) and 64.

26/ Ibid., Article 65.

27/ Ibid., Article 66.

28/ Ibid., Article 76.

29/ Ibid., Article 77(4) defines sedentary species as living organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil. In order to distinguish between marine life covered by the regime of the high seas and that included in the regime of the deep seabed/Area, it might be pertinent to consider whether the characteristics of the genetic resources on the deep seabed are such that these resources are included in the definition of sedentary species

30/ Ibid., Article 77(2).

31/ Ibid., Article 82.

(b) Maritime areas beyond the limits of national jurisdiction

32. The United Nations Convention on the Law of the Sea establishes different regimes for resources found respectively in the two maritime areas beyond the limits of national jurisdiction, namely the high seas and the Area. The high seas are defined by the United Nations Convention on the Law of the Sea as all parts of the sea that are not included in the exclusive economic zone, in the territorial sea or in the internal waters of a State, or in the archipelagic waters of an archipelagic State. 32/ On the high seas, all States enjoy, *inter alia*, certain freedoms of the high seas, which include the freedom of fishing and of marine scientific research. However, these freedoms must be exercised with due regard for the interests of other States and also with due regard for the rights under the United Nations Convention on the Law of the Sea with respect to activities in the Area. 33/ Moreover, all activities on the high seas are regulated. Some, such as fishing and navigation, are governed by quite elaborate regimes.

33. On the high seas, all States enjoy freedom of fishing subject to their treaty obligations, the rights and duties, as well as the interests, of coastal States, 34/ and the obligation of all States to cooperate in the conservation and management of the living resources of the high seas. 35/ The duty of the relevant coastal States and States fishing on the high seas to cooperate in the conservation and management of straddling fish stocks and highly migratory fish stocks has been further developed in the 1995 United Nations Straddling Stocks Agreement.

34. The Area is defined by the United Nations Convention on the Law of the Sea as the seabed and ocean floor and the subsoil thereof, beyond the limits of national jurisdiction. The Area and its resources are the common heritage of mankind, the exploration and exploitation of which shall be carried out for the benefit of mankind as a whole, irrespective of the geographical location of States. 36/ Part XI of United Nations Convention on the Law of the Sea and the Part XI Agreement, provide the legal regime for the Area, in particular for activities relating to its mineral resources. For the purposes of Part XI, resources are "solid, liquid or gaseous mineral resources *in situ* in the Area at or beneath the seabed, including polymetallic nodules". 37/

35. The legal regime for the Area and its resources establishes that no State is allowed to claim or exercise sovereignty or sovereign rights over any part of the Area or its resources. 38/ All rights in the resources of the Area are vested in mankind as a whole, on whose behalf the International Seabed Authority shall act. 39/ The Area is to be used exclusively for peaceful purposes. 40/ Activities must be carried out for the benefit of mankind as a whole, irrespective of whether States are coastal or land-locked, and taking into particular consideration, *inter alia*, the requirements of developing States. 41/ The general conduct of States in relation to the Area shall be in conformity with the principles embodied in the Charter of the United Nations and other rules of international law in the interests of maintaining peace and security and promoting international cooperation and understanding. 42/

32/ Ibid., Article 86.
33/ Ibid., Article 87.
34/ Ibid., Article 116 (b).
35/ Ibid., Articles 117, 118 and 119.
36/ Ibid., preamble.
37/ Ibid., Article 133 (a).
38/ Ibid., Article 137 (1).
39/ Ibid., Article 137 (2).
40/ Ibid., Article 141.
41/ Ibid., Article 140 (1)
42/ Ibid., Article 138.

36. The United Nations Convention on the Law of the Sea requires the International Seabed Authority to provide for the equitable sharing of financial and other economic benefits derived from activities in the Area through any appropriate mechanism, on a non-discriminatory basis, in accordance with the rules, regulations and procedures recommended to this effect by its Council, taking into particular consideration, *inter alia*, the interests and needs of developing States. 43/

37. No specific provisions are in place for the sustainable use (including access and management) and conservation of the biodiversity of the Area, besides those regulating marine scientific research in the Area and the protection and preservation of the flora and fauna from activities relating to mineral resources in the Area (see the following sections).

2. Marine scientific research

(a) General principles

38. Marine scientific research must be conducted in conformity with the guiding principles set out in Part XIII of the United Nations Convention on the Law of the Sea. It must be conducted exclusively for peaceful purposes and with appropriate scientific methods and means compatible with the Convention. States and competent international organizations are required to promote international cooperation in marine scientific research for peaceful purposes, including the flow of scientific data and information and the transfer of technology resulting from marine scientific research, especially to developing States. 44/ Article 240 of the Convention requires that marine scientific research must not unjustifiably interfere with other legitimate uses of the sea compatible with the United Nations Convention on the Law of the Sea and must be in compliance with all relevant regulations adopted in conformity with the Convention, including those for the protection and preservation of the marine environment. Moreover, the Convention reminds States and competent international organizations of their responsibility and liability for measures taken in contravention of the Convention and for damage caused by pollution of the marine environment arising out of marine scientific research undertaken by them or on their behalf. 45/

39. Thus, marine scientific research activities are characterized by their transparency and openness, the obligation to disseminate information and data obtained therefrom, as well as the subsequent publication of results of the research. 46/ Marine scientific research has, therefore, to be distinguished from other investigative marine activities with any kind of commercial component, such as prospecting, exploration, or fish stock assessment, which may involve confidentiality or proprietary rights. Under the United Nations Convention on the Law of the Sea, marine scientific research is primarily aimed at furthering mankind's knowledge of the marine environment, its resources and various phenomena, and is not a vehicle for searching for natural resources for commercial purposes. In this connection, the Convention provides that marine scientific research activities "shall not constitute the legal basis for any claim to any part of the marine environment or its resources". 47/

40. A second important feature to be noted about marine scientific research activities is that they can pose a threat to the marine environment. Therefore marine scientific research activities must be regulated or controlled so that they do not cause damage to the marine environment and/or marine resources.

43/ Ibid., Articles 140 (2) and 160 (2) (f) (i).

44/ Ibid., Articles 242, 243 and 244.

45/ Ibid., Article 263.

46/ Ibid., Article 244.

47/ Ibid., Article 241.

(b) Maritime areas within national jurisdiction

41. The United Nations Convention on the Law of the Sea provides that the coastal State has the right to regulate, authorize and conduct marine scientific research in the territorial sea, the exclusive economic zone and the continental shelf. Marine scientific research conducted by other States and international organizations in these maritime areas is subject to the consent of the coastal State. In the territorial sea, marine scientific research shall be conducted only with the express consent and under the conditions set forth by the coastal State. 48/ The coastal State is expected, in normal circumstances, to grant its consent for marine scientific research activities by other States or competent international organizations in its exclusive economic zone or on its continental shelf to be carried out exclusively for peaceful purposes and in order to increase scientific knowledge of the marine environment for the benefit of all mankind. States and competent international organizations that undertake marine scientific research in areas under the national jurisdiction of a coastal State have a duty to provide information to that coastal State and the duty to comply with conditions established by it. 49/

42. It is at the coastal State's discretion to withhold its consent in certain circumstances specified in UNCLOS, for example, if the research in the exclusive economic zone or on the continental shelf is of direct significance for the exploration and exploitation of natural resources, whether living or non-living. 50/ The coastal State may not exercise its discretion to withhold its consent in respect of marine scientific research projects on the continental shelf beyond 200 nautical miles, outside those specific areas, which the coastal State may at any time publicly designate as areas in which exploration and exploitation activities are being carried out or will be carried out within a reasonable period of time. 51/ Thus, the United Nations Convention on the Law of the Sea distinguishes between marine scientific research intended to increase scientific knowledge for the benefit of all mankind and marine scientific research of direct significance for the exploration and exploitation of natural resources, i.e., for private profit.

(c) Maritime areas beyond the limits of national jurisdiction

43. The United Nations Convention on the Law of the Sea provides that all States, irrespective of their geographical location, and competent international organizations are entitled to conduct marine scientific research in the water column beyond the limits of the exclusive economic zone. 52/ Marine scientific research constitutes one of the freedoms of the high seas recognized for all States by the Convention. 53/ However, such research is governed by the general principles outlined in Article 240 of UNCLOS, some of which are noted in paragraphs 38-40 above.

44. In the Area, all States and competent international organizations have the right to conduct marine scientific research, in conformity with the provisions of Part XI of the United Nations Convention on the Law of the Sea, 54/ which provides that marine scientific research concerning the Area and its resources shall be carried out exclusively for peaceful purposes and for the benefit of mankind as a whole. 55/ For this purpose, the United Nations Convention on the Law of the Sea requires the International Seabed Authority to promote and encourage the conduct of marine scientific research in the Area and to coordinate and disseminate the results of such research and analysis. The International Seabed Authority

48/ Ibid., Article 245
49/ Ibid., Articles 248 and 249.
50/ Ibid., Article 246.
51/ Ibid., Article 246 (6).
52/ Ibid., Article 257.
53/ Ibid., Article 87(1)(f).
54/ Ibid., Article 256.
55/ Ibid., Article 143 (1).

may carry out marine scientific research concerning the Area and its resources. 56/ The United Nations Convention on the Law of the Sea requires States Parties that conduct marine scientific research in the Area to, *inter alia*, develop programmes, including through the Authority or other international organizations, for the benefit of developing States and technologically less developed States, and also to effectively disseminate the results of their research and analysis when available, through the International Seabed Authority or as appropriate other international channels. 57/

3. The regime of marine scientific research and commercial activities

(a) Marine scientific research and bioprospecting

45. The foregoing analysis of the provisions of the United Nations Convention on the Law of the Sea demonstrates that the legal regime for marine scientific research is clearly established in the Convention. Consequently, marine scientific research relating to genetic resources falls within that regime. On the other hand, there appears to be a lacuna in the legal regime for the commercially-oriented activities, such as bioprospecting, relating to genetic resources of the deep seabed beyond national jurisdiction, including their conservation and sustainable use, because the regulation of such activities is not directly addressed.

46. It should be noted that the United Nations Convention on the Law of the Sea does not provide a definition of marine scientific research, or a definition of "commercially-oriented activities", in particular "prospecting". Indeed, the difficulties of distinguishing between the two categories of activities prompted the drafters of the Convention to include a specific provision that "States shall seek to promote through competent international organizations the establishment of general criteria and guidelines to assist States in ascertaining the nature and implications of marine scientific research". 58/ This would be particularly important in the case of genetic resources, since the distinction between marine scientific research and commercially oriented activities can be difficult to establish. 59/

47. In the absence of a formal definition, marine scientific research could be defined as an activity that involves collection and analysis of information, data or samples aimed at increasing mankind's knowledge of the environment, and is not undertaken with the intent of economic gain. Since the object is the enhancement of knowledge, marine scientific research is characterized by openness, dissemination of data, exchange of samples, as well as publication and dissemination of research results as provided for in Part XIII.

48. A definition of "prospecting" can be found in the International Seabed Authority's Regulations on Prospecting and Exploration for Polymetallic Nodules. 60/ Regulation 1 (3) (e) defines prospecting as the search for deposits of polymetallic nodules in the international seabed Area, including estimation of the composition, sizes and distributions of polymetallic nodule deposits and their economic values, without any exclusive rights. Although the definition applies specifically to mineral resources, in particular polymetallic nodules, a number of principles implied in the definition can be applicable in the case of marine genetic resources. Thus, it is understood that "prospecting", does not constitute marine scientific research and is considered to be an investigative activity undertaken, *inter alia*, for the estimation of the economic value of a resource, prior to its future commercial exploitation. Although it does not confer any rights on the resources, 61/ it is nonetheless believed that prospecting would allow the prospector to keep samples and data collected from such activity from the public.

56/ Ibid., Article 143 (2).

57/ Ibid., Article 143(3)(b) and (c).

58/ Ibid., Article 251.

59/ See Lyle Glowka, "Genetic Resources, Marine Scientific Research and the Area", Ocean Yearbook 12, ed. E.M. Borgese, N. Ginsburg, J.R. Morgan, The University of Chicago Press, 1996, p.173.

60/ ISBA/6/A/18, annex.

61/ UNCLOS, Annex III, Article 2 (2); Regulations, Regulation 2(a).

49. In a similar vein, bioprospecting has been identified with "the exploration of biodiversity for commercially valuable genetic and biochemical resources" and further defined as "the process of gathering information from the biosphere on the molecular composition of genetic resources *for the development of new commercial products*." (emphasis added). 62/ This corresponds with the general principles behind the definition of prospecting provided for in the International Seabed Authority Regulations. Due to the potential commercial value of collected samples and data, the results of bioprospecting activities may not be made freely available to the public. Indeed, such activities may involve confidentiality and proprietary rights.

50. To underscore the point, it has been indicated that, as far as marine genetic resources are concerned, the distinction between marine scientific research and other commercially oriented activities, such as bioprospecting, resides solely in the purposes and intent for which the activity is undertaken. It has been further pointed out that the situation had been compounded by the increasingly blurred distinction between the two types of activities when organisms collected from marine scientific research are passed on to the biotechnological industry to secure funding, although this may not be the primary objective of such research activity. 63/

51. Once the distinction has been made and an activity is identified as belonging to one or the other category, certain legal implications ensue. As noted above, the results of marine scientific research must be publicly disseminated, especially to developing States. Furthermore, the autonomous marine scientific research capabilities of developing States should be strengthened through, *inter alia*, programmes to provide adequate education and training of their technical and scientific personnel. The legal regime for marine scientific research relating to genetic resources on the deep seabed is established in Parts XI and XIII of the United Nations Convention on the Law of the Sea.

(b) Legal regime applicable to marine scientific research relating to genetic resources in maritime areas beyond the limits of national jurisdiction

52. Marine scientific research in the Area is regulated by the provisions of Parts XI and XIII of the United Nations Convention on the Law of the Sea, which recognize the rights of all States and competent international organizations to conduct marine scientific research in the Area, subject to the principles of the "common heritage of mankind" and "for the benefit of mankind as a whole", including dissemination of the results of the research and analysis, as well as consideration of the requirements of developing States and technologically less developed States. Such marine scientific research may bring to the international community a better understanding of, for example, the ecological relationships among hydrothermal vent communities, the evolutionary relationship of hyperthermophilic bacteria with other organisms, the adaptation of such organisms to the extreme conditions of deep seabed environment, and in general, the clues they may offer about the evolution of life itself. 64/

53. The results of marine scientific research on the high seas and the Area are neither subject to proprietary rights nor confidentiality and should be made widely available to the general public. In this connection, the role of competent international organizations in the dissemination of information, and with specific reference to the Area, that of the International Seabed Authority, should be considered. Furthermore, it is important to bear in mind that, should the results of the research be used at any stage for commercial gains, the regime of marine scientific research would no longer apply and therefore such a research would be deemed to have been a commercially-oriented activity, such as bioprospecting.

54. Marine scientific research activities themselves can affect the marine environment. With regard to damage to the marine environment and/or the resources of the high seas or the Area from marine

62/ UNEP/CBD/COP/5/INF/7, para.6.

63/ Lyle Glowka, *supra* footnote 66, at p. 173

64/ See generally L. Glowka, *supra* footnote 66.

scientific research activities, Part XIII of the United Nations Convention on the Law of the Sea provides that States and competent international organizations have a duty to protect and preserve the marine environment and are responsible and liable, pursuant to the relevant provisions of the Convention, for damage caused by pollution of the marine environment arising out of marine scientific research undertaken by them or on their behalf. 65/ A study on the effects of marine scientific research activities on the marine environment and genetic resources in particular, may be useful in assessing whether there is a need for more specific regulation of the conduct of marine scientific research and/or a possible monitoring role for relevant international organizations.

4. Other relevant provisions

(a) The protection and preservation of the marine environment

(i) General principles

55. The United Nations Convention on the Law of the Sea imposes on all States a general obligation to protect and preserve the marine environment in all maritime zones, 66/ and requires them, *inter alia*, to take measures to prevent, reduce and control pollution of the marine environment, including "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". 67/ States are also required to avoid the use of technologies, or the intentional or accidental introduction of alien species to a particular part of the environment, which may cause harmful changes thereto. 68/

56. In addition, States are required to exercise their prescriptive and enforcement jurisdictions to prevent, reduce and control pollution from all sources. 69/ They are also to cooperate on a global and, as appropriate, on a regional basis, in the formulation of international rules, standards, recommended practices for the protection and preservation of the marine environment. 70/ They must monitor the risks or effects of pollution of any activities conducted under their control, as well as assess the potential effects of planned activities on the marine environment. 71/ In this regard, Article 206 provides that when States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause significant and harmful change to the marine environment, they are required to carry out an assessment of the potential effects on the marine environment of such activities and report on the results. Moreover, States are required to provide scientific and technical assistance to developing States to enhance their capabilities to protect and preserve the marine environment. 72/

(ii) Maritime areas within national jurisdiction

57. With respect to the protection and preservation of the marine environment in areas under national jurisdiction, the United Nations Convention on the Law of the Sea grants to the coastal State jurisdiction over the protection and preservation of the marine environment in its exclusive economic zone, 73/ and to this effect it shall take all measures necessary to ensure that activities under its jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment, and that pollution

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65/ UNCLOS, Article 192.

66/ UNCLOS, Article 192.

67/ Ibid., Article 194 (5).

68/ Ibid., Article 196.

69/ Ibid., Articles 194 (1), 207 (1), 208 (1), 209 (2), 210 (1), 211 (2) (3) (4), 212 (1) and section 6 of Part XII generally on "Enforcement".

70/ Ibid., Articles 207 (4), 208 (5), 209 (1), 210 (4), 211 (1), 212 (3).

71/ Ibid., Articles 204, 205, 206.

72/ Ibid., Articles 202 and 203.

73/ Ibid., Article 56 (1) (b) (iii).

arising from incidents or activities under its jurisdiction or control does not spread beyond the areas where it exercises sovereign rights. 74/

(iii) Maritime areas beyond the limits of national jurisdiction

58. With particular reference to the Area, the United Nations Convention on the Law of the Sea imposes upon the International Seabed Authority the duty to take the necessary measures in respect of activities in the Area to provide effective protection for the marine environment from activities that may have harmful effects, including interference with the ecological balance of the marine environment. Such measures shall, *inter alia*, be aimed at protecting and conserving the natural resources of the Area, as well as at preventing damage to the flora and fauna of the marine environment. 75/

59. A substantial proportion of the regulatory responsibility of the Authority relates to the protection and preservation of the marine environment. The mandate for the Authority's work in this field is established both by the United Nations Convention on the Law of the Sea, which stipulates that the Authority shall adopt appropriate rules, regulations and procedures to ensure the effective protection for the marine environment 76/ and by the Authority's Regulations for Prospecting and Exploration for Polymetallic Nodules in the Area, which also require the adoption of rules, regulations and procedures for environmental protection. 77/

60. In Article 145, the United Nations Convention on the Law of the Sea requires the Authority to adopt appropriate rules regulations and procedures for: (i) the prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment; and (ii) the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment. Moreover, Annex III, 78/ provides that the Authority shall adopt and uniformly apply rules, regulations and procedures on mining standards and practices, including those relating to the conservation of resources and the protection of the marine environment, 79/ and that such rules, regulations and procedures shall secure effective protection of the marine environment from harmful effects directly resulting from activities in the Area or from shipboard processing immediately above a mine site. The Part XI Agreement reconfirms these duties. 80/ The Authority's Regulations provide that further rules, regulations and procedures, in particular on the protection and preservation of the marine environment may be adopted to supplement and periodically review the existing ones. 81/

61. The Council of the International Seabed Authority, on the recommendation of the Legal and Technical Commission 82/ has the power to: (i) disapprove areas for exploitation by contractors or the Enterprise in cases where substantial evidence indicates the risk of serious harm to the marine environment; 83/ and (ii) 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. 84/ The Legal and Technical Commission is also required to formulate and submit to the

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74/ Ibid., Article 194 (2).

75/ Ibid., Article 145.

76/ Ibid.

77/ Regulations for Prospecting and Exploration for Polymetallic Nodules in the Area, ISBA/6/A/18, 13 July 2000.

78/ Article 17 (1)(b)(xii).

79/ Annex III, article 17 (2)(f).

80/ Part XI Agreement, Annex, section 1, para 5(g).

81/ Regulation 1(5) and 31 (1).

82/ Article 165 (2)(l) and (k).

83/ Article 162 (2)(x).

84/ Article 162 (2)(w).

Council rules, regulations and procedures, taking into account all relevant factors including assessments of the environmental implications of activities in the Area, as well as keep such rules, regulations and procedures under review and recommend to the Council from time to time amendments, if necessary. 85/

62. Under the International Seabed Authority Regulations for Prospecting and Exploration for Polymetallic Nodules in the Area, it is further specified that prospecting cannot be undertaken, if substantial evidence indicates the risk of serious harm to the marine environment; nor may there be prospecting in an area which the Council has disapproved for exploitation because of the risk of serious harm to the marine environment. 86/ Regulation 31 provides that in order to ensure effective protection for the marine environment from harmful effects which may arise from activities in the Area, the Authority and sponsoring States shall apply a precautionary approach, as reflected in principle 15 of the Rio Declaration, to such activities. The Legal and Technical Commission is requested to make recommendations to the Council on the implementation of this paragraph. Furthermore, Regulation 31 sets out rules for contractors to discharge their duty to take necessary measures to prevent, reduce and control pollution and other hazards to the marine environment arising from their activities in the Area. In particular, if a Contractor applies for exploitation rights, it is required to propose areas to be set aside and used exclusively as "impact reference zones" (defined as areas to be used for assessing the effect of each contractor's activities in the Area on the marine environment and which are representative of the environmental characteristics of the Area) and "preservation reference zones" (defined as areas in which no mining shall occur to ensure representative and stable biota of the seabed in order to assess any changes in the flora and fauna of the marine environment).

63. While the Regulations adopted by the International Seabed Authority apply exclusively to the prospecting and exploration for polymetallic nodules, the Authority has now initiated work on draft regulations for prospecting and exploitation for polymetallic sulphides and cobalt-rich ferromanganese crusts in the Area. 87/ This work will have an impact on some of the most biodiversity-rich ecosystems of the Area.

64. The international rules, regulations and procedures applicable to the Area, for the purposes of mitigating pollution from seabed activities, which the International Seabed Authority is required by the United Nations Convention on the Law of the Sea to establish, represent the minimum standards which States are required by the Convention to incorporate when adopting national laws and regulations to prevent, reduce and control pollution of the marine environment from activities undertaken by vessels, installations, structures and other devices flying their flag or of their registry in the Area. 88/

(b) Development and transfer of marine technology

(i) General principles

65. Part XIV of the United Nations Convention on the Law of the Sea establishes the general principle by which States are required to cooperate, either directly or through competent international organizations, with a view to promoting the development and transfer of marine science and marine technology on fair and reasonable terms and conditions, particularly for the benefit of developing States, which may need and request technical assistance in this field, with regard to the exploration, exploitation, conservation and management of marine resources, the protection and preservation of the marine environment, marine scientific research and other activities in the marine environment. In promoting cooperation in the development and transfer of marine technology, States shall have due regard for all

85/ Article 165 (2)(f) and (g).

86/ Regulation 2(2).

87/ ISBA/8/A/5.

88/ Ibid., Article 209.

legitimate interests, including, *inter alia*, the rights and duties of the holders, suppliers and recipients of marine technology. 89/

66. The United Nations Convention on the Law of the Sea also encourages States to establish national and regional marine scientific and technological centres, particularly in developing coastal States, and to strengthen existing ones, in order to advance the conduct of marine scientific research in these States and enhance their national capabilities to utilize and preserve their marine resources for their economic benefit. 90/ Such regional centres are to provide training and educational programmes on various aspects of marine scientific and technological research, particularly marine biology, including conservation and management of living resources, etc. 91/

(ii) Maritime areas beyond the limits of national jurisdiction

67. With particular reference to the Area, the United Nations Convention on the Law of the Sea requires the International Seabed Authority to acquire technology and scientific knowledge relating to activities in the Area and to encourage their transfer to developing States and the Enterprise (the mining "arm" of the International Seabed Authority). 92/ Under the Part XI Agreement, 93/ seabed mining technology shall be acquired on "fair and reasonable commercial terms and conditions on the open market, or through joint-venture arrangements" and "consistent with the effective protection of intellectual property rights". 94/ States Parties are duty bound to promote international technical and scientific cooperation with regard to activities in the Area either between the parties concerned or by developing training, technical assistance and scientific cooperation programmes in marine science and technology and the protection and preservation of the marine environment. 95/

C. Overview of the provisions of the Convention on Biological Diversity

68. The Convention on Biological Diversity is the principal international legal framework concerning the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the utilization of genetic resources. It is the first international treaty to take a holistic, ecosystem-based approach to the conservation and sustainable use of biological diversity. The Convention is a framework instrument laying down broad goals, key objectives and general principles which are to be operationalized by Contracting Parties through concrete measures at the national level on the basis, *inter alia*, of guidance provided by the Conference of the Parties.

1. The jurisdictional scope of the Convention on Biological Diversity

69. The jurisdictional application of the Convention is defined in its Article 4. Its provisions make two important distinctions relevant to the current study. On the one hand, there is a clear distinction between "components of biological diversity" and "processes and activities" and, on the other, between areas within and beyond the limits of national jurisdiction. In areas within national jurisdiction, the substantive provisions of the Convention apply to: (i) components of biological diversity; and (ii) the processes and activities that can affect biological diversity. In both instances, a State has the jurisdictional authority to determine the legal rules applicable to resources found within its national

89/ Ibid., Articles 266 and 267.

90/ Ibid., Article 275(1).

91/ Ibid., Article 277.

92/ Ibid., Article 144.

93/ The Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (the Part XI Agreement) was drawn up primarily to address certain difficulties a number of States had in relation to the deep seabed mining provisions contained in Part XI and the related Annexes. The Agreement was adopted in 1994. The provisions of the Agreement and Part XI shall be interpreted and applied together as a single instrument.

94/ Part XI Agreement, Section 5(1)(a) and (b).

95/ Ibid., Section 5(1)(c).

territory and to regulate processes and activities whether undertaken by nationals or foreigners. These powers are an incident of the State's sovereignty over its territory. It follows, therefore, that the conservation and sustainable use of genetic resources in the deep seabed in maritime areas within national jurisdiction are subject to the same regulation regime applicable to genetic resources in the terrestrial ecosystems under national jurisdiction.

70. As regards areas beyond the limits of national jurisdiction, the provisions of the Convention only apply to processes and activities carried out under a Contracting Party's jurisdiction or control. In these areas, States have no territorial jurisdiction and, consequently, Contracting Parties may only regulate processes or activities under their jurisdiction or control that may have an impact on the components of biological diversity in these areas. For example, Parties could regulate the activities of their nationals in such areas. In effect, Parties have no obligation with respect to the conservation and sustainable use of specific components of biological diversity in areas beyond the limits of national jurisdiction.

71. The Convention, however, underlines the need for cooperation among Parties regarding issues pertaining to areas beyond national jurisdiction or other matters of mutual interest, for the conservation and sustainable use of biological diversity (Article 5). This cooperation can be undertaken either directly or through competent international organizations.

72. Given the limitations in the relevant provisions of the Convention, issues regarding the genetic resources of the deep seabed beyond the limits of national jurisdiction can only be addressed comprehensively through further cooperative initiatives amongst Parties and Governments. Of course, individual Parties may impose certain strictures on their nationals regarding the exploitation of genetic resources in these areas. However, such interventions would not represent a coordinated approach to the issue and do not constitute an effective response to the vast array of issues that need to be dealt with. The Convention on Biological Diversity nevertheless contains important principles and concepts that would be relevant in any international effort to address this problem.

2. Relevant principles of international law

73. Article 3 of the Convention on Biological Diversity, which embodies an important principle of international customary law, requires States to "ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction". This is a primary principle of contemporary international environmental law. It implies not only the duty to prevent damage, but also a precautionary approach to activities that might cause damage. These concepts are of particular relevance to the issue of conservation and sustainable use of genetic resources of the deep seabed beyond the limits of national jurisdiction.

74. The precautionary approach is contained in the preamble to the Convention on Biological Diversity and reiterated in decision IV/5 of the Conference of the Parties adopting a work programme for the conservation and sustainable use of marine and coastal biodiversity. 96/ In accordance with this approach, the lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize a threat of significant reduction or loss of biological diversity. The reduction or loss of deep seabed biological diversity may not be imminent in light of the technical and financial constraints attached to deep seabed operations and of the fact that small quantities of a material are enough for laboratory research and various uses across a wide range of activities.

96/ Decision IV/5, annex, para. 2.

75. However, there is a threat of such a loss in view of the difficulties and cost associated with the study of extremophiles in *ex situ* conditions 97/ and the possible loss of chemical and other unique natural properties when resources are cultivated outside their natural habitats. 98/ This means that for both scientific and commercial purposes, it may be necessary to investigate or to harvest certain organisms in their natural habitats. Where consortia/joint ventures are created for financial synergy, it has become more cost-effective to run *in situ* operations. Moreover, very little is known about the life cycle of deep seabed resources yet. Those organisms may have a very slow growth rate and low fecundity. In order to avoid the scenario observed in respect of high-seas fisheries, which are largely over-exploited, a precautionary approach would be advisable.

76. The second general principle of international environmental law, contained in the preamble to the Convention on Biological Diversity and further elaborated upon by Article 5, requires States to cooperate with regard to the global commons and their resources. The Convention on Biological Diversity states that Parties "shall, as far as possible and as appropriate, cooperate with other Contracting Parties, directly or, where appropriate, through competent international organizations, in respect of areas beyond national jurisdiction and on other matters of mutual interest, for the conservation and sustainable use of biological diversity". 99/ To date, the Conference of the Parties has not specifically addressed the importance of and the modalities for the implementation of this provision.

3. Conservation and sustainable use of deep seabed genetic resources

77. Conservation of biological diversity and sustainable use of its components are two inter-linked and mutually supportive objectives of the Convention on Biological Diversity. 100/ Ensuring the conservation and sustainable use of deep seabed genetic resources and their ecosystem is a necessary element of these objectives since genetic variability is essential to biodiversity.

78. Bearing in mind that the Convention does not directly address the conservation of deep seabed genetic resources in areas beyond the limits of national jurisdiction, but regulates processes and activities which may adversely impact the biodiversity of these areas, several tools in the Convention can be used to ensure indirectly the conservation of deep seabed ecosystems and the sustainable use of their genetic resources.

79. The Convention on Biological Diversity provides for both *in situ* and *ex situ* conservation of biological diversity. 101/ The exploitation of deep seabed genetic resources implies a succession of value-adding activities, from exploration through laboratory analysis to the eventual commercialization. The initial steps of exploration, sampling and analysis in the chain of those activities and processes is referred

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97/ *Ex situ* analysis requires the replication of extreme environmental conditions prevailing *in situ*. The Japan Marine Science and Technology Centre (JAMSTEC), tripartite consortium between the government, industry and academia, constructed automated surface facilities that reproduce a wide range of pressures, temperatures and pH for the manipulation of micro-organisms. They can currently retrieve and transport under pressure living micro-organisms from depths of 6500 metres, as well as cultivate and manipulate them under pressure. See L.Glowka, 1995, p.9.

98/ Preliminary studies, by scientists of the TBGRI, of the plant *Trichopus zeylanicus travancoricus*, one of the ingredients of the Indian herbal compound *Jeevani*, revealed that the specific chemical properties that give the plant its medicinal value are most pronounced when the plant is grown in its natural habitat, thereby suggesting that extraction for *ex situ* cultivation might run counter to the expected benefits.

99/ Convention on Biological Diversity, Article 5.

100/ Ibid., Article 1.

101/ Ibid., Art. 8 and 9.

to as bioprospecting. 102/ Some of those activities are carried out *in situ* while others, such as analysis and testing, which refer to the notion of use, are carried out in laboratories, i.e. in *ex situ* conditions.

(a) Direct regulation of deep seabed activities

80. The Convention on Biological Diversity requires Parties to "promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings". 103/ This objective can be achieved through the adoption of regulations for the conduct of activities with a potential impact on deep seabed genetic resources. This can translate into technical standards for the equipment used, planning expeditions to avoid an uncoordinated random collection, the requirement that collection of materials be carried out by trained individuals, or the definition of a maximum amount of material that can be collected without damaging biodiversity. Similarly, the Convention on Biological Diversity requires Parties to "regulate and manage collection of biological resources from natural habitats for *ex situ* conservation purposes so as not to threaten ecosystems and *in situ* populations of species (…)". 104/ To date, the Conference of the Parties has not addressed this provision, but it is assumed that technical standards, planning processes, or quotas would respond to the objective.

81. More importantly, however, the Convention on Biological Diversity requires Parties to "identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques". 105/ Parties to the Convention could therefore engage, on a cooperative basis, a process for the identification of activities and processes which may significantly adversely impact deep seabed ecosystems in order to establish whether such activities as exploration and extraction of deep seabed genetic resources should be regulated and managed. In this respect, major threats to hydrothermal vents have been identified as being intensive scientific sampling, bioprospecting, and potential ecotourism and mining. 106/ Of these, mining is already regulated by the International Seabed Authority.

82. The Convention further requires Parties to regulate or manage the relevant processes and categories of activities "where a significant adverse effect on biological diversity has been determined". 107/ This appears to suggest that management measures be only adopted in respect of activities for which a certainty of "significant adverse effect on biological diversity" has been established. In the absence of any comprehensive assessment and monitoring of deep seabed ecosystems so far, damaging effects of explorative and extractive activities can only be supposed at this stage. However, the precautionary approach, embedded in the preamble to the Convention, clearly requires the adoption of measures even in the absence of a certainty of significant adverse impact. Moreover, the Convention provides no practical definition or threshold of "significant adverse effect on biological diversity". It is

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102/ The term is neither defined nor even used in the Convention on Biological Diversity. The *Encyclopedia of biodiversity* (Academic Press, 2001, p.471) defines bioprospecting as the "systematic search for genes, natural compounds, designs, and whole organisms in wild life with a potential for product development by biological observation and biophysical, biochemical, and genetic methods, without disruption to nature". Fiji's draft sustainable development bill restricts bioprospecting to "any activity undertaken to harvest or exploit biological resources *for commercial purposes*…[including] investigative research and sampling" (emphasis added). The Philippines' Executive Order 247 is broader in defining bioprospecting as the "collection and utilization of biological and genetic resources for purposes of applying the knowledge derived therefrom to scientific and/or commercial purposes". UNCLOS refers to marine scientific research. The term alludes only to activities with a scientific purpose. The difference with bioprospecting seems to lie in the duty to make research data and results available for use by all, in the case of scientific research (Article 244), while there is a right to retain data and research results as proprietary when prospecting is involved.

103/ Convention on Biological Diversity, Article 8 (d).

104/ Ibid., Article 9 (d).

105/ Ibid., Article 7 (c).

106/ Kim Juniper, Paper presented at the Expert Workshop on managing risks to biodiversity and the environment on the high-seas, including tools such as marine protected areas, Isle of Vilm, 27 Februrary-4 March 2001.

107/ Convention on Biological Diversity, Article 8 (1).

assumed that both quantitative and qualitative aspects of an impact would have to be appreciated, as well as the short- and long-term effects.

83. States are also required to introduce environmental impact assessment (EIA) procedures for any project likely to have significant adverse effects with a view to avoiding or minimizing those effects, and to exchange information and consult on activities which are likely to significantly and adversely affect the biological diversity beyond the limits of national jurisdiction. 108/ In relation to activities carried out in respect of resources of the global commons, such as deep seabed genetic resources, Parties may have to develop international standards for the conduct of environmental impact assessment in order to ensure common approaches. Indeed, the Convention underlines the need to conclude multilateral arrangements in this regard.

84. The provision of the Convention on Biological Diversity regarding the prevention of introduction and control of alien species that threaten ecosystems, habitats or species is also relevant to the regulation of processes and activities carried out in the deep seabed. The prevention and eradication of alien species is one of the five thematic areas of the work programme on marine and coastal biodiversity. 109/ Special reference to the transboundary effects of alien species in the marine environment is made under operational objective 5.2. In the context of deep seabed genetic resources, it is not certain whether alien species have caused any harm as no assessment of the status of the deep seabed has yet been carried out. 110/ However, the risks of introduction associated with shipping, submarine and other prospective activities cannot be ignored.

(b) Indirect regulation of deep seabed activities: marine protected areas

85. To some extent, marine protected areas (MPAs) are a practical modality of the precautionary and preventive approaches. Marine protected areas are designed to protect what is assumed to be of significant value, even if clear impacts cannot yet be identified. 111/

86. Article 8, the core provision of the Convention on Biological Diversity relating to *in situ* conservation of biodiversity, provides, *inter alia*, for the establishment and management of "protected areas or areas where special measures need to be taken to conserve biological diversity". Protected areas are "geographically defined area[s] which [are] designated or regulated and managed to achieve specific conservation objectives". 112/ The work programme on marine and coastal biodiversity refers to marine and coastal protected areas (MCPAs) as one of its five thematic issues and areas for action. 113/ Under programme element 3, Parties are to facilitate research and monitoring activities related to the value and effects of marine and coastal protected areas or similarly restricted management areas, on the sustainable use of marine living resources. 114/ Criteria for the establishment of, and or management of marine and coastal protected areas should also be developed. 115/ Critical habitats for marine living resources are identified as being an important criteria. 116/

108/ Ibid., Article 14 (a) and (c).

109/ Programme element 5.

110/ As of 1995, only 100 vent systems had been visited and very few biologically sampled. See Glowka, 1995, p.20.

111/ A. Charlotte de Fontaubert, "The Status of Natural Resources on the High Seas – Part II: Legal and Political Considerations", WWF/IUCN/WCPA, 2001, p.86.

112/ Convention on Biological Diversity, Article 2.

113/ Programme element 3.

114/ Operational objective 3.1.

115/ Operational objective 3.2.

116/ Operational objective 3.2 (b).

87. Article 8 (a) of the Convention on Biological Diversity has to be interpreted in light of the ecosystem approach which has been elaborated by the Conference of the Parties in its Decision V/6. Under the Convention on Biological Diversity, an ecosystem "means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit". 117/ The ecosystem approach would seem to support the creation of marine protected areas that straddle both areas within and beyond the limits of national jurisdiction. The establishment and management of marine protected areas beyond the limits of national jurisdiction, within common areas such as the deep sea and its floor and subsoil, would require international cooperation as envisaged by Article 5 of the Convention.

88. The establishment of marine protected areas in international areas such as the high seas has been extremely controversial, mainly because of the perceived limitation to the freedom of the high seas stemming from restrictions on access to specific protected areas. It is also questionable whether marine protected areas would be appropriate for the high seas, due to the very different legal and factual situation, most importantly because there is no sovereign authority and all states would have to participate and to control their nationals, which has proven to be difficult to achieve in relation to shipping and fishing. Furthermore, unlike coastal areas, in the water column of the high seas, neither biodiversity nor activities affecting it are highly concentrated in one place for any length of time.

89. The term "protected area" encompasses a wide array of regimes, ranging from fully protected marine reserves where no human activities are allowed, to large zoned areas managed to accommodate sustainable uses. Even within the same protected area, different uses and levels of use can be organized. 118/ Marine protected areas in international areas should balance conservation objectives and restriction of uses. A State that complies with measures creating high-seas marine protected areas agrees to a restriction on its use of the high seas, when it could avoid doing so. It should be stressed that the freedom of the high seas is not absolute and is strictly limited in the United Nations Convention on the Law of the Sea itself, in particular in the obligation on all States to protect and preserve the marine environment (Article 192), as well as the obligation to take all necessary measures to ensure the protection and preservation of rare or fragile ecosystems and the habitat of depleted, threatened or endangered species and other forms of marine life (Article 194(5)).

90. However, marine protected areas should only be created where no other traditional measures could achieve the same goal. 119/ A general constraint associated with activities in the deep seabed, and therefore a limitation to the efficacy of high-seas marine protected areas, is the difficulty to monitor activities and enforce measures in the deep sea area. Moreover, marine protected areas as tools for the conservation and sustainable use of marine biodiversity are only effective if they form part of a multiple marine protected area system, complemented by management measures in surrounding areas, such as buffer zones, in order to achieve an integrated management. In the case of deep seabed genetic resources, environmental concerns may prompt a complete prohibition on access to the deep seabed area. However, a ban would be counterproductive in restricting scientific advancement or industrial and medicinal processes. A more realistic approach would be a regulatory regime that encompasses all the biological resources of the Area.

(c) General framework for sustainable use of deep seabed genetic resources

91. The Convention on Biological Diversity defines "sustainable use" as "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future

117/ Ibid., Article 2.

118/ The Great Barrier Reef Marine Park, in Australia, the largest marine and coastal protected area in the world, is divided in zones where various uses are allowed and regulated.

119/ See Fontaubert (2001 p.88) who refers to such measures as the United Nations General Assembly drift-net resolution.

generations". Although the United Nations Convention on the Law of the Sea does not refer to sustainable use, as the phrase became current some time after its adoption, it emphasizes throughout the need to conserve and manage the living resources of the sea so as to ensure that they are not endangered by over-exploitation. In the sections on fisheries in both the exclusive economic zone and the high seas, States are required to manage and conserve both harvested and associated and dependent species so that populations are maintained at or restored to levels at which their ability to reproduce is not threatened and so that harvested species produce the maximum sustainable yield. The objective of these principles is to ensure the sustainable use of the resources. 120/

92. The concept of sustainable use, with respect to genetic resources, has never been elaborated upon by the Parties to the Convention on Biological Diversity. Two elements need to be considered from the definition provided under the Convention: (i) the way in which the genetic resources are utilized; and (ii) the rate at which they are utilized. Those two elements are interdependent, the rate at which the resource is being utilized largely depending on the use to which it is put.

93. The issue of the way in which the resources are used raises questions as to whether only scientific activities should be authorized in regard to deep seabed genetic resources or whether commercial exploitation should also be allowed, especially if it threatens to destroy the resource. The rate at which the resources are exploited differs according to the type of activity, whether scientific or commercial. Thus, commercial exploitation may require larger quantities of resources in order to isolate a particular commercially useful chemical, 121/ all the more so, since, for example, cultivating extremophiles in *ex situ* conditions is difficult.

94. The Convention on Biological Diversity calls on Parties to "adopt measures relating to the use of biological resources to avoid or minimize adverse impacts on biological diversity". 122/ Some genetic manipulations may be banned as a result of their adverse impact on biodiversity. In view of the unique extremophilic properties of deep seabed organisms, this raises the issue of their use for genetically improved organisms. In light of the potential impacts on biodiversity resulting from a loss and uniformization of the genetic make-up of original organisms, such a use may be considered unsustainable. The uncertainties associated with the use of genetically modified organisms prompt the adoption of a precautionary approach and encourages the regulation of such uses.

95. Similarly, the Convention on Biological Diversity requires Parties "to provide the conditions needed for compatibility between present uses and the conservation of biological diversity and the sustainable use of its components". 123/ A good incentive for the sustainable use of a resource is to grant rights and responsibility over the resource to the user. As regards deep seabed genetic resources, this may include granting access and user rights or the creation of a *sui generis* system of intellectual property rights (IPRs) over recovered genetic resources. The system would have to take due account of the unique nature and economic value of such organisms. Intellectual property rights involve the granting of a monopoly to the right holder to control the use, production and dissemination of the innovation protected under the right. Under current intellectual-property-rights regimes, patent protection applies only to new non-obvious and useful inventions, whether processes or products. Natural organisms are not covered by patent regimes because they do not respond to the criteria of originality or novelty. However, plant varieties may be protected through *sui generis* systems such as those under the International Convention for the Protection of New Varieties of Plants. Under this system Plant Breeders' Rights are granted for varieties of plant, which are novel, distinct, uniform and stable. The question is then one of the degree of innovation represented by a new organism, and whether deep seabed genetic resources could fall under such a regime. Because intellectual property rights do not require the holder to share benefits, serious

120/ UNCLOS, Articles 61, 116-119.

121/ Farrier and Tucker, 2001, pp.218-219.

122/ Convention on Biological Diversity, Article 10 (b).

123/ Ibid., Article 8(i).

issues of equitable benefit sharing may arise with respect to the potentially valuable applications of deep seabed genetic resources by industry, the medical or chemical sector, or agriculture. An "innovator" could use intellectual property rights to limit the production and availability of innovations based on deep seabed genetic resources, in order to make profits or discourage the conduct of research for improvement of the innovation. 124/ It has to be stressed that any rights over the biological resource can be distinguished from the rights over the genetic material of the resource. 125/

96. Finally, the Convention calls on Parties to encourage cooperation between governmental authorities and the private sector in developing methods for the sustainable use of biological resources. Bioprospecting of deep seabed genetic resources is often only possible as a result of joint ventures/consortia between government, industry and academia. 126/ Parties could utilize such cooperative arrangements with the private sector to ensure sustainable use of such resources.

4. Fair and equitable sharing of benefits arising out of the use of deep seabed genetic resources

97. The third objective of the Convention is the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. 127/ One of the goals of benefit-sharing, beyond equity considerations and the reward of intellectual and financial contributions, is the creation of incentives for conserving and sustainably using biological diversity. Significantly, the United Nations Convention on the Law of the Sea also embodies the idea of equity in relation to the utilization of marine living resources, scientific research and the transfer of technology and the sharing of benefits from the deep seabed mining regime.

98. Benefit-sharing is particularly relevant concerning deep seabed genetic resources, which are not easily accessible to all States due to scientific and technological constraints but have great potential scientific and economic value. As legitimate as the protection of private data and proprietary interests through intellectual property rights may be, a balance needs to be struck between private benefits and benefits to humankind as a whole through the advancement of scientific knowledge. The grant of intellectual property rights may need to take into account and abide by the rules on marine scientific research in the Area for the benefit of humankind as a whole, 128/ especially in light of the close links between marine scientific research projects and commercial activities.

99. The forms and modalities of benefit sharing are varied and depend on the nature of the resources, their end use, the mechanism employed to guarantee benefit-sharing and the transaction costs involved. However, the Convention on Biological Diversity refers, *inter alia*, to appropriate access to the resources, appropriate transfer of relevant technologies and appropriate funding. 129/ Issues relating to benefit-sharing have been further elaborated in the Bonn Guidelines on Access and Benefit-sharing adopted by the Conference of the Parties at its sixth meeting. 130/

124/ S. Jonhston & F. Yamin, "Intellectual Property rights and Access to Genetic Resources", in *Access to genetic Resources – Strategies for Sharing of Benefits*, J.Mugab, C.V. Barber, G. Henne, L, Glowka, A. La Viña, Acts Press, Nairobi, 1997, p.248.

125/ In this respect, the Andean Pact Common Regime distinguishes, in Article 6, between the legal status of biological resources and genetic resources. While biological resources can be subject to private or collective ownership, genetic resources are inalienable and imprescriptible and cannot be seized, without prejudice to property regimes applicable to biological resources which contain them, the land on which they are found, or the associated intangible component.

126/ UNEP/CBD/SBSTTA/2/15.

127/ Convention on Biological Diversity, Article 1.

128/ UNCLOS, Article 143.

129/ See Convention on Biological Diversity, Article 1, 15, 16 and 19.

130/ Decision VI/24A.

100. The sharing of benefits arising from the exploitation of the genetic resources of the deep seabed beyond the limits of national jurisdiction can only be effected if such resources are brought under a regime similar to the one governing the mineral resources of the Area under UNCLOS. The principles embodied in the Convention on Biological Diversity may be useful in any attempt to deal with issues of equity regarding access to and the exploitation of such resources.

5. Scientific research and commercial uses

101. While marine scientific research is primarily undertaken with a view to furthering knowledge of the evolutionary relationship between various organisms or of the adaptive mechanisms allowing organisms to thrive in an extreme environment with unique characteristics, some prospective activities are run to discover commercially useful information and resources for subsequent industrial, chemical, agricultural or medical purposes. However, what may have been, in the first place, an expedition with scientific purposes, where intent of economic gain was absent, may result in the genetic resources being transferred to industry for biotechnological applications. 131/ This is sometimes explicitly required under the terms of some public research grants, the primary source of funding in respect of deep seabed research. 132/

102. The Convention on Biological Diversity does not draw any distinction between research for scientific purposes and prospection for commercial gain. It generally requires Parties to promote and encourage research which contributes to the conservation and the sustainable use of biological diversity 133/ and to promote and co-operate, in keeping with the provisions of Articles 16, 18 and 20, in the use of scientific advances in biological diversity research in developing methods for the conservation and sustainable use of biological resources. 134/

III. CONCLUSIONS AND RECOMMENDATIONS

A. Assessment of the current framework and its applicable legal principles

103. It is clear from the foregoing analysis that neither the United Nations Convention on the Law of the Sea nor the Convention on Biological Diversity provides a specific legal regime for commercially oriented activities relating to marine genetic resources on the high seas and in the Area. Because such activities have already begun, it would appear necessary to consider the development of a legal regime to regulate them. Arguments that could be advanced in support of the establishment of such a regime include the following: (i) importance of marine genetic resources to the international community is increasing; (ii) the rights and obligations of States regarding the conservation, sustainable use and benefit-sharing arising out of the utilization of genetic resources on the high seas and in the Area are not clearly defined; and (iii) States and their nationals currently engaged in, or those who may be interested in engaging in, commercially-oriented activities with regard to marine genetic resources may benefit from a regulatory framework which would clearly state their rights and duties in the utilization of the resources. Furthermore, such a regulatory framework could also assist in instilling confidence in current and potential investors in such commercially-oriented activities in that it could promote legal certainty and predictability, an important element in any commercial venture.

104. The objectives pursued by the international community both under the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity are similar. Both

131/ American academicians researching on deep seabed communities were contracted by a biotechnology company cloning and commercializing enzymes from organisms living in extreme environments. The case is not limited to United States-based companies. See Glowka, 1999, p.59.

132/ Glowka, 1995, p.18.

133/ Convention on Biological Diversity, Article 12 (b).

134/ Ibid., Article 12 (c).

instruments aim at the conservation of marine biodiversity. Both instruments attempt to ensure a sustainable use of its components. The Convention on Biological Diversity further aims at a fair and equitable sharing of the benefits arising out of the use of genetic resources, while the United Nations Convention on the Law of the Sea aims at an equitable sharing of benefits from mineral resources in the Area.

105. The question is whether those objectives can be effectively achieved concerning deep seabed genetic resources, which do not fall per se within the scope of either instruments, but the exploitation of which is relevant to both. As it stands, the conservation and sustainable use of these resources are regulated through a patchwork of measures focusing on activities and processes that may have adverse impact on the marine environment in general. In light of the unique character and value of deep seabed genetic resources, a regime dealing specifically with their conservation, sustainable use and the sharing of benefits arising out of their use would be more appropriate. Such a regime can only be elaborated once the status of deep seabed genetic resources is clearly defined.

106. To some extent, as a complement to the legal framework within which all activities in the oceans and seas must be carried out provided by the United Nations Convention on the Law of the Sea, the principles, concepts and measures contained in the Convention on Biological Diversity for the conservation and sustainable use of biological diversity as well as for benefit-sharing, provide a basis for the development of a regime for deep seabed genetic resources. In respect of benefit-sharing, the provisions of the Convention on Biological Diversity are far from being adequate, since they are based on a proprietary approach to resources found within national jurisdictions that is not applicable to common resources in areas beyond national jurisdiction.

107. However, a specific legal regime for the commercially-oriented activities relating to marine genetic resources beyond the limits of national jurisdiction would not be established in a vacuum, rather it would need to incorporate the legal principles already set out in the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity. The General Assembly has recognized the United Nations Convention on the Law of the Sea as the legal framework within which all activities in the oceans and seas must be carried out. Moreover, as indicated earlier, the Convention on Biological Diversity must be implemented consistently with the rights and obligations contained in the United Nations Convention on the Law of the Sea. In fact, the legal principles embodied in the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity are fundamentally compatible, and can and should constitute the basis upon which the legal regime governing commercially oriented activities pertaining to the genetic resources in marine areas beyond the limits of national jurisdiction can be built. Establishing such a regime and applying it alongside the regime for marine scientific research, would provide the ways and means for ensuring conservation and sustainable use of genetic resources on the deep seabed beyond national jurisdiction.

108. It should be noted that the United Nations Convention on the Law of the Sea provides the following principles in respect to activities relating to resources on the high seas and in the Area: (i) the prohibition of claims to sovereignty in any part of the high seas or the Area;135/ (ii) the highly regulated freedom of high seas (with due regard for the interests of other States in their exercise of the freedom of the high seas, the need to conserve marine living resources, the obligation to protect and preserve the marine environment, and the rights with respect to activities in the Area and within extensive sets of rules and regulations applicable to almost all activities therein, especially fishing); 136/ (iii) the obligation of States to conserve and to cooperate in the conservation of high seas marine living resources, 137/ as well as associated and dependent species; (iv) the designation of the Area and its resources as the common heritage of mankind not subject to national or individual appropriation; (v) the obligation to carry out

135/ UNCLOS, Articles 89 and 137.

136/ Ibid., Article 116 (b).

137/ Ibid., Articles 117, 118 and 119.

activities in the Area (including marine scientific research) benefit of humankind; 138/ (vi) the obligation of States to protect and preserve the marine environment on the high seas and in the Area 139/ and to cooperate in the formulation and elaboration of international rules, standards and recommended practices and procedures to this end; 140/ (vii) the promotion and transfer of marine technology; 141/ and (viii) the recognition of the particular needs of developing States with respect to all marine activities on the high seas and in the Area. 142/

109. It is worth noting that the regime for access and management of living resources under the United Nations Convention on the Law of the Sea provides for resources and related activities and uses that were current at the time of the negotiations, primarily fisheries and fishing activities for consumption. Such provisions are therefore based on the specific characteristics of such resources and activities, and take into account the historic development of the regime for fisheries. A more recent development is the understanding of the value of marine biodiversity and ecosystems and of the need to protect and manage them in a sustainable manner using new approaches and considerations. 143/ At the same time, the discovery of the scientific and economic value of benthic/deep-sea biodiversity, including its value as a pool of genetic resources, also poses interesting questions on how to ensure their conservation and sustainable use. While the United Nations Convention on the Law of the Sea establishes that in areas under national jurisdiction, the coastal States have sovereignty and sovereign rights over conservation and uses of marine resources, including marine genetic resources, in the deep seabed/Area there is no specific regime for the conservation and sustainable use of biodiversity, apart from the responsibility of the International Seabed Authority to protect the marine environment and the fauna and flora from mining activities. 144/

110. The regime for the management of the resources of the Area was negotiated on the basis of the knowledge available in the early 1970s, which was limited to an appreciation of the importance of the mineral resources of the Area, and in particular of polymetallic nodules. Recent developments have demonstrated that other types of mineral resources might become the object of commercial activities. In fact the International Seabed Authority is currently working, pursuant to a request by the Russian Federation made in 1998, on draft regulations for prospecting and exploration for polymetallic sulphides and cobalt-rich ferromanganese crusts in the Area. 145/ As this study explains, new discoveries on natural resources of the deep seabed are not limited to minerals. The knowledge and understanding of the deep seabed ecosystems and biodiversity is increasing dramatically and in fact the biodiversity on the deep seabed is becoming the focus of both scientific research and bioprospecting. Attention needs to be addressed both to these activities and to the relative impacts to which such biodiversity might be indirectly exposed, such as prospecting, exploration and exploitation of mineral resources and activities directly relating to it, such as scientific research and bioprospecting.

111. While the International Seabed Authority has a clear mandate to deal with the impact of mining on biodiversity and the rules are clear in relation to marine scientific research in the Area, it is not clear what legal regime applies to bioprospecting for genetic resources in the Area. What is certain, however, is that the Area and the resources of the Area whose existence and value was known by the negotiators of

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138/ Ibid., Article 140.

139/ Ibid., Articles 145 and 194 (2).

140/ Ibid., Article 197.

141/ Ibid., Part XIV.

142/ Ibid., Articles 119(1) (a); 140(1)); 143(3) (b); 144(1)(b), (2) (a) and (b); 148; 202; 203; 244(2); the 1994 Agreement relating to the Implementation of Part XI, Annex, Sect.1(5) (e); Sect.3(15)(c) and (d); Sect.5(1)(b); and Sect. 7.

143/ For example, the debate on the need for an ecosystem approach; debate on the need for networks of marine protected areas both in coastal areas and on the high seas – see the report of the Consultative Process A/57/80; the Plan of Implementation of WSSD A/CONF.199/CRP.7, General Assembly Resolution A/RES/57/141).

144/ UNCLOS, Article 145.

145/ Report of the Secretary-General of the ISA, ISBA/8/A/5.

the United Nations Convention on the Law of the Sea are the common heritage of mankind (Article 136). Particular attention should also be paid to the fact that all these activities carried out in the Area may interfere with each other, since mineral and genetic resources may coexist in the same sites (e.g. polymetallic sulphides and thermophiles associated with the same hydrothermal vents). Furthermore, the biological resources at hydrothermal vents depend upon the sulphides for their sustenance.

112. As explained by the Authority:

> "The hydrothermal vents concentrate polymetallic sulphide deposits and disperse metals into the oceans that contribute to the accumulation of cobalt-rich ferromanganese crusts, but also provide chemical energy from the earth's interior that is used by the genetic resources for their growth. These genetic resources are at the base of the food chain of an ecosystem of life forms at the hydrothermal vents that is largely independent of the light energy that fuels the photosynthesis in plants at the base of the food chain on land. A current challenge is to incorporate these new mineral resources into the Convention regime in a way that protects the valuable life forms that they host. It is not currently possible to predict how rapidly vent sites may recover from mining operations – hence the importance of international collaboration in environmental research."146/

B. Options for a status of deep seabed genetic resources

113. Three options are available to the international community with regard to genetic resources of the deep seabed beyond the limits of national jurisdiction.

1. Maintaining the status quo

114. Leaving deep seabed genetic resources unregulated and freely available to those that have the resources to collect and exploit them, as is currently the case, would provide an incentive for investment and exploitation of valuable resources. However, deep seabed genetic resources would be constantly under threat of over-exploitation, as is the case with the present regime for the living resources of the high seas, and there would be no guarantee that the benefits arising out of their exploitation will be shared on a fair and equitable basis amongst all States. Such a free-for-all would not only to contrary to the regulatory intent of the United Nations Convention on the Law of the Sea as a whole, it would also run counter to the specific regime of the Area, which was designed to carefully regulate and protect seabed resources designated as the common heritage of mankind. 147/ Therefore, it is suggested that a precautionary and equity-based approach could be adopted and a specific regime established.

2. Use of the regime of the Area and its resources under the United Nations Convention on the Law of the Sea

115. Using the regime provided for the Area and its mineral resources under the United Nations Convention on the Law of the Sea and the 1994 Agreement would entail the application of the common heritage of mankind principle to deep seabed genetic resources. Under the United Nations Convention on the Law of the Sea, the common heritage of mankind concept was limited to the Area, defined as the seabed and ocean floor and subsoil thereof beyond the limits of national jurisdiction, 148/ and to its resources restricted to "all solid, liquid or gaseous mineral resources *in situ* in the Area at or beneath the

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146/ Contribution of the International Seabed Authority to the Report of the Secretary General on Oceans and the Law of the Sea to the 58th Session of the United Nations General Assembly.

147/ Furthermore, it should be recalled that maintaining the status quo also means implementing the regime for marine scientific research in the Area and the requirement that marine scientific research in the Area is carried out for the benefit of humankind as a whole.

148/ Ibid., Article 1.

seabed". 149/ The regime was limited to mineral resources only because at the time the Convention was negotiated, the biological resources of the deep seabed were largely unknown. The general view in the 1970s was that the seabed was a vast desert covered only by a scattering of polymetallic nodules. Hydrothermal vents were discovered in 1977, but it was some years before they were intensively investigated and their potential resource value fully appreciated. It is possible, that had more been known about deep seabed biological resources during the negotiation of the Convention, those resources would have been included in the international regime.

116. Using the common heritage of mankind established under the regime for the Area has certain specific advantages for addressing issues of uncontrolled exploitation and benefit-sharing. This is mainly because the common-heritage-of-mankind principle embodies four important concepts: non-appropriation, international management, peaceful use and benefit-sharing.

(a) Non-appropriation

117. The first principle relating to a common-heritage area is that no State or any other public or private entity can claim any exclusive rights or appropriate the resource, Area or part of the Area 150/ endowed with common-heritage-of-mankind status. 151/ Use and exploitation are the only allowed activities. A compelling argument to apply non-appropriation to deep seabed genetic resources lies in the fact that genetic resources are the essence of biological diversity since they contain functional units of heredity. In this respect, while the physical entity may fall within private ownership once extracted (like a fish from the high seas is owned by the person that fished it), the information contained in the resource may remain common heritage of humankind and therefore be inalienable. 152/

(b) International management

118. The second principle is that the area or resource endowed with the common heritage of mankind status is jointly managed by the international community as a whole, through an international authority or body, such as the International Seabed Authority for mineral resources of the Area. Bringing genetic resources within such a regime would allow an integrated management of the Area, enabling the International Seabed Authority to manage both the biological and the mineral resources in a comprehensive coherent manner. This is especially important as some of the mineral and biological resource co-exist and depend upon each other and as the biological resources may be damaged or even destroyed by mining and or bioprospecting. It would be strange indeed if the biological/genetic resources were protected against damage caused by mining but not against damage caused by marine scientific research or by bioprospecting. Further, it would appear to be reasonable to have the same body managing all the resources and activities that could affect them directly or indirectly so as to prevent any interference or even conflict.

(c) Peaceful use

119. A common-heritage-of-mankind area or resource is to be used for peaceful purposes only. Military activities are prohibited by the United Nations Convention on the Law of the Sea in respect of

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149/ Ibid., Article 133.

150/ Article 137 of UNCLOS states that "All rights in the resources of the Area are vested in mankind as a whole"

151./ Article 137 of UNCLOS provides that no State shall claim or exercise sovereignty or sovereign rights over any part of the Area or its resources, nor shall any State or natural or juridical person appropriate any part thereof. All rights in the resources of the Area are vested in mankind as a whole, on whose behalf the Authority shall act.

152/ For example, the Andean Pact Common Regime, in its article 6, distinguishes between the legal status of biological resources and genetic resources. While biological resources fall under private or collective ownership, the genetic resources are said to be inalienable and imprescriptible and cannot be seized. This is without prejudice to property regimes applicable to biological resources, which contain them, the land on which they are found, or the associated intangible component.

the Area. 153/ As this principle aims at preventing both armed conflict and the placement of weapons on the deep seabed, it is not relevant to the sustainable use of genetic resources, except to ensure that they are not destroyed by military activities.

(d) Sharing of benefits

120. All activities undertaken with respect to a common heritage of mankind resource or area are to be carried out in the interest and for the benefit of humankind. The United Nations Convention on the Law of the Sea provides for the sharing of benefits derived from activities carried out in the Area. This covers both financial benefits arising out of deep seabed mining and other benefits derived from the exploitation such as transfer of technology and capacity-building, taking into particular consideration the interests and needs of developing States. The Authority is to provide for the equitable sharing of financial and other economic benefit through any appropriate mechanism. The 1994 Agreement incorporates a change in approach, under which transfer of technology is to be undertaken according to "sound commercial principles". The free availability of the information data and research results gathered is limited by the protection of intellectual property rights.

121. The principle of benefit-sharing and management for the benefit of humankind is particularly relevant for deep seabed genetic resources in two respects: the numerous valuable applications of such resources and the financial and technical discrepancies existing between countries, especially the inadequate financial and technical resources that prevent developing countries from exploiting these resources on equal terms with wealthier and more industrialized States.

133. Overall, the inclusion of deep seabed genetic resources within the regime dealing with the Area and its resources would respond to the ideas of benefit-sharing and permanent management. However, in light of the differences between mineral and biological resources, one might consider using the regime as a model rather than copying the United Nations Convention on the Law of the Sea exactly.

122. Making use of the International Seabed Authority would be advantageous in two respects. The institution is already operational and has already a mandate relating to the protection and preservation of the Area's marine environment. Moreover, enlarging the institution's scope to include genetic resources would allow an integrated management of the Area, as called for under the Jakarta Mandate in respect of marine and coastal biodiversity. The institution may be granted responsibility to manage deep seabed genetic resources through modalities defined by the Parties to the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea, such as marine protected areas, or a licensing system for extraction and exploitation. It could also monitor activities undertaken, and act as a clearing-house for international cooperation in deep seabed scientific research through dissemination of data and research results. The mechanisms of operation and the principles according to which it is to operate would need to be clearly defined 154/ in order to accommodate all Parties to the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea, some of which may be Parties to one but not to the other.

123. Enlarging the mandate of the International Seabed Authority would require amending the United Nations Convention on the Law of the Sea, the procedure for which is set out in Article 312 of the Convention. However, the same end might be achieved by adopting a protocol or an implementing agreement to add management of the biological resources of the Area to the mandate of the International Seabed Authority. A possible alternative could be for a meeting of the States Parties to adopt an "agreed interpretation" of the Convention stating that "resources" shall be read as including biological resources, with all the necessary consequential amendments.

153/ UNCLOS, Article 141.

154/ See the International Ocean Institute proposal, June 2001.

3. Use of the framework under the Convention on Biological Diversity

124. Bringing genetic resources of the deep seabed beyond the limits of national jurisdiction within the framework of the Convention on Biological Diversity, which, it should be recalled, has to comply with the United Nations Convention on the Law of the Sea, would provide a number of tools to ensure the conservation and sustainable use of the resources not specifically envisaged under the United Nations Convention on the Law of the Sea.

125. However, due to the national approach adopted under the Convention on Biological Diversity, the idea of continuous common management of the resource would need to be appropriately dealt with through the creation of a specialized body.

126. Procedurally, amending the Convention on Biological Diversity would be easier than in the case of the United Nations Convention on the Law of the Sea (adoption by the Conference of the Parties by consensus or a two thirds majority, entry into force on the ninetieth day after deposit of instruments of ratification by two thirds of the Parties).

C. Concluding remarks

127. Given the unique characteristics and habitats of marine genetic resources on the deep seabed beyond the limits of national jurisdiction, 155/ it would be appropriate to adopt an ecosystem approach in elaborating a regime for their conservation and sustainable use. In the identification of possible elements to be considered when establishing a regime for the regulation of commercially-oriented activities relating to such marine genetic resources the following features of both the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity would need to be borne in mind: (i) the United Nations Convention on the Law of the Sea already provides the legal principles governing the prospecting, exploration and exploitation of mineral resources in the Area; (ii) the regime for the Area requires the sharing of benefits from the utilization of mineral resources as well as the sharing of the results of marine scientific research; (iii) the International Seabed Authority is the institutional mechanism of the United Nations Convention on the Law of the Sea entrusted with the management of activities, including the equitable sharing of benefits, in the Area; (iv) the United Nations Convention on the Law of the Sea provides the legal framework for the protection and preservation of the marine environment on the high seas and in the Area; 156/ (v) the Convention on Biological Diversity contains a number of principles and concepts that could serve as useful tools for the conservation and sustainable use of genetic resources of the deep seabed; and (vi) the Convention on Biological Diversity has, as one of its main objectives, the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

128. The foregoing analysis suggests that there are three available options for a regime for the management of activities relating to genetic resources beyond the limits of national jurisdiction, including bioprospecting:

(a) Maintaining the status quo;

(b) Application of the regime under Part XI of the United Nations Convention on the Law of the Sea, currently limited to the management of mineral resources;

(c) Application of the regime of conservation and sustainable use of genetic resources under the Convention on Biological Diversity.

The last two options are not mutually exclusive and could, in fact, be integrated.

155/ L. Glowka, *supra* footnote 66, pp. 56-57.

156/ UNCLOS, Articles 145 and 194 (2).

129. All three types of regime would have the same objective, namely to fill the legal lacuna that exists in the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity regarding the conservation and sustainable use of genetic resources in maritime areas beyond the limits of national jurisdiction. The Parties to the Convention on Biological Diversity, the Parties to the United Nations Convention on the Law of the Sea and/or the General Assembly of the United Nations may wish to discuss how best to achieve this objective. In this regard, the collaboration of other relevant international organizations could also be envisaged.

Annex

BIODIVERSITY OF THE DEEP SEABED IN AREAS OUTSIDE NATIONAL JURISDICTION: A SUMMARY OF THE MAIN FEATURES

1. The following section presents a summary of the main benthic biodiversity features in areas outside of national jurisdiction, as well as the major threats they face. The text is based on the 2001 WWF/IUCN publication *The Status of Natural Resources on the High Seas*, as well as on the proceedings of the *Expert Workshop on Managing Risks to Biodiversity and the Environment on the High Sea, Including Tools such as Marine Protected Areas–Scientific Requirements and Legal Aspects* (Isle of Vilm, Germany, 27 February – 4 March 2001).

2. As indicated in the title, this summary is restricted only to the deep seabed in areas outside of national jurisdiction, and does not consider biodiversity features in the water column.

1. HYDROTHERMAL VENTS

A. Biodiversity

3. Hydrothermal vents, which are highly localized sites of high temperature fluid-escape from the seabed, are typically located on mid-ocean ridges in areas, which are actively spreading, in subduction zones, fracture zones, back-arc basins and on seamounts. Active venting occurs only at restricted locations on spreading ridges. Hydrothermal vents typically support abundant biological populations, fuelled by chemosynthesis. The discovery of chemosynthetic-based ecosystems at hydrothermal vents in the deep ocean was arguably one of the most important findings in biological science in the latter quarter of the twentieth century. More than 500 new animal species, most of which are endemic to vents, have been described from this environment. These animal species have adapted to exploit the extreme physio-chemical conditions found at vents.

B. Threats

4. The only current anthropogenic threat to hydrothermal vent systems is from marine scientific research. The current research efforts concentrate on temporal changes at individual sites, which often involves repeated sampling, observation and instrumentation of a small number of well-known hydrothermal vent sites. Already, effects of biological and geological sampling operations on vent faunal communities have been documented. As vent sites become the focus of intensive, long-term investigation, it will become essential to introduce mitigative measures to avoid significant loss of habitat or oversampling populations.

5. Bioprospectors may require large quantities of a particular organism in order to obtain useful quantities of all natural products. Clearly, harvesting specimens at high, unsustainable levels could have an effect upon both the target species and the ecosystem as a whole. However, with advances in molecular techniques, the collection of smaller quantities of animal tissue may become sufficient.

6. The mining of polymetallic sulphide deposits associated with vent systems poses a substantial threat in terms of physical damage and inevitable severe disturbance to the associated biological community. Mining activity may also result in increased sedimentation and plume generation, and disturb the vent water circulation systems. However, although there have been proposals to extract minerals and metals from vents, commercial mining of these sites appears to be speculative at present.

7. A further potential threat to hydrothermal vents comes from tourism, and one such tourist expedition using submersibles has already taken place, with potential for additional activities to follow. Although such tourism may have educational value, uncontrolled visits have potential negative impact on vent animals and their habitats via physical damage and light. It is thought that light from submersible vehicles may damage the sensitive eyes or light receptive organs of some vent animals.

2. SEAMOUNTS

A. Biodiversity

8. Seamounts are undersea mountains of volcanic origin, although some are formed by vertical tectonic movement along converging plate margins. Seamounts are steep-sided and conical, comprising a distinct deep sea environment, with hard exposed substrata and relatively little sediment deposition. Polymetallic crusts, mounds or chimneys may also be present, formed via hydrothermal precipitates. Seamounts are distributed in all ocean basins. Estimations of their abundance suggest that 30,000 exist in the Pacific, 810 in the Atlantic, and an intermediate number in the Indian Ocean.

9. Seamounts may interact with the upper water column, enhancing surface ocean productivity. It is thought that the abundance of fish around seamounts, which is higher than in surrounding waters, is due to this increased productivity. The tops and upper flanks of seamounts may also be biological hot spots, which have potentially high species diversity and endemism. Hard substrate suspension feeding communities, for example sponges and corals, dominate the benthic fauna of seamounts. Corals generally occur on the most exposed portions of the seamount, where water currents are strongest. Some 600 invertebrate species have been recorded from seamounts. Scientific exploration around seamounts is however still lacking, particularly biological sampling.

B. Threats

10. Seamounts are under increasing pressure from fishing, leading to depletion of many stocks. Benthic communities on seamounts have been impacted by both directed fisheries for corals (coral harvesting for jewellery) and physical damage from trawl fisheries. Studies in Tasmania have found that the reef, which covers approximately 50% of un-fished seamounts, is effectively removed from the most heavily fished seamounts, reducing 95% of the slopes to bare rock. Benthic biomass was reduced by 83% and the number of species per sample by 59% on heavily fished seamounts, indicating considerable damage from demersal trawl fishing to these ecosystems.

11. In the future, there may also be impacts if seamounts are mined for manganese crusts, but such enterprises have not yet been undertaken.

3. DEEP SEA TRENCHES

A. Biodiversity

12. Deep-sea trenches occur along island arcs and continental coastlines, and many, though not all, are contained within the exclusive economic zones of a number of nations. Trenches are formed through the subduction process, which takes place where two tectonic plates collide as the seafloor spreads. The majority of trenches range in depth from 6,000 to 11,000m and comprise approximately 1% of the total area of the ocean bottom.

13. The benthic fauna of deep sea trenches is called “hadal fauna” and consist of unique organisms adapted to cope with massive hydrostatic pressure, unusual trophic conditions and frequent physical disturbance. Much of this fauna consists of newly discovered species and genera. A high percentage of species are endemic only to one trench, likely due to isolation. Endemic species make up 56% of hadal fauna, some 600 species. The fauna consists mainly of animals living on soft sediment, notably the detritus-feeding holothurians. In addition, bivalve mollusks and polychates are common, as are ophiuroids, sipunculans, crustaceans and sea stars. Samples of the fauna have been collected from most deep sea trenches, but there have been few detailed studies.

B. Threats

14. Deep-sea trenches have been proposed as suitable sites for waste disposal, including disposal of high-level nuclear wastes, owing to their supposed isolation and ability to retain waste materials. The

risks associated with such disposal are unknown, particularly as trenches are tectonically active, and the waters in these areas undergo frequent and relatively rapid mixing.

15. In terms of mineral resources, deep-sea trenches are unlikely to prove economically viable for exploitation. However, the new species in trenches may have important medical and biotechnology applications in the future. For example, bacteria from trenches have been found to contain novel genes of unknown function, and bioprospecting genes for industrial application is currently underway.

4. DEEP SEA "CORAL REEFS"

A. Biodiversity

16. Deep sea coral reefs are widely distributed in the world's oceans and occur in depths ranging from tens to thousands of metres. They occur in a variety of environmental settings, vary in size from individual colonies to extended patch reefs, and consist of several species, the most well known of which is *Lophelia pertusa*. This coral forms a hard, branched external skeleton of calcium carbonate that houses the individual polyps. *L. pertusa* are found throughout the North Atlantic, west Africa, sides of the Atlantic, Gulf of Mexico, Caribbean, some areas of the Pacific and Indian Oceans, and western Norway. The distribution may be even more widespread, as *L. pertusa* are often difficult to detect.

17. There are few quantitative studies of the megafauna associated with deep-water corals. More than 800 species have been reported living on or in *L. pertusa* reefs in the north-east Atlantic, although this may be an underestimation as few studies have been conducted in detail.

B. Threats

18. The biggest threat to deep-sea coral reefs comes from trawling activities, which cause physical damage to the fragile reefs. Much of the coral habitat in the north-east Atlantic region coincides with suitable seabed for trawling operations, and reef damage has been documented in many areas. It is likely to have occurred in many other undocumented areas as well.

19. Deep-water coral reefs may have importance in terms of environmental technology and medicine. For example, fouling resistant substances may occur in corals and may possibly be used as an environmentally safer alternative to the heavy metal compounds currently used in ship-bottom paints.

20. Buried carbonate reefs are favoured hydrocarbon prospecting targets as they have a potential to contain large quantities of petroleum. Oil exploration and production is currently occurring in areas where *L. pertusa* reefs are abundant in the north-east Atlantic.

5. POLYMETALLIC NODULES

A. Biodiversity

21. Polymetallic nodules are commonly referred to as either manganese or ferromanganese nodules, and they are rounded concretions that range from 1 to 25 cm in diameter. They may occur in vast fields on the deep ocean floor at depths between 4,000m and 6,000 m. Polymetallic nodules occur in all oceans as well as in certain freshwater environments. The nodules of greatest commercial value are found in the Pacific and Indian Oceans. In the Pacific Ocean, the majority of nodules are concentrated in the central abyssal basins. In the Indian Ocean, polymetallic nodules are most abundant south of the Equator, in basins to the east and west of the Ninety Degree Ridge.

22. The surfaces of some forms of polymetallic nodules are inhabited by diverse epifauna composed of bacteria, protozoa and metazoa, typically hard-bottom taxa. Nodules on the deep seabed provide hard substratum that enhances local/regional diversity. Overall, the crevice fauna are distinctly different from the ooze fauna surrounding the nodules.

B. Threats

23. Polymetallic nodules present considerable potential for commercial exploitation. In order to achieve economically viable nodule mining, thousands of square kilometres of relatively flat seabed are needed for dredging. Each of the proposed mining techniques entails some degree of environmental disturbance, and deep-sea mining of polymetallic nodules is likely to have significant impact on deep-sea benthic and pelagic communities. The rate of recolonization of disturbed areas will depend on the area swept for polymetallic nodules and on the timing and intensity of mining events. Thus far, pilot scale mining studies have been undertaken.

6. COLD SEEPS AND POCKMARKS

A. Biodiversity

24. Cold seeps and pockmarks are highly localized sites of low temperature fluid escape from the seabed. "Seepage" encompasses everything from the vigorous bubbling gas from the seabed to the small-scale emanation of microscopic bubbles or hydrocarbon compounds in solution. Seep fluids may be hydrocarbon, hydrothermal or volcanic in origin, or may simply represent a groundwater escape. Seeps occur in a wide variety of physiographic and geological settings, and they typically support abundant biological populations, fuelled by chemosynthesis. The fauna are highly specialized, of relatively low diversity, but high endemism. The large majority of seep fauna are endemic to single seep sites and to the seep ecosystem. Of the 211 species reported thus far, only 13 occur at both seeps and hydrothermal vents.

B. Threats

25. Seeps have high biotechnology potential as many new species have been discovered in these habitats over the past 20 years. Bacteria from seeps contain novel genes, which may be useful to the biotechnology industry. For example, applications such as bioremediation and oil pollution may be of particular interest.

26. Seepages may be used along with other methods as a prospecting tool for the petroleum industry. Seepages may also become subject to direct exploitation in the future, if high-grade mineral-laden fluids expelled from the deep seabed can be tapped. Several patents exist for the direct harvest of seepage minerals from point sources on the seabed.

7. GAS HYDRATES

Biodiversity

27. Gas hydrates consist mainly of methane gas housed within the crystalline cage structure of ice. The gas is packed at very high densities, amounting to around 160 times greater densities than gas at normal atmospheric pressures. The hydrates look like dry ice, but will burn. The methane in oceanic hydrate deposits is virtually free from liquid petroleum and condensates, allowing them to be considered as having a very low potential for pollution hazard. Gas hydrates are probably widespread in deep-sea environments.

28. The associated fauna are little known. However, recent studies have identified the presence of bacteria at depths of over 800m below the seafloor in marine sediments in the Pacific Ocean. It is estimated that about 60% of all bacteria on earth live in sub-seafloor sediments. Hydrates constitute a unique deep bacterial habitat in marine sediments, as the abundance and activity of bacteria are elevated at depth. Polychaete worms have also been found in exposed gas hydrate in the Gulf of Mexico.

B. Threats

29. Methane hydrate is an attractive economic source of methane. Methane can be used directly as fuels or may be converted to methanol, or higher molecular weight synthetic fluid fuel. Recent interest in

the exploration of gas hydrates is partly a result of their potential as an energy resource and also for energy storage. Methane combustion produces less carbon dioxide emissions than coal and oil, and therefore may be considered a more environmentally sound option. Oceanic methane hydrates constitute a major energy exploration frontier for the future.

30. The huge gas hydrate reservoir in ocean sediments has significant implications for climate because a mass unit of methane introduced into the atmosphere would have 56 times the global warming effect of an identical mass of carbon dioxide over a 20-year period. Methane from the gas hydrate reservoir may have escaped and affected the climate in the past.

8. SUBMARINE CANYONS

A. Biodiversity

31. Submarine canyons are common, steep-sided erosional deep-sea features that cut across continental slopes. They are found along the slopes of most continental margins, and are likely to have been formed by turbidity currents or sediment slumps, or both. At the mouths of many canyons, enormous fan-like sediment deposits are found. These sediments are likely to have been channelled down the canyon by turbidity currents. Canyons influence local bottom water flows and may act as traps for organic matter. They may be biological hot spots with enhanced benthic and fish populations. Canyons are also nursery areas for some commercial species and have higher faunal densities and biomass than nearby non-canyon regions at similar depths.

B. Threats

32. Submarine canyons have higher biomass and diversity of commercially important species, and are therefore subject to commercial fishing activity. They may also be subject to terrestrial pollution, and to petroleum exploitation.
