

**Protecting the Diversity of the Depths:  
Environmental Regulation of Bioprospecting and  
Marine Scientific Research Beyond National  
Jurisdiction**

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**INTRODUCTION**

As scientific knowledge of marine areas beyond national jurisdiction increases and developments in oceans technology permit greater access to the high seas water column and the deep seabed, new and more intensive uses of these areas bring consequential impacts on the marine environment. The discovery of hydrothermal vents in 1977 revealed communities of organisms with unique genetic and biochemical properties and a seemingly limitless catalogue of medical, pharmaceutical, and industrial applications.<sup>1</sup> Similar repositories of genetic and biochemical resources have been discovered in other deep-sea environments such as cold water seeps; it is expected that sediment communities of the deep seabed will eventually reveal comparable but more sparsely distributed diversity.<sup>2</sup> These resources

1. C. Allen, "Protecting the Oceanic Gardens of Eden: International Law Issues in Deep Sea Vent Resource Conservation and Management," *Geopolitical International of Environmental Law Review* 13(3) (2001): 563; P. Re, "Deep Sea Hydrothermal Vents: Oases of the Abyss," in *New Technologies and Law of the Marine Environment*, ed. J.P. Beurier, A. Kiss and S. Mahmoudi (London: Kluwer Law International, 2000), pp. 67-74; D.K. Leary, "Bioprospecting and the Genetic Resources of Hydrothermal Vents on the High Seas: What Is the Existing Legal Position, Where Are We Heading and What Are Our Options?," *Marine Journal of International and Comparative Environmental Law* 1 (2004): 137 at 143-148 lists some of the biotechnology companies involved in research and/or product development in relation to hydrothermal vents, potential applications of ongoing research, and products developed which are currently on the market.

2. L. Glowka, "Beyond the Deepest of Frontiers: Genetic Resources, Marine Scientific Research and International Seabed Authority," in Beurier *et al.*, see n. 1 above, pp. 75-93; H. Korn, S. Friedrich and U. Feit, *Deep Sea Genetic Resources in the Ocean Yearbook* 22: 411-443.

are already being sampled for scientific research and commercial purposes by State-sponsored scientific research bodies in conjunction with commercial enterprises.<sup>3</sup>

The term "bioprospecting" is used for this dual-purpose activity, which does not fit neatly under the rubric of either marine scientific research or commercial exploitation of marine living resources.<sup>4</sup> Bioprospecting activities were not addressed in the 1982 United Nations Convention on the Law of the Sea (UNCLOS) negotiations,<sup>5</sup> and although the 1992 Convention on Biological Diversity (CBD) does address access to genetic resources, its primary focus to date has been on areas within national jurisdiction.<sup>6</sup>

The regulation of bioprospecting activities in marine areas beyond national jurisdiction (and related issues) has been on the agenda of various international bodies for over a decade. The Conference of the Parties of the CBD has held sporadic discussions on access to the genetic resources of the deep seabed<sup>7</sup> and the issue was also discussed in detail by the fifth and

3. *Context of the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea* (Bonn: German Federal Agency for Nature Conservation, BfN-Skripten, 2003), p. 17; Leary, see n. 1 above, p. 138.

4. Although there is no internationally agreed-upon definition of bioprospecting, a note prepared by the Convention on Biological Diversity Secretariat (UNEP/CBD/SBSTTA/8/INF/3/Rev. 1, para. 68) defines bioprospecting as "the process of gathering information from the biosphere on the molecular composition of genetic resources for the development of new commercial products." D. Farrier and L. Tucker, "Access to Marine Bioresources: Hitching the Conservation Cart to the Bioprospecting Horse," *Ocean Development and International Law* 32 (2001): 213 at 214 define bioprospecting as "the collection of small samples of biological material for screening in the search for commercially exploitable biologically active compounds or attributes such as genetic information."

5. I.L.N. Scheiber, "The Biodiversity Convention and Access to Marine Genetic Materials in Ocean Law," in *Order for the Oceans at the Turn of the Century*, ed. D. Vidas and W. Østregg (The Hague: Kluwer Law International, 1999), 187 at 199 notes that it was far too late to introduce the subject of marine genetic resources, still confined in its development to the realm of the laboratory and basic science, into the UNCLOS deliberations.

6. Article 15 of the CBD regulates access to genetic resources within national jurisdiction.

7. The second meeting of the Conference of the Parties (COP) of the CBD in Jakarta, 16–17 November 1995, adopted a Decision II/10 (UN Doc UNEP/CBD/COP/2/CW/L.21/Rev 1 (1995) which requested the CBD Secretariat, "in consultation with the United Nations Office for Ocean Affairs and the Law of the Sea, to undertake, a 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 the genetic resources on the deep seabed." The results of this study were not considered until the eighth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) in 2003 and the seventh meeting of the COP in 2004. The outcome of those discussions will be considered below: Leary, see n. 1 above, p. 154.

eighth meetings of the United Nations Informal Consultative Process on the Oceans (UNICPOLOS) in June 2004 and June 2007.<sup>8</sup> The broader legal and scientific issues associated with the related topic of high seas biodiversity were discussed in February 2006 at the first meeting of an Ad Hoc Open-Ended Informal Working Group, established by the United Nations General Assembly at its 59th Session in 2004 to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction.<sup>9</sup> As yet, however, the international community has not adopted any definitive proposal for a regime to govern bioprospecting activities in marine areas beyond national jurisdiction. Three decades have now passed since the discovery of hydrothermal vents—with their abundant biodiversity and biotechnological potential—and the international community has not taken any concrete steps to develop a regime for their sustainable exploitation.<sup>10</sup>

Marine scientific research is another largely unregulated use of marine areas beyond national jurisdiction, and one that is often conducted simultaneously with bioprospecting. In recent decades, marine scientific research activities in marine areas beyond national jurisdiction have expanded to meet diverse demands related to scientific knowledge and resource exploitation. Repeated research probes on deep-sea sites can introduce alien elements such as noise, light, and other biological matter into the marine environment, with adverse effects on fragile marine habitats unaccustomed to such intrusions.<sup>11</sup> This article will review the nature and

8. *Report on the Work of the United Nations Open-Ended Informal Consultative Process on Oceans and the Law of the Sea at Its Fifth Meeting*, UN Doc. A/59/129 (2004) and *Report on the Work of the United Nations Open-Ended Informal Consultative Process on Oceans and the Law of the Sea at Its Eighth Meeting*, UN Doc. A/62/169 (2007).

9. *Report of the Ad Hoc Open-Ended Informal Working Group to Study Issues Relating to the Conservation and Sustainable Use of Marine Biological Diversity Beyond Areas of National Jurisdiction*, UN Doc. A/61/65 (20 Mar. 2006). The report notes in its Summary of Trends at p. 22 that "There is a need to study and determine whether there is a governance gap in marine areas beyond national jurisdiction. If such a gap is identified, there is a need to clarify how it should be addressed, including assessing the need for the development of an implementing agreement under the Convention to address, inter alia, the establishment and regulation of multi-purpose marine protected areas on a scientific basis, as well as other related issues." Following acceptance of its report by the UN General Assembly at its 61st Session, the Ad Hoc Open-ended Informal Working Group will meet again in the first half of 2008.

10. Scheiber, see n. 5 above, pp. 199–200, comments that the deeply rooted North/South divisions that characterized the debate on the UNCLOS deep seabed mining provisions will surface again in the context of appropriate regimes to govern access to the genetic resources of the deep seabed: Korn et al., see n. 2 above, p. 9.

11. S. Arico and C. Salpin, *Bioprospecting of Genetic Resources in the Deep Seabed: Scientific, Legal and Policy Aspects* (Yokohama: United Nations University Institute of Advanced Studies, 2005), para. 3.3; C.M. Baker, B.J. Bett, D.S.M. Billett, A.D. Rogers and A.C. de Fontaubert, *The Status of Natural Resources on the High Seas* (Gland,

extent of bioprospecting and marine scientific research activities in marine areas beyond national jurisdiction and the potential impact of these activities on the surrounding marine environment. It will then examine the applicability of existing legal instruments such as the UNCLOS and the CBD to these activities, and the viability of some options for developing a more comprehensive environmental protection regime to govern their conduct.

### BIOPROSPECTING IN MARINE AREAS BEYOND NATIONAL JURISDICTION

The extreme environment of the deep seabed is host to a wide array of biological communities. These communities exhibit high biodiversity and contain genetic and biochemical resources with multiple commercial applications in fields such as medical science, pharmaceuticals, agriculture, food processing, waste treatment, mining, and cosmetics.<sup>12</sup> As bioprospecting activities in the deep seabed intensify, so will the impact of such activities on the fauna associated with particular deep seabed features such as hydrothermal vents and cold seeps. Since their discovery in 1977, hydrothermal vents have attracted the most extensive scientific research and bioprospecting activity on the deep seabed.<sup>13</sup> More than five hundred new species, mostly invertebrates, have been discovered in hydrothermal vent communities both within and beyond national jurisdiction.<sup>14</sup> These invertebrate species are dependent on chemosynthetic activity rather than photosynthesis for their existence. They are surrounded by micro-organisms that oxidize sulphides and other chemicals, such as hydrogen, iron or manganese, from the hydrothermal vents and convert them into organic matter, which nourishes both the micro-organisms themselves and other vent species.<sup>15</sup> The capacity of these species to adapt to extreme physical

Switzerland: WWF/IUCN/WCPA, 2001), p. 19; L. Glowka, "Putting Marine Scientific Research on a Sustainable Footing at Hydrothermal Vents," *Marine Policy* 27(4) (2003): 303.

12. Scheiber, see n. 5 above, p. 198; Glowka, see n. 2 above, pp. 76-77; M. Gorina-Ysern, "Legal Issues Raised by Profitable Biotechnology Development Through Marine Scientific Research," *ASIL Insights*, available online: <<http://www.asil.org/insights/insight116.htm>>.

13. S.K. Juniper, "Background Paper on Deep-Sea Hydrothermal Vents" in *Managing Risks to Biodiversity and the Environment on the High Seas, Including Tools such as Marine Protected Areas—Scientific Requirements and Legal Aspects*, ed. H. Thiel and J.A. Koslow (Bonn: Federal Agency for Nature Conservation, 2001), p. 91; Arico et al., see n. 11 above, para. 3.2, which analyzes the type and level of activities involving genetic resources from the deep seabed; Leary, see n. 1 above, p. 1, also provides details of the strong scientific and commercial interest in extremophiles found at hydrothermal vent sites.

14. Korn et al., see n. 2 above, p. 9; Leary, see n. 1 above, p. 140.

15. Juniper, see n. 13 above, p. 90; Korn et al., see n. 2 above, p. 13; Leary, see n. 1 above, p. 141; Glowka, see n. 2 above, p. 78.

and chemical conditions has excited the interest of scientists, who consider that the extraordinary diversity of species present in hydrothermal vent communities will contribute to a better understanding of basic life processes.<sup>16</sup> Commercial enterprises can envisage a variety of uses for the bacteria, known as extremophiles, and particularly for hyperthermophiles or thermophiles, derived from such environments.<sup>17</sup> The discovery of hydrothermal vent communities has also prompted scientists to re-examine theories of the origin of life on earth<sup>18</sup> and to consider geothermal energy as a potential source for biosynthesis.<sup>19</sup>

Areas of the deep seabed where fluids diffuse from the seafloor, known as cold seeps, are also associated with biological communities supported by chemosynthetic processes.<sup>20</sup> Seep fluids, including natural petroleum, natural gas, and artesian water flow, are rich in methane and are sometimes accompanied by the formation of gas hydrates.<sup>21</sup> These fluids interact with bacteria to produce carbon, which supports invertebrate species similar to those found in the hydrothermal vent communities.<sup>22</sup> Bacteria from cold seeps contain novel genetic material with a wide range of commercial applications.<sup>23</sup> In addition to the vent and seep communities, the sediments of the deep seabed found on seamounts, deep sea trenches, and submarine canyons also harbor a profusion of varied species, including slugs, snails, crabs, and a wide array of nematodes.<sup>24</sup> These species depend on descending detritus from the superjacent ocean layers, where photosynthesis occurs, for energy.<sup>25</sup> This biodiverse region may also be the subject of bioprospecting interest in the future.<sup>26</sup>

### The Level of Bioprospecting Activity Beyond National Jurisdiction and Its Potential Impact on the Marine Environment

Exploration activities related to deep seabed ecosystems were described in a 2005 report by Arico and Salpin as "scattered, small scale, independent

16. Juniper, see n. 13 above, p. 92.

17. Korn et al., see n. 2 above, p. 16; Leary, see n. 1 above, p. 141; Glowka, see n. 2 above, p. 79.

18. Arico et al., see n. 11 above, para. 2.2; Glowka, see n. 2 above, p. 79.

19. Juniper, see n. 13 above, p. 89.

20. Juniper, see n. 13 above, p. 91; Glowka, see n. 2 above, p. 78.

21. Juniper, see n. 13 above, p. 91; Arico et al., see n. 11 above, para. 2.1.2.

22. Juniper, see n. 13 above, p. 91; Korn et al., see n. 2 above, p. 17; Arico et al., see n. 11 above, para. 2.1.2.

23. Glowka, see n. 2 above, p. 78; Korn et al., see n. 2 above, p. 18.

24. Glowka, see n. 2 above, p. 77.

25. *Id.*

26. Glowka, see n. 2 above, p. 78; Arico et al., see n. 11 above, para. 2.1.4.

research activities and programmes ongoing in many universities and research institutions in the world"; while not directly commercially oriented, these activities will generate the scientific information necessary for commercial exploitation of these resources.<sup>27</sup> The report contains several examples of joint public and private ventures at the interface of research and development, linking research activities with the development of products and processes.<sup>28</sup> The majority of research cruises to the deep sea are conducted by State-sponsored operators, but there are now numerous examples of the data gathered on such cruises being shared by State research institutions with commercial enterprises under joint venture agreements.<sup>29</sup> The list of patents involving genetic resources from the deep seabed is steadily growing, and it reveals increasing potential for sustained commercial interest and investment in the deep seabed. Bioprospecting has already eclipsed commercial interest in mining for deep seabed minerals.<sup>30</sup>

Bioprospecting, while not as invasive as deep seabed mineral exploration, does entail physical disturbance, and alteration of the marine environment and introduces alien elements into deep-sea habitats.<sup>31</sup> Current deep sea research projects, principally on hydrothermal vent sites, have progressed beyond simple observation of benthic fauna by manned or remotely controlled submersible vessels to actual sampling of the fauna and animal infrastructure and installation of scientific instruments in the deep seabed environment.<sup>32</sup> In addition to disturbing the physical habitat, research vessels and scientific equipment introduce light and abnormal noise patterns into the fragile deep sea environment and may discharge marine pollutants and alien biological material into the previously pristine environment of the deep seabed.<sup>33</sup> The negative impact of frequent research expeditions on particular deep seabed sites and the potential for conflicting or incompatible research activities that cause cumulative adverse effects on fragile deep-sea sites has been noted by scientists and other

27. Arico et al., see n. 11 above, para. 3.2.1.

28. *Id.*

29. Leary, see n. 1 above, p. 148, notes that there is no substantiated evidence at any company has mounted their own dive to hydrothermal vents for collection purposes but there is anecdotal evidence that at least one company is planning its own series of dives independent of any research institution.

30. Arico et al., see n. 11 above, para. 3.2.2; Glowka, see n. 2 above, p. 80; Heiber, see n. 5 above, p. 198.

31. Arico et al., see n. 11 above, para. 3.3.

32. Juniper, see n. 13 above, p. 93, notes that research focus in hydrothermal science is shifting to time-series observations, resulting in the concentration of upping, observation and instrumentation at a small number of fixed observatories on the deep seafloor.

33. Arico et al., see n. 11 above, para. 3.3.

commentators.<sup>34</sup> The absence of compulsory environmental protection measures, such as environmental baseline data collection, ongoing environmental impact assessment of sampling sites, and impact reference zones, could result in substantial loss of deep seabed biodiversity over time.<sup>35</sup> Scientists involved in deep-sea research have developed some voluntary protocols to reduce the negative impacts of their research on the deep seabed environment. They have requested the global scientific community to consider certain deep seabed sites as scientific reserves; to conform to voluntary codes of conduct that seek to minimize adverse effects on the environment; and to coordinate deep seabed research to reduce the occurrence of simultaneous expeditions to deep seabed sites and conflicting use of these sites.<sup>36</sup> Because bioprospecting activities are currently intermingled with marine scientific research, these initiatives have the dual purpose of reducing the adverse effects of both bioprospecting and marine scientific research activities on the deep-sea environment.

#### The Applicability of Existing International Law Principles to Bioprospecting Activities Beyond National Jurisdiction

Much of the discussion among international bodies and academic commentators on deep seabed and bioprospecting activities has centered on ownership and access to these resources under the law of the sea and the question of whether research and exploitation activities related to such resources can be regulated under the existing international law framework. There has also been widespread recognition on the part of international bodies, scientists, and other academic commentators that a comprehensive environmental protection regime covering the multiple uses of the deep seabed environment is essential, and overdue, if the abundant biodiversity of the deep seabed is to be adequately protected.<sup>37</sup>

34. Juniper, see n. 13 above, p. 93; Glowka, see n. 2 above, p. 303.

35. Scheiber, see n. 5 above, p. 199; Juniper, see n. 13 above, p. 93, notes that 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 over-sampling of populations.

36. H. Thiel, "Approaches to the Establishment of Protected Areas on the High Seas," in *International Marine Environmental Law: Institutions, Implementation and Innovations*, ed. A. Kirchner (The Hague: Kluwer Law International, 2003), p. 172; Arico et al., see n. 11 above, para. 5.6.1.

37. Korn et al., see n. 2 above, pp. 9-10; Leary, see n. 1 above, p. 166; Allen, see n. 1 above, p. 563; Glowka, see n. 11 above, p. 303; Juniper, see n. 13 above, p. 93; Scheiber, see n. 5 above, p. 199; Thiel, see n. 36 above, p. 174; *UN General Assembly Res. on Oceans and the Law of the Sea*, UN Doc A/RES/59/24; *Report on the Work of the United Nations Open-Ended and Informal Consultative Process on Oceans and the Law of the Sea at Its Fourth Meeting*, UN Doc A/58/95, para. 20.



**1982 United Nations Law of the Sea Convention Provisions**

The spatial system of jurisdiction under the UNCLOS has produced some anomalies with respect to the newly discovered resources of the deep seabed. The physical extent of the water column and the deep seabed beyond national jurisdiction are divergent. UNCLOS's bifurcated approach, together with the current uncertainties in relation to the precise outer limits of the continental shelf of all coastal States, adds to the complexity of determining the exact legal regime that applies to a particular marine area beyond national jurisdiction. In marine areas within 200 nautical miles of the territorial sea baselines, the jurisdictional situation for all marine resources is clear. Under Article 56(1)(a) of UNCLOS, 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 sea-bed and of the sea-bed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone." Within its exclusive economic zone, the coastal State also has jurisdiction over marine scientific research and protection and preservation of the marine environment—subject to other provisions of UNCLOS, in particular the provisions in Part XII on Protection and Preservation of the Marine Environment, and in Part XIII on Marine Scientific Research. Although the term "natural resources" is not defined in UNCLOS, the all-encompassing description of natural resources in Article 56, which includes living or non-living resources, would appear to include the living resources supported by the chemosynthetic processes of the deep seabed when they are located in the exclusive economic zones of coastal States.<sup>38</sup> The coastal State may therefore exercise all the rights and responsibilities prescribed under UNCLOS and other hard and soft law instruments for the protection and preservation of the marine environment in relation to genetic and biochemical resources in its exclusive economic zone, and has the right to regulate commercial exploitation and marine scientific research activities in relation to such resources.

The jurisdictional situation becomes more ambiguous beyond the outer boundary of the exclusive economic zone. Where a coastal State's continental shelf extends beyond 200 nautical miles from its territorial sea baselines, the coastal State exercises sovereign rights over the area for the purpose of exploring and exploiting the natural resources of the shelf under Article

77(1) of UNCLOS. "Natural resources" as defined in Article 77(4) includes mineral and other non-living resources of the seabed and subsoil as well as living organisms belonging to sedentary species—organisms which, at the harvestable stage, are either immobile or unable to move except in constant physical contact with the seabed or subsoil. Some of the species that inhabit hydrothermal vent communities, seep communities, and deep sea sediment, such as nematodes and molluscs, will qualify as sedentary species and therefore fall within coastal State jurisdiction; others such as the micro-organisms that abound in hydrothermal plumes will not.<sup>39</sup> Where living resources on the extended continental shelf fall outside the definition of sedentary species only those provisions in Part VII that relate to the marine living resources of the high seas would appear to be relevant.<sup>40</sup> Leary notes that in any case there may be limitations on the coastal State's jurisdiction over some sedentary species on the extended continental shelf. Many of the hydrothermal vent communities discovered so far are located on mid-ocean ridges and Article 76(3) specifically excludes the deep ocean floor, its oceanic ridges, and the subsoil thereof from the definition of the continental margin.<sup>41</sup>

Although not originally envisaged in the UNCLOS negotiations, a flexible interpretation that takes account of subsequent developments would allow the application of Part VII to the genetic resources that inhabit deep seabed environments beyond national jurisdiction. If the species emanating from the chemosynthetic processes of the deep seabed are regarded as having independent life, they are more logically associated with marine living resources under the current provisions of UNCLOS than with the non-living resources governed by the deep seabed regime under Part XI. The term "marine living resources" is not defined in UNCLOS; it could potentially encompass the new forms of marine life recently discovered in hydrothermal vents and other deep seabed environments.<sup>42</sup> Article 87 does not limit freedoms of the high seas to those specifically enumerated in Article 87(1), presaging the addition of new components to the freedom of the high seas with the words, "It comprises, *inter alia* . . ." Although the articles of UNCLOS that relate to the conservation and management of the living resources of the high seas have so far been applied principally to high seas fisheries and marine mammals, they are broad enough to include the new species discovered in deep seabed environments. Article 118 imposes a general duty on States to cooperate with each other in the conservation and

39. Korn et al., see n. 2 above, pp. 38–40; Leary, see n. 1 above, p. 150; Arico et al., see n. 11 above, para. 5.1.1.

40. Korn et al., see n. 2 above, p. 40; Arico et al., see n. 11 above, para. 5.1.1.

41. Leary, see n. 1 above, p. 151.

42. Korn et al., see n. 2 above, pp. 41–42.

38. Arico et al., see n. 11 above, para. 5.1.1 notes that UNCLOS provisions are based on "the specific characteristics of the resources and activities known at the time of its negotiation, the language of which may need to be adapted to genetic material and related activities. The theory of the evolutive interpretation of treaties supports this observation."

management of living resources on the high seas and provides that States whose nationals exploit living resources in the same area shall enter into negotiations with a view to taking the measures necessary to conserve the living resources concerned. The establishment of regional or subregional fisheries organizations is a primary example of such cooperation, but the Article does not exclude the creation of other regional arrangements for the conservation of living resources. The language of Article 119, which deals with conservation measures, is directed more specifically at fisheries conservation and management. However, the 2005 Arico and Salpin report on bioprospecting activities related to the genetic resources of the deep seabed, mentioned above, canvassed the possibility of conservation measures such as total allowable catch being adapted to the genetic resources context, e.g., by setting sample quotas for the amount of genetic resources which could be taken in any year from particular deep seabed areas.<sup>43</sup> The benefits and disadvantages of negotiating an implementing agreement under Article 118 will be examined in the next section.

In a study instigated by the Conference of the Parties of the CBD, Part XI of UNCLOS was identified as an appropriate foundation for an international law regime that could be amended to include the regulation of access to the genetic and biochemical resources associated with deep seabed features and could provide the necessary environmental protection measures to sustainably develop such resources.<sup>44</sup> Under Article 136, the Area (which is defined in Article 1(1) as the seabed and ocean floor and the subsoil thereof beyond the limits of national jurisdiction) and its resources are declared the common heritage of humankind. Currently, the resources of the Area include "all solid liquid or gaseous mineral resources in situ in the Area or beneath the sea-bed, including polymetallic nodules."<sup>45</sup> The jurisdictional ambit of Part XI therefore does not currently extend to living resources located in the Area, although some of its provisions regulate the impact of deep seabed mining activities on such resources. The possible expansion of the jurisdictional mandate of the International Seabed Authority (ISA) to the genetic resources of the deep seabed as a potential method of securing a more comprehensive environmental protection regime for these resources will be discussed below.

An analysis of the marine scientific research provisions of UNCLOS and their applicability to bioprospecting activities in marine areas beyond national jurisdiction reveals some ambiguities and uncertainties in applica-

tion. In marine areas beyond national jurisdiction, including both the Area and the high seas water column, all States have the right, subject to other relevant provisions of UNCLOS, to conduct marine scientific research.<sup>46</sup> Part XIII of UNCLOS does not define marine scientific research but does specify some of the characteristics that pertain to such activities. Under Part XIII, marine scientific research is to be conducted for exclusively peaceful purposes and shall not constitute the legal basis for any claim to any part of the marine environment or its resources.<sup>47</sup> States and competent international organizations are required to promote and facilitate the development and conduct of marine scientific research and cooperate in creating favorable conditions for the conduct of marine scientific research in the marine environment.<sup>48</sup> They must also make available, by publication and dissemination, knowledge resulting from marine scientific research and information on proposed major research programs and their objectives.<sup>49</sup> There is a specific obligation under Article 244 of UNCLOS for States to actively promote the flow of scientific data and information and the transfer of knowledge resulting from marine scientific research—especially to developing States—and provide training programs to developing States to strengthen their autonomous marine scientific research capabilities. Where marine scientific research is conducted in the Area, whether in connection with living or non-living resources, many of the same conditions enumerated in Part XIII apply and States must also cooperate with the ISA in disseminating the results of their research and developing training programs for developing countries.<sup>50</sup> Many of these conditions are incompatible with the concept of bioprospecting, which is an exploration activity specifically directed towards commercial objectives—making the confidentiality of sampling results a paramount concern.<sup>51</sup> In view of the commercial objectives of bioprospecting it is arguable that the provisions of Part XIII will only apply to those aspects of deep-sea research activities that meet the criteria of pure scientific research. In practice, however, this distinction is difficult to draw. The search for, sampling, and testing of genetic and biochemical resources from the deep seabed will frequently be conducted for both scientific and commercial purposes. The absence of any clear distinction between the purely scientific and commercial aspects of deep sea research activities beyond national jurisdiction introduces the potential for less transparency in the exchange of scientific information and the possibility of a less equitable distribution of the benefits of such research.

46. *Id.*, art. 238.47. *Id.*, arts. 240(a) and 241.48. *Id.*, arts. 242(1) and 243.49. *Id.*, art. 244(1).50. *Id.*, art. 143(1) and (3).

51. Arico et al., see n. 11 above, para. 5.1.5.

43. Arico et al., see n. 11 above, para. 5.1.2.

44. *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*, UN Doc UNEP/CBD/SBSTTA/3/INF/3/Rev.1 (2003) (hereafter CBD/UNDOALOS Study), para. 72.

45. UNCLOS, art. 133(a).

Under Article 240(d) of UNCLOS, marine scientific research must also comply with all relevant regulations adopted under UNCLOS for the protection and preservation of the marine environment. If the distinction between marine scientific research and bioprospecting activities is rigorously maintained, this obligation would not apply to the bioprospecting aspects of deep-sea research operations. The framework principles of Part XII of UNCLOS would nevertheless impose general obligations of environmental protection on States Parties conducting bioprospecting activities in marine areas beyond national jurisdiction.

Part XII (Protection and Preservation of the Marine Environment) contains a series of broad framework principles that would apply to States Parties and their flag vessels conducting bioprospecting activities in marine areas beyond national jurisdiction. The general obligation of States Parties to protect and preserve the marine environment in Article 192 of UNCLOS is not limited in its geographic application to areas within State jurisdiction and would apply to bioprospecting activities conducted by States Parties and their flag vessels for genetic and biochemical resources on the deep seabed. Article 194 amplifies this general obligation by prescribing that States Parties are to take measures to prevent, reduce, and control pollution of the marine environment from any source, using the best practicable means at their disposal, in accordance with their capabilities. They are also encouraged to harmonize their policies in this connection. Article 194(3) has particular relevance to bioprospecting activities on the deep seabed as it requires States Parties to take measures that minimize pollution from installations and devices used in exploration and exploitation of the natural resources of the seabed and the subsoil to the fullest extent possible. This Article would apply to any scientific or extraction equipment currently used in the sampling and observation of genetic resources on the deep seabed. Article 194(5) resonates with the nature of the deep seabed ecosystems and habitats that contain genetic resources as it requires States Parties to take measures 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.

Article 196(1) echoes the concerns expressed by marine scientists and other commentators over the introduction of light, noise, and alien biological material into sensitive deep seabed environments such as hydrothermal vents and cold seeps. It requires States Parties to take all measures necessary to prevent, reduce, and control pollution of the marine environment, both from the use of technologies under their jurisdiction or control and the intentional or accidental introduction of alien or new species to a particular part of the marine environment that may cause significant and harmful changes to that environment. Article 197 clearly envisages cooperation between States Parties on a global and regional basis to achieve the objectives of Part XII; Article 197 provides that such

cooperation shall occur directly or through competent international organizations and shall include the formulation and elaboration of international rules, standards, and recommended practices and procedures for the protection and preservation of the marine environment, taking into account characteristic regional features. This provision could form the basis for the negotiation of an implementing agreement that would seek to protect and preserve representative examples of deep seabed ecosystems such as hydrothermal vents, cold seeps, and seamounts, independently of the access and ownership issues surrounding the genetic and biochemical resources of the deep seabed. The positive and negative attributes of this option will be discussed below.

#### *Convention on Biological Diversity Provisions*

The three broad objectives of the Convention on Biological Diversity (CBD), set out in Article 1 of the Convention, are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. While directly applicable to the subject matter of access to genetic resources and the protection of biodiversity, the CBD is only a framework convention. Its guiding principles are designed to be implemented by the Contracting Parties.<sup>52</sup> The jurisdictional scope provision in Article 4 limits the application of the CBD to components of biological diversity within national jurisdiction and to processes and activities related to biological diversity carried out under the jurisdiction or control of Contracting Parties, both within and beyond national jurisdiction. Several commentators have observed that no Contracting Party has yet legislated to control the processes and activities of its nationals related to biological diversity in areas beyond national jurisdiction.<sup>53</sup> Under Article 5 of the CBD, States Parties have a duty to cooperate with other Contracting Parties directly or through competent international organizations in respect of areas beyond national jurisdiction for the conservation and sustainable use of biodiversity. This provision is ripe for further implementation or possibly incorporation as an amendment to Part XII of UNCLOS, and represents one potential starting point for a more holistic protection of the marine environment beyond national jurisdiction. Although it might face political obstacles, an implementing agreement under this provision could facilitate the advent of area-based protection for deep sea habitats rich in biodiversity such as hydrothermal vents, cold seeps, and seamounts, and provide an

<sup>52</sup> Leary, see n. 1 above, p. 153.

<sup>53</sup> Leary, see n. 1 above, p. 154; Arico et al., see n. 11 above, para. 5.3.1.

opportunity to limit the adverse effects of activities such as bioprospecting on these areas through carefully targeted environmental protection measures.<sup>54</sup> As specified in Article 22 of the CBD, such an agreement would need to be implemented consistently with the rights and obligations of States under UNCLOS. The feasibility of such an agreement and the need for supporting regional infrastructure is discussed below.

The remaining substantive provisions of the CBD relate to the conservation, sustainable use, and benefit sharing of the components of biological diversity within national jurisdiction. They provide a template for establishing national programs for biodiversity conservation. These provisions contain elements that could also be useful in any program implemented collaboratively by States Parties in the future for the conservation and sustainable use of the components of biodiversity beyond national jurisdiction. Under Article 7 of the CBD, Contracting Parties are required to identify components of biological diversity important for conservation and sustainable use; Annex I of the CBD lists indicative components of biodiversity such as ecosystems and habitats containing large numbers of endemic or threatened species and described genomes or genes of social, scientific or economic importance. The process of identifying such components in marine areas beyond national jurisdiction has already begun in the work of the Ad Hoc Open-ended Working Group on Protected Areas, established by the Conference of the Parties of the CBD in 2004. The Working Group has commissioned a study of scientific information on biodiversity in marine areas beyond the limits of national jurisdiction.<sup>55</sup>

54. The concept of an implementing agreement to the CBD has been raised in the context of the work of the Ad Hoc Open-Ended Working Group on Protected Areas established by the Conference of the Parties of the CBD in 2004. The Working Group considered this and other proposals for the development of a binding legal instrument that provides for identification and establishment of marine protected areas beyond the limits of national jurisdiction at their first meeting in Montecatini, Italy from 13 to 17 June 2005 (see Item 3.1 of the Agenda for the First Meeting of the Ad Hoc Open-Ended Working Group on Protected Areas, *Options for Cooperation for the Establishment of Marine Protected Areas Beyond the Limits of National Jurisdiction*, UN Doc UNEP/CBD/WG-PA/1./2) (20 Apr. 2005), para. 37(b). The Eighth Meeting of the Conference of Parties of the CBD noted in its Decision VIII/24 the Report of the Ad Hoc Informal Open-Ended Working Group to study issues relating to the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction established by the General Assembly and the possible options and approaches identified in the summary of trends prepared by the Chairpersons of that Working Group in particular for establishing marine protected areas beyond national jurisdiction, including assessing the need for an implementing agreement under UNCLOS (*Report of the Eighth Meeting of the Parties to the Convention on Biological Diversity UNEP/CBD/COF/9/31*, 15 June 2006, p. 300, para. 40).

55. See n. 54 above, *Report of the First Meeting of the Ad Hoc Open-Ended Working Group on Protected Areas*, Apr. 2005, para. 6.

Contracting Parties are also required to monitor identified components of biological diversity through sampling and other techniques, paying particular attention to the need for urgent conservation measures and to those components which offer the greatest potential for sustainable use.<sup>56</sup> As part of this information-gathering activity, Contracting Parties are required to identify processes and categories of activities that have or are likely to have significant adverse impacts on the conservation and sustainable use of biologically diverse areas and monitor the effects of these activities.<sup>57</sup> Data obtained from the identification and monitoring processes is to be maintained and organized by Contracting Parties.<sup>58</sup>

Two key biodiversity protection measures are set out in Articles 8 and 9 of the CBD. Article 8 contains a comprehensive description of the principles and measures involved in *in situ* conservation, which is defined in Article 2 as the "conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domestic or cultivated species, in the surroundings where they have developed their distinctive properties." One of the principal means of achieving *in situ* conservation is the establishment of a system of protected areas where special measures are taken to conserve biological diversity.<sup>59</sup> Contracting Parties are required to develop guidelines for the selection, establishment, and management of such areas.<sup>60</sup> In advance of a specific legal basis for declaring marine protected areas beyond national jurisdiction agreed upon by the international community, the Ad Hoc Open-ended Working Group on Protected Areas is already engaged in gathering the scientific information necessary for the selection and establishment of such areas.<sup>61</sup> The other objectives associated with *in situ* conservation described in Article 8, are also relevant to the conservation and sustainable use of the deep seabed resources. Contracting Parties are required to regulate or manage biological resources important for the conservation of biological diversity, whether inside or outside protected areas, with a view to ensuring their conservation and sustainable use.<sup>62</sup> Contracting Parties must also promote the protection of ecosystems and natural habitats, maintain viable populations of species in natural surroundings, rehabilitate and restore degraded ecosystems, and promote the recovery of threatened species.<sup>63</sup> A provision similar to that in Article 8(h)

56. CBD, art. 7(b).

57. *Id.*, art. 7(c).

58. *Id.*, art. 7(d).

59. *Id.*, art. 8(a).

60. *Id.*, art. 8(b).

61. See n. 54 above.

62. CBD, art. 8(c).

63. *Id.*, art. 8(d) and (f).



of the CBD would have particular relevance to the relatively pristine deep sea environment, as Article 8(h) requires Contracting Parties to prevent the introduction of alien species that would threaten ecosystems, habitats, or native species.

Article 9 of the CBD sets out the measures to be implemented for *ex situ* conservation of biological diversity, defined in Article 2 as the "conservation of components of biological diversity outside their natural habitats." Although *ex situ* conservation is not as critical for deep sea environments, where the objective is to maintain viable populations of species *in situ*, it may become more relevant in the future when more organisms are removed from deep seabed environments. Under Article 9 Contracting Parties are required to establish and maintain facilities for *ex situ* conservation of research on plants, animals, and micro-organisms, and to adopt measures for the recovery and rehabilitation of threatened species and their re-introduction into their natural habitats.<sup>64</sup> Contracting Parties are also required to regulate and manage collections of biological resources from natural habitats for *ex situ* conservation purposes so as not to threaten ecosystems and *in situ* populations.<sup>65</sup> Article 14 prescribes further environmental protection measures relevant to regulating bioprospecting activities in marine areas beyond national jurisdiction. Contracting Parties are required to introduce environmental impact assessment procedures for proposed projects that are likely to have significant adverse effects on biological diversity, with a view to avoiding or minimizing such effects.<sup>66</sup> Contracting Parties are also required to promote notification, exchange of information, and consultation on activities under their jurisdiction or control that are likely to have significant adverse effects on the biological diversity of areas beyond national jurisdiction by encouraging the conclusion of regional and multilateral arrangements.<sup>67</sup> This provision is relevant to any regional or global agreements that may be negotiated in order to protect the biodiversity of marine areas beyond national jurisdiction and minimize the adverse effects of activities such as bioprospecting on the biodiversity of such areas.

While the CBD does not currently provide any regulatory framework for minimizing the adverse effects of bioprospecting activities in marine areas beyond national jurisdiction, it does contain a number of elements that would be relevant to negotiating an implementing agreement under Article 5 (or under amended UNCLOS provisions incorporating Article 5). The viability of these options for regulating the adverse effects of

64. *Id.*, art. 9(b) and (c).

65. *Id.*, art. 9(d).

66. *Id.*, art. 14(1)(a).

67. *Id.*, art. 14(1)(c).

bioprospecting activities on the marine environment of areas beyond national jurisdiction will be considered in more detail in the next section.

#### Potential Environmental Protection Regimes for Bioprospecting in Marine Areas Beyond National Jurisdiction

There is a range of options for regulating the impact of bioprospecting activities on the marine environment in areas beyond national jurisdiction. These options have been raised in general terms by academic commentators.<sup>68</sup> This section will examine the most widely canvassed of those options and analyze their legal bases, their potential advantages and disadvantages in terms of effective protection for the marine environment beyond national jurisdiction, and some of the political issues affecting their negotiation and implementation. Some of the options discussed have broader implications for the protection and preservation of the marine environment beyond national jurisdiction and the potential for regulatory oversight of a variety of uses in marine areas beyond national jurisdiction.

#### *Expansion of the International Seabed Authority's Mandate*

The co-location of genetic and biochemical resources with deep seabed minerals has prompted a number of commentators and the CBD/UNCLOS Study to examine the option of expanding the International Seabed Authority's (ISA) mandate to regulate these resources within the geographic scope of the Area.<sup>69</sup> This option would entail a political decision on the part of the States Parties to UNCLOS that genetic and biochemical resources of the deep seabed constitute the common heritage of humankind, and an amendment to Part XI of UNCLOS to include these resources in the definition of resources under Article 137. As Part XI and the Part XI Implementing Agreement are currently tailored to the regulation of deep

68. Leary, see n. 1 above, p. 155; Allen, see n. 1 above, p. 563; Arico et al., see n. 11 above, paras. 5.1.2, 5.1.3 and 5.3.2; F. Pfirter, "The Management of Seabed Living Resources in 'the Area' under UNCLOS," *Revista Electronica De Estudios Internacionales* 11 (2006): 26; M. Lodge, "Improving International Governance in the Deep Sea," *The International Journal of Marine and Coastal Law* 19(3) (2004): 308-313.

69. L. Glowka, "The Deepest of Ironies: Genetic Resources, Marine Scientific Research and the Area," in *Ocean Yearbook* 12 ed. E. Mann Borgese, N. Ginsburg and J.R. Morgan (Chicago: University of Chicago Press, 1996): 171; Leary, see n. 1 above, p. 152; CBD/UNCLOS Study, see n. 44 above, para. 72; Pfirter, see n. 68 above, p. 26.

seabed mineral resources only, extensive amendment of those provisions would be needed—possibly through the mechanism of a further implementing agreement.

This option has the advantage of drawing on the existing institutional infrastructure of the ISA and the scientific and technical expertise that the ISA has developed relating to the exploration of the deep seabed and the protection and preservation of the deep seabed environment.<sup>70</sup> The extensive environmental protection framework and specific measures that have been developed in the Polymetallic Nodules Regulations and the draft Polymetallic Sulphides and Ferromanganese Cobalt Rich Crusts Regulations could be employed as a model for a similar environmental protection system governing the exploration and exploitation of the genetic and biochemical resources of the deep seabed.<sup>71</sup> Measures such as the collection of environmental baseline data, environmental impact assessment, and monitoring of the environment during and after exploration activities would be equally applicable to bioprospecting activities for genetic and biochemical resources. The establishment of impact reference zones and biochemical reference zones as prescribed in the Polymetallic Nodules Regulations and the draft Polymetallic Sulphides and Ferromanganese Cobalt Rich Crusts Regulations for both exploitation and exploration activities would be particularly relevant to bioprospecting activities, where dramatic loss of deep seabed species as yet undiscovered is a real concern.

Notwithstanding these benefits, the proposal to expand the ISA's mandate would have to overcome some significant legal and political hurdles. Under the current provisions of UNCLOS and customary international law, resources of the high seas water column and non-mineral resources of the deep seabed are subject to an open access regime. Political support for including these resources in the common heritage of humankind and regulating their access through a global body such as the ISA would be difficult to obtain, particularly as there are already substantial commercial interests involved in their exploitation.<sup>72</sup> The political obstacles to obtaining international agreement on any expansion of the Part XI regime may be even more intractable now, in an international climate where ideologies of free trade and non-intervention in markets are predominant motifs.<sup>73</sup> In addition, the involvement of the United States in bioprospecting activities and its acknowledged reservations to the Part XI regime do not augur well for the achievement of international consensus on an expanded mandate for the ISA. Another complication adverted to by

70. Leary, see n. 1 above, p. 156; Arico et al., see n. 11 above, para. 5.1.3.

71. Arico et al., see n. 11 above, para. 5.1.4.

72. Leary, see n. 1 above, p. 157; Glowka, see n. 2 above, p. 80.

73. Scheiber, see n. 5 above, pp. 199–200.

Leary is the difficulty of distinguishing bioprospecting activities from marine scientific research and the categorization of marine scientific research as a freedom of the high seas under UNCLOS.<sup>74</sup> While the ISA has the right to carry out marine scientific research concerning the Area and its resources, States Parties and their research institutions have equal freedom to carry out marine scientific research in the Area provided that the research is carried out for peaceful purposes and that the States Parties cooperate with the ISA in developing research programs, training the personnel of developing countries, and effectively disseminating the results of their research and analysis through the ISA or other international channels.<sup>75</sup> In the absence of appropriate amendments to Paris XI and XIII the ISA would have no regulatory powers in relation to marine scientific research activities that were also bioprospecting activities.<sup>76</sup> In addition, Leary notes that recent statements from member States of the ISA and the Secretary General of the ISA indicate a lack of support for an extension of its mandate to include bioprospecting activities.<sup>77</sup>

#### *Implementing Agreements Under Other UNCLOS Provisions*

UNCLOS provides several further anchoring points for an implementing agreement for regulating the environmental protection aspects of bioprospecting activities. One option, foreshadowed above, would be to include the genetic and biochemical resources of the deep seabed under the rubric of marine living resources, along with fisheries and marine mammals. If the resources of the deep seabed were classified in this way they would continue to be subject to an open access regime under the high seas provisions of UNCLOS, subject to any qualifications contained in an implementing agreement—which qualifications could be modelled on the United Nations Fish Stocks Agreement (UNFSA) and underpinned by regional resource management arrangements similar to the regional fisheries management organizations charged with implementing the provisions of UNFSA.<sup>78</sup> Such an implementing agreement could be based on Article 118 of UNCLOS, which provides that States shall cooperate with each other in the conservation and management of living resources in areas of the high seas; it may also entail amendment of UNCLOS to make it clear that marine living

74. Leary, see n. 1 above, pp. 152–153; Arico et al., see n. 11 above, para. 5.1.5.

75. UNCLOS, art. 143.

76. Leary, see n. 1 above, p. 152; Glowka, see n. 11 above, p. 304; Arico et al., see n. 11 above, para. 5.1.3.

77. Leary, see n. 1 above, pp. 161–162.

78. Arico et al., see n. 11 above, para. 5.1.2, discusses the concept of creating marine protected areas under Article 119 rather than the option discussed above.

resources covered by that provision include the genetic and biochemical resources of the deep seabed.

This option has the advantage of avoiding the political disputes associated with the re-classification of the genetic and biochemical resources of the deep seabed as the common heritage of humankind, but has other disadvantages that could make it politically and legally unpalatable. First, the language of Article 118 and the surrounding articles in Section 2 of Part VII is specifically crafted to address the conservation and management of high seas fisheries, with one reference to marine mammals in Article 120. While an implementing agreement could provide supplementary language to address specific conservation and management measures for genetic resources, basing such an agreement on Article 118 may require too expansive an interpretation of this provision and may not attract the support of many States.<sup>79</sup> An agreement modeled on the UNFSA for the conservation and management of genetic and biochemical resources would be a framework agreement only and would still require a network of subsidiary regional agreements similar to regional fisheries management organization agreements for its operation.

Since its adoption in 1995, the UNFSA has not attracted the widespread support expected.<sup>80</sup> A further implementing agreement regulating genetic and biochemical resources may not attract the necessary support from States Parties, particularly if it entails establishing new regional management bodies. While it would, theoretically, be possible to add extra responsibilities for conserving and managing genetic and biochemical resources to the mandate of existing regional fisheries management organizations, these bodies would not possess the expertise or resources to perform such functions. In addition, the geographic jurisdiction of these organizations does not generally correspond to the areas of interest for bioprospecting, with the possible exception of seamounts. Importing the inconsistencies and varying levels of conservation and management inherent in the system of regional fisheries management organizations may be problematic for this new sphere of environmental regulation. Such a network of regional arrangements would require a strong global oversight mechanism to ensure the harmonization of conservation and management measures across different regions. The United Nations Food and Agriculture Organization does not currently have the technical expertise to assume this responsibility for deep seabed resources. Finally, the conservation and management of

79. Glowka, see n. 11 above, p. 304, notes that "it is however unsatisfying to read into these provisions more than what they were originally intended to apply to: species targeted by fisheries activities, especially since MSR activities at hydrothermal vents do not resemble fishing activities."

80. The UNFSA has 67 States Parties as of 31 Dec. 2007: <[http://www.un.org/Depts/los/reference\\_files/chronological\\_lists\\_of\\_ratifications.htm](http://www.un.org/Depts/los/reference_files/chronological_lists_of_ratifications.htm)>.

genetic and biochemical resources on the extended continental shelf that are not sedentary species under the definition in Article 77 of UNCLOS might not be covered under this option unless an amendment recognizing this lacuna in the law were incorporated in the implementing agreement.<sup>81</sup>

An implementing agreement to protect marine areas beyond national jurisdiction where genetic and biochemical resources of the deep seabed are located could also be based on a combination of various articles in Part XII of UNCLOS. The general obligation of States Parties to UNCLOS to protect and preserve the marine environment under Article 192, together with their duty to cooperate in formulating and elaborating international rules, standards, and recommended practices and procedures for the protection and preservation of the marine environment under Article 197, could be the foundation for such an agreement. These two articles could be supplemented by Article 194(5), which provides that States shall take measures to protect and preserve rare and fragile ecosystems as well as the habitats of depleted, threatened, or endangered species and other forms of marine life; and by Article 196(1), which provides that States shall take all measures necessary to prevent, reduce, and control pollution of the marine environment, whether resulting from the use of technologies under their jurisdiction or control or from the intentional or accidental introduction of species alien or new to a particular part of the marine environment.

The option of basing an implementing agreement on provisions of UNCLOS has been canvassed by both the CBD's Ad Hoc Open-ended Working Group on Protected Areas, in the context of establishing a legal basis for marine protected areas beyond national jurisdiction, and the UNGA's Ad Hoc Open-ended Informal Working Group on the Protection of High Seas Biodiversity. However, the specific terms of such an agreement have not been determined.<sup>82</sup> The scheme of marine protected areas envisaged in the CBD Working Group discussions would not be limited to protecting the genetic and biochemical resources of the deep seabed; the scheme would provide broader, area-based environmental protection measures for the various components of the marine ecosystems situated in selected marine areas beyond national jurisdiction identified as requiring protection. Likewise, the UNGA Informal Working Group is discussing an implementing agreement to UNCLOS within the broader context of the protection of high seas biodiversity as a whole.

The option of an implementing agreement based on a combination of articles from Part XII of UNCLOS has the advantage of being founded in significant part on what is recognized in most other international environ-

81. Leary, see n. 1 above, p. 151.

82. See n. 9 and 54 above.

mental instruments as the constitutive instrument for oceans governance.<sup>83</sup> The relevant articles in Part XII also relate exclusively to the protection and preservation of the marine environment, and not to the politically contentious aspects of access to and ownership of marine resources. On the other hand, the articles in Part XII are very general in character and do not reflect international environmental law concepts of a more recent vintage, such as the protection of biodiversity and the sustainable use or development of marine resources, contained in the CBD and Chapter 17 (Oceans Chapter) of Agenda 21. An implementing agreement based on Part XII of UNCLOS would be reinforced if the duty of States to cooperate in the conservation and sustainable use of biodiversity in areas beyond national jurisdiction (in Article 5 of the CBD) were incorporated in Part XII, together with concepts such as the conservation of marine biodiversity, the precautionary principle, environmental impact assessment, and ecosystem-based management of the marine environment. At the time it was negotiated, Part XII contained (in articles such as Article 194(5) and Article 196(1)) some embryonic recognition of these concepts, which were subsequently represented in the CBD and Chapter 17 of Agenda 21.<sup>84</sup> Unlike Part XI, Part XII does not establish any particular multilateral institution that could assume responsibility for putting such an implementing agreement into operation. Politically, it may prove difficult to garner support among States Parties for an implementing agreement based on a combination of very general articles in Part XII, unless amendments to UNCLOS introduce the concept of marine biodiversity and impose a duty to cooperate on States Parties in the conservation and management of biodiversity in areas beyond national jurisdiction.

#### **Implementing Agreement Under the CBD**

The provisions of the CBD provide a possible foundation for an implementing agreement for regulating the impact of bioprospecting activities on deep seabed environments in marine areas beyond national jurisdiction.

<sup>83</sup> UNCLOS has 155 States Parties as of at 31 Dec. 2007: <[http://www.un.org/Depts/los/reference\\_files/chronological\\_lists\\_of\\_ratifications.htm#](http://www.un.org/Depts/los/reference_files/chronological_lists_of_ratifications.htm#)>.

<sup>84</sup> D. Freestone, "The Conservation of Marine Ecosystems," in *International Law and the Conservation of Biological Diversity*, ed. M. Bowman and C. Redgwell (The Hague: Kluwer Law International, 1996), p. 107, notes "At the level of customary international law the coming into force of the 1982 Law of the Sea Convention must be seen as a most positive force in the crystallization of the general obligations of States to protect the marine environment. Nevertheless, important though the obligations of Part XII are in this respect, they too require further substantial elaboration and implementation." See also the discussion in Chapters 3 and 4.

Article 5 of the CBD mandates cooperation between the Contracting Parties, directly or through competent international organizations, for the conservation and sustainable use of biological diversity in areas beyond national jurisdiction. Biological diversity is defined in Article 1 as the "variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." The conservation of biodiversity and the sustainable use of its components—including genetic and other biological resources—is inextricably linked to the objectives of the Convention as expressed in Article 1.<sup>85</sup> An implementing agreement under Article 5 could draw on the full range of environmental protection measures expounded in the CBD, including marine protected areas and the other measures prescribed in Articles 8, 9, and 14 relating to *in situ* and *ex situ* conservation, environmental impact assessment, and the minimization of adverse impacts on marine biodiversity. Such an implementing agreement could provide an environmental protection template for selected marine areas beyond national jurisdiction that are rich in biodiversity.<sup>86</sup>

Based on advice from regional marine environmental protection organizations such as the UNEP Regional Seas Programmes and the Subsidiary Body for Scientific, Technical, and Technological Advice (SBSTTA), the Conference of the Parties (COP) of the CBD could identify marine areas beyond national jurisdiction where special measures are needed to conserve biological diversity. It could also develop best practice guidelines for the establishment and management of protected areas, or

<sup>85</sup> S. Johnston, "Sustainability, Biodiversity and International Law," in *International Law and the Conservation of Biological Diversity* (The Hague: Kluwer Law International, 1996), p. 69, enumerates some of the basic features of the term "sustainable use" which are increasingly being accepted including "preservation; management on the basis of biological unity; a holistic ecosystem approach to management; rehabilitation of denuded aspects of biodiversity; integrated approach; intergenerational equity; research efforts; monitoring the effects of use; establishment of flexible management systems and the precautionary approach are all arguably corollary duties implied by the concept."

<sup>86</sup> Glowka, see n. 11 above, p. 304, notes that: "with respect to biodiversity conservation the CBD fills in some of the gaps left by UNCLOS. . . . Beyond the limits of national jurisdiction, as with UNCLOS, the situation becomes less defined and depends on the proactive actions of Parties working alone or together with other Parties and States. Parties are to cooperate on processes and activities that may threaten biological diversity. This provides a basis for action in the Area." Glowka also points out that the CBD is more than its obligations and has an elaborate work program which gives it "the ability to further define and deepen the Convention's obligations directly or as they are applied in particular contexts. In contrast to UNCLOS' more static nature, this dynamic process makes the CBD adaptable and facilitates its evolution."



areas where special measures need to be taken to protect biodiversity. The COP's recommendations could then be implemented through global and regional organizations with regulatory competencies in particular marine areas beyond national jurisdiction. For example, the marine environmental protection organization for the North East Atlantic (OSPAR) and the North East Atlantic Fisheries Commission (NEAFC) might collaborate to implement environmental protection measures related to the conservation and sustainable use of biological diversity on a seamount in their joint areas of regulatory competence. For hydrothermal vent areas beyond national jurisdiction, the ISA might collaborate with one of the UNEP Regional Seas organizations with responsibility for the proximate area in which the vent occurs to implement environmental protection measures related to the conservation and sustainable use of biological diversity. Collaboration between global and regional organizations with regulatory competencies beyond national jurisdiction would strengthen and integrate protection and preservation of the marine environment beyond national jurisdiction. Negotiating such an implementing agreement would necessarily raise the issue of ownership and access to genetic and biochemical resources on the deep seabed in marine areas beyond national jurisdiction. As discussed above, the political will to classify these resources as the common heritage of humankind may be elusive in view of the substantial commercial interests already involved in sampling these resources. In the absence of political consensus among the members of the international community, it may still be politically and legally viable to regulate the adverse environmental impacts of the current open access regime through collaborative action.

#### *Status Quo and Self-Regulation*

A fourth option to consider is leaving the open access situation which currently applies to the genetic and biochemical resources of the deep seabed and to bioprospecting activities in these areas undisturbed. This option would parallel the free market conditions which applied to all high seas fisheries before the advent of the UN Fish Stocks Agreement and the involvement of regional fisheries management organizations in the management and conservation of straddling stocks and highly migratory stocks in marine areas beyond national jurisdiction. As one commentator has observed, this may lead to some long-term advantages for humankind in general, because the competition engendered by competitive exploitation of genetic and biochemical resources found on the deep seabed will stimulate new inventions and research techniques.<sup>87</sup> On the other hand,

87. Scheiber, n. 5 above, p. 200.

commercial investors will have little incentive to introduce costly measures for the conservation and sustainable use of genetic and biochemical resources and the protection of deep seabed biodiversity. Marine scientists and other commentators have predicted that the failure to implement environmental protection measures for deep seabed environments such as hydrothermal vents, cold seeps, and seamounts risks rapid loss of species and general degradation of fragile habitats.<sup>88</sup> In addition, the primary motive for commercial investment will continue to be the maximization of profits, rather than any commitment to the fair and equitable benefit sharing of global commons resources among current and future generations. While bioprospecting activities continue to be predominantly conducted by State-sponsored research institutions with the primary purpose of marine scientific research, voluntary codes of conduct introduced by deep-sea scientists will afford some level of protection for the surrounding marine environment. The next section will examine the content of one of these codes. However, these measures are voluntary, and will not bind commercial operators who conduct bioprospecting activities in a private enterprise framework. Ultimately, the failure to address the regulation of bioprospecting activities could lead to rapid over-exploitation of these valuable resources of the deep seabed and the loss of important genetic and biochemical material not yet discovered by marine scientists.

#### MARINE SCIENTIFIC RESEARCH

Marine scientists and environmental commentators are becoming increasingly concerned at the risks posed by the proliferation of research activities in vulnerable areas of the deep seabed beyond national jurisdiction.<sup>89</sup> Although the highly specialized and expensive technology used to access the deep seabed is still the preserve of well-funded research institutions in very few countries, research cruises are becoming more frequent and are leaving more tangible imprints on sensitive deep seabed ecosystems.<sup>90</sup> The conduct of marine scientific research beyond national jurisdiction is subject to very few international law norms. This has led marine scientists involved in deep-sea research to formulate their own codes of conduct for such research in order to minimize the adverse impacts of their work on the marine

88. Juniper, n. 13 above, p. 95; Thiel, n. 36 above, p. 171; Scheiber, n. 5 above, pp. 200-210; Leary, n. 1 above, p. 166.

89. Juniper, see n. 13 above, p. 93; Thiel, see n. 36 above, pp. 171-172; Glowka, see n. 11 above, p. 303; Baker et al., see n. 11 above, p. 18.

90. Baker et al., see n. 11 above, p. 18; Glowka, see n. 11 above, p. 303; Arico et al., see n. 11 above, para. 3.3; *Science News*, Week of Oct. 7, 2000, available online: <<http://www.sciencenews.org/articles/20071007/bob7.asp>>.

environment. This section will examine the applicability of international law principles to the conduct of marine scientific research beyond national jurisdiction and the content of a code of conduct which has been negotiated between some deep-sea research scientists. It will also review some options for further international law regulation of marine scientific research beyond national jurisdiction.

#### The Level of Marine Scientific Research Beyond National Jurisdiction and Its Impact on the Marine Environment

The remote nature (more than 1,000 metres below the surface of the ocean) and extreme conditions of deep seabed environments impose automatic limitations on scientific expeditions to the deep seabed.<sup>91</sup> Nevertheless there is now a wide array of independent public and private research institutions engaged in deep seabed research, with definite physical impacts on the marine environment.<sup>92</sup> Several commentators note that deep-sea science has now moved from a descriptive and observational phase to a more interventionist stage that involves sampling and the installation of scientific equipment on the deep sea floor to conduct *in situ* experiments.<sup>93</sup> Arico and Salpin describe the second American Museum of Natural History black smokers expedition to the Endeavour segment of the Juan de Fuca mid-ocean ridge, which removed four chimneys of several tons each from this hydrothermal vent area at a depth of 2,300 metres.<sup>94</sup> Other reported impacts include the removal of benthic fauna and the introduction of alien elements such as light and noise into the deep-sea environment.<sup>95</sup> Some deep-sea experiments have resulted in changes of water temperature and the disposal of biological material in areas different from the sampling area.<sup>96</sup> Scientists are also concerned about the rising frequency of visits to hydrothermal vents and the pressure caused by concentrated observation and sampling on a few well-known vent communities which have been

91. Arico et al., see n. 11 above, para. 3.4: "A limited number of institutions worldwide own or operate vehicles that are able to reach areas deeper than 1000 metres below the ocean's surface, and can therefore be actively involved in deep seabed research."

92. Arico et al., see n. 11 above, para. 3.2.1; Leary, see n. 1 above, pp. 137-138, 148.

93. Juniper, see n. 13 above, p. 167; Glowka, see n. 11 above, p. 304; Baker et al., see n. 11 above, p. 18.

94. Arico et al., see n. 11 above, para. 3.2.1.

95. Leary, see n. 1 above, p. 167; Baker et al., see n. 11 above, p. 18; Arico et al., see n. 11 above, para. 3.3.

96. Leary, see n. 1 above, p. 167; Arico et al., see n. 11 above, para. 3.3.

subjected to multiple research expeditions.<sup>97</sup> The absence of restrictions on access to the deep seabed has led to different research institutions proposing duplicate and incompatible scientific experiments for the same deep seabed area.<sup>98</sup> While deep-sea scientists themselves have begun to impose some constraints on their research expeditions through a research reserve system that operates by consensus, amplified research of deep seabed sites in the future may require a more systematic approach where access to certain sites is controlled to reduce adverse impacts on the marine environment.<sup>99</sup>

#### The Applicability of Existing International Law Principles to Marine Scientific Research Beyond National Jurisdiction

UNCLOS is the principal international law instrument governing marine scientific research both within and beyond national jurisdiction. UNCLOS provisions concerning marine scientific research beyond national jurisdiction are very liberal, reflecting the continuing need to promote scientific research in this largely uncharted realm of the oceans. Scientific research is listed as one of the freedoms of the high seas in Article 87(1)(f); Article 257 reinforces this freedom by providing that all States and competent international organizations have the right to conduct marine scientific research in the water column beyond the limits of the exclusive economic zone. As discussed above in relation to bioprospecting activities, some general principles apply to the conduct of marine scientific research in the high seas water column, including the requirement to conduct such research exclusively for peaceful purposes and not to unjustifiably interfere with other legitimate uses of the sea such as navigation and fisheries.<sup>100</sup> States are also required to promote and create favorable conditions for marine scientific research and publish and disseminate information on proposed major research programs as well as knowledge from marine scientific research.<sup>101</sup> The only method of enforcement for any of these general principles in marine areas beyond national jurisdiction is the system of flag State jurisdiction, which would apply to State-sponsored vessels conducting marine scientific research in these areas.

UNCLOS also provides a permissive environment for State-sponsored marine scientific research in the Area. States Parties have the right to carry

97. Arico et al., see n. 11 above, para. 3.3; Glowka, see n. 11 above, p. 304.

98. Glowka, see n. 11 above, p. 304; Baker et al., see n. 11 above, p. 18.

99. Arico et al., see n. 11 above, para. 3.3.

100. UNCLOS, art. 240 (a) and (b).

101. *Id.*, arts. 239 and 244(1).

out marine scientific research in the Area in parallel with the ISA, which has a right to carry out marine scientific research concerning the Area and its resources.<sup>102</sup> Marine scientific research in the Area must be carried out for the benefit of humankind as a whole.<sup>103</sup> States Parties conducting marine scientific research in the Area are encouraged to collaborate with the ISA in conducting international marine scientific research programs, to ensure that such programs involve training and participation by personnel from developing States and that the results of their research are disseminated when available through the Authority.<sup>104</sup> Some commentators have noted that the ISA clearly has a mandate to implement measures to regulate marine scientific research associated with deep seabed minerals.<sup>105</sup> The scope of the ISA's authority, however, does not extend to prohibiting or controlling marine scientific research related to non-living resources in the Area.<sup>106</sup> To date, the ISA has concentrated on the impact of deep seabed mining activities on the marine environment of the Area and generally taken a *laissez-faire* approach to the conduct of marine scientific research and bioprospecting activities in the Area. In this context the Secretary General of the Authority, Ambassador Satya Nandan commented in an ISA press release of 7 August 2003: "We are not looking to control or manage or regulate marine scientific research. We are not looking to license bioprospectors or to deal with the patent rights of bioprospectors."<sup>107</sup>

As discussed above in relation to bioprospecting activities beyond national jurisdiction, the CBD merely exhorts Contracting Parties to cooperate in respect of areas beyond national jurisdiction for the conserving and sustainable use of biological diversity in Article 5. If an implementing agreement were to be negotiated based on Article 5 regarding the conservation and sustainable use of biological diversity beyond national jurisdiction, there may be some regulatory consequences for marine scientific research conducted in areas identified as requiring special environmental protection measures. Currently, however, with the international law *canvas* devoid of any access regime or environmental protection measures applicable to marine scientific research beyond national jurisdiction, scientists have taken some steps to regulate their own marine scientific research activities in areas beyond national jurisdiction and their impact on the marine environment.

102. *Id.*, art. 143 (2) and (3).

103. *Id.*, art. 143(1).

104. *Id.*, art. 143(3).

105. R. Churchill and A. Lowe, *The Law of the Sea* (3rd ed.) (Manchester: Manchester University Press, 1999), p. 404; Leary, see n. 1 above, p. 152.

106. Leary, see n. 1 above, pp. 152-153.

107. ISA, *Press Release—Ninth Session of Seabed Authority Concludes in Kingston*, ISA Doc SB/9/13, 7 Aug. 2003, p. 2.

### Self-Regulation by the Marine Scientific Community Beyond National Jurisdiction

Concerned by the potential threats to the deep sea environment posed by the escalation in research expeditions and associated activities such as deep sea tourism, the marine scientific community has taken a number of initiatives to coordinate research projects and develop codes of conduct to minimize harmful impacts to deep seabed sites. InterRidge, which is a scientific research body formed to exchange information and support international research on mid-ocean ridges, has issued a voluntary Code of Conduct for the Scientific Study of Marine Hydrothermal Vent Sites.<sup>108</sup> The objective of the Code is to minimize the impacts of scientific research on such sites and to maximize the efficiency of necessary research by reducing or avoiding potential use conflicts.<sup>109</sup> The Code applies to organizations and affiliated individuals undertaking marine scientific research and deep-sea tourism at hydrothermal vent sites.<sup>110</sup> Elements of the Code were developed at meetings of an InterRidge Working Group on Mid-Ocean Ridge Ecosystems.<sup>111</sup> In their application to marine areas beyond national jurisdiction, these elements included:

- (a) notifying InterRidge of intended research cruise dates, sites of activity and types of activity;
- (b) contacting other users to gather information and discuss compatible uses;
- (c) avoiding or minimizing activities that
  - (i) cause long-term decline of the resource to the detriment of future users;
  - (ii) decrease biodiversity at ecosystem, species and genetic levels;
  - (iii) interfere with other ongoing investigations; or
  - (iv) compromise the safety of underwater vehicles;
- (d) maximize sampling efficiency by, for example,
  - (i) minimizing waste;

108. The InterRidge Code of Conduct was issued in July 2006 (*Science News*, Week of Oct. 7, 2006, available online: <<http://www.sciencenews.org/articles/20061007/bob7.asp>>).

109. Arico et al., see n. 11 above, para. 5.6.1.

110. *Id.*

111. InterRidge Meetings, *Working Group Meeting Report: Mid Ocean Ridge Ecosystems*, University of Bremen, 18-19 Jan. 2004, Discussion of Code of Conduct Project, para. 6, available online: <<http://www.interridge.org>>.

- (ii) developing micro-analytical techniques and alternatives to physical sampling; and
- (iii) making productive use of any excess materials.<sup>112</sup>

InterRidge has also been proactive in establishing a research reserve scheme, which evolved from a 1995 recommendation by the InterRidge Biological Studies Ad Hoc Committee to demarcate seabed sanctuaries.<sup>113</sup> Under this system scientists conducting deep seabed research and observations submit requests to the InterRidge website, which requests other scientific researchers to avoid disturbing scientific experiments at a specific deep seabed site.<sup>114</sup> This system appears to have fallen into disuse in recent years, although there were a number of requests posted on the InterRidge website for marine areas beyond national jurisdiction in 1998 and 1999.<sup>115</sup> In the absence of any international instrument regulating the impact of marine scientific research on the marine environment beyond national jurisdiction the InterRidge initiatives are important interim measures in the conservation and sustainable use of biodiversity in these areas.

#### **Potential Environmental Protection Regimes for Marine Scientific Research Beyond National Jurisdiction**

The options for regulating the adverse impacts of marine scientific research on the marine environment beyond national jurisdiction resemble those for regulating the related activity of bioprospecting. As discussed above, the two activities will frequently be intertwined. The key differences between the two activities lie in the commercial objectives associated with bioprospecting and the access and benefit sharing issues related to the resources, rather than the environmental protection aspects. The international law instruments that provide a basis for negotiating a regulatory framework that would capture marine scientific research activities beyond national jurisdiction are UNCLOS and the CBD. This section will examine some potential options for such regulation of the adverse impacts of marine scientific research on the marine environment beyond national jurisdiction and analyze their benefits and disadvantages.

112. Glowka, see n. 11 above, p. 309, n. 15.

113. Glowka, see n. 11 above, p. 309; Arico et al., see n. 11 above, para. 3.3.

114. Glowka, see n. 11 above, p. 309.

115. *Id.*

#### **Expansion of the ISA's Mandate**

Expanding the ISA's mandate to incorporate genetic and biochemical resources of the deep seabed would have potential regulatory consequences for the conduct of marine scientific research on living resources of the deep seabed in the Area. If an implementing agreement were negotiated to accomplish that expansion, the ISA would likely acquire more regulatory authority over the combined bioprospecting and marine scientific research activities currently associated with these resources in the Area. As with the mineral resources of the deep seabed, the ISA would then have unambiguous power to prescribe environmental protection measures to be followed by research consortia engaged in sampling and testing activities related to the genetic and biochemical resources of the Area.<sup>116</sup> Pure marine scientific research with no commercial objectives may continue to be permitted under the parallel regime prescribed in Article 143 of UNCLOS, but may be subject to more constraints associated with environmental protection and accommodation of uses. Under an expanded mandate, the ISA would have the authority to coordinate environmental protection measures for all the activities taking place in the Area and the authority to resolve any problems associated with conflicting uses and incompatible scientific experiments. The ISA is already engaged in collaborative research projects with the marine scientific research community on the impact of mineral exploitation activities on deep seabed ecosystems and is developing considerable expertise in environmental protection issues associated with the Area.<sup>117</sup> The political obstacles to expanding the ISA's mandate to cover the genetic and biochemical resources of the Area have been discussed above and relate principally to the designation of such resources as the common heritage of humankind, the implications for equitable sharing of such a designation, and some reluctance on the part of the ISA itself to assume additional responsibilities beyond its current mandate.

#### **Implementing Agreement Under UNCLOS or the CBD**

An implementing agreement under the UNCLOS provisions discussed above or under Article 5 of the CBD with the broad objective of conserving marine biodiversity beyond national jurisdiction offers some potential for limiting the adverse impacts of marine scientific research on the deep seabed environment. If marine protected areas beyond national jurisdiction are established under such an agreement, regional organizations overseeing

116. Glowka, see n. 11 above, p. 309, n. 15.

117. Leary, see n. 1 above, pp. 161-162.



management plans in these areas could be responsible for ensuring that activities undertaken are compatible with the conservation and sustainable use of marine biodiversity. Consultation and collaboration with the marine scientific community, as one of the principal users of such areas, would be an essential element in that process. Regional organizations involved in such planning will inevitably need to utilize the expertise of the marine scientific research community in implementing a range of *in situ* and *ex situ* conservation measures for deep seabed areas. The array of *in situ* and *ex situ* conservation measures prescribed in Articles 8 and 9 of the CBD have application to and benefits for the marine scientific research community. In conflicts between a proposed marine scientific research use and a conservation objective, the only disadvantage of an implementing agreement under either UNCLOS or the CBD might be that the UNCLOS provisions concerning the freedom of marine scientific research would prevail. In these circumstances, consultation among regional conservation organizations and the marine scientific research community should resolve any disputes.

#### *Status Quo and Self-Regulation*

Preserving the status quo, in which the conduct of marine scientific research beyond national jurisdiction is largely unregulated, will inevitably lead to conflicts with other uses as resource exploitation in these areas increases and a consequential loss of marine biodiversity is experienced. While InterRidge's initiatives to develop a code of conduct for deep sea scientists and establish a system of research reserves have the potential to provide an interim shield against the adverse impacts of intrusive scientific experiments in deep sea environments, these measures focus on reducing the effects of individual scientific experiments on the deep seabed environment and do not incorporate long-term, holistic environmental protection measures such as the collection of environmental baseline data, environmental impact assessment, and monitoring of the impact of scientific experiments on particular areas of the deep seabed. These initiatives are also entirely voluntary, with no built-in enforcement mechanisms to bind scientific researchers to their strictures. The system of requesting research reserves introduced by InterRidge to reduce the impact of multiple scientific experiments on the deep seabed, while initially popular, has failed to attract widespread support from scientific researchers. The current permissive environment for marine scientific research beyond national jurisdiction does not provide any explicit or binding mechanisms at the global or regional level for resolving disputes over uses which may conflict with marine scientific research activities in particular deep seabed areas. While the environmental protection initiatives taken by the marine scientific

community are commendable, they only represent an incremental step in achieving comprehensive environmental protection for the deep seabed beyond national jurisdiction.

#### CONCLUSION

A review of the international law principles applicable to bioprospecting and marine scientific research in marine areas beyond national jurisdiction exposes gaping fissures in the international law frameworks and institutional arrangements available to provide long-term environmental protection to remote but valuable deep seabed ecosystems and their surrounding habitats. The only concrete environmental protection measures currently being implemented in relation to the deep seabed are those prescribed in the ISA's Polymetallic Nodules Regulations for exploration contractors involved in the embryonic deep seabed minerals industry. UNCLOS will need considerable amplification and imaginative interpretation of its provisions on the protection and preservation of the marine environment, marine living resources, the Area, and the high seas before it can provide a legal basis for a holistic system of protection of the marine environment beyond national jurisdiction that can accommodate new and intensifying uses of these areas, such as bioprospecting and marine scientific research. The CBD is a more recent instrument that employs the unifying concept of biological diversity as the basis for its environmental protection provisions and incorporates international environmental law principles such as the precautionary approach and environmental impact assessment. If the duty on States to cooperate in the conservation and sustainable use of biodiversity in areas beyond national jurisdiction under Article 5 of the CBD were to be incorporated as an amendment to Part XII of UNCLOS, this could form the legal basis for an implementing agreement for protecting marine biodiversity beyond national jurisdiction. Such an agreement could be modelled on the measures prescribed in the CBD for the conservation and sustainable use of biodiversity within national jurisdiction, including the identification, monitoring, and prescription of biodiversity conservation measures for components of marine biodiversity beyond national jurisdiction. Ultimately, the coalescence of the international environmental law principles reflected in the CBD and the law of the sea principles codified in UNCLOS will be necessary if international law is to provide a strengthened framework for protection of the marine environment beyond national jurisdiction against the adverse impacts of activities such as bioprospecting and intensified marine scientific research.

