Marine Biodiversity Beyond National Jurisdictions Workshop
January 17, 2006

- Final Report -

Marine & Environmental Law Institute
Dalhousie Law School
6061 University Avenue
Halifax, NS B3H 4H9
Canada
Tel: (+1 902) 494-1988
Fax: (+1 902) 494-1316
http://www.dal.ca/law/MELAW

DALHOUSIE UNIVERSITY
MARINE & ENVIRONMENTAL LAW INSTITUTE

Workshop Co-Chairs:

Dr. Moira L. McConnell (Director, Marine & Environmental Law Institute, Dalhousie Law School)
Dr. David VanderZwaag (Canada Research Chair in Ocean Law & Governance, Dalhousie Law School)

Workshop Rapporteur:

Megan Sikaneta (Coordinator, Ocean Management Research Network)

Table of Contents

List of Acronyms ..... *i*

Overview (Dr. Moira L. McConnell and Dr. David VanderZwaag) ..... *ii*

Summary of the Workshop Sessions *1*

Overview & Introduction: "Setting the context" **1**

Session I: The Context – Science and Law with a Focus on High Seas Fisheries and Marine Biodiversity **2**

High Seas Fish Stocks and Marine Biodiversity (Professor Boris Worm, Dalhousie University – *Dr. Worm's PowerPoint presentation can be found in Appendix III.)* 2

Deep Sea Corals (Professor Martin Willison, Dalhousie University) 2

The Legal Regime (Dean Phillip Saunders, Dalhousie Law School) 3

Session II: Canadian Government Perspectives **6**

The UN Working Group: How We Got There and What We Can Expect (Mr. Louis Simard, Director, Oceans and Environmental Law Division, Department of Foreign Affairs) 6

The UN Working Group and the International Oceans Governance Agenda (Mrs. Lori Ridgeway, Director General, International Coordination and Policy Analysis, Fisheries and Oceans Canada) 7

Session III: Genetic Resources of the Seabed **9**

The Scientific Perspective (Professor Kim Juniper, University du Quebec a Montreal) 9

The Interest of the Biotechnology Sector (Dr. Adam Burja, Principal Research Scientist, Metabolic Eng. & Fermentation Group Leader, Ocean Nutrition Canada) 10

Government Perspective (Mr. Andrew Hurst, Policy Advisor, Biodiversity Convention Office, Environment Canada) 10

Session IV: Integrated Oceans Governance and Protection of Marine Biodiversity – Issues and Directions **12**

Options for Improving International Protection of Marine Biodiversity Beyond National Jurisdiction (Ms. Lee Kimball, IUCN, Washington) 12

The Fishing Industry's Interest (Mr. Pat McGuinness, President, Fisheries Council of Canada) 13

An ENGO View (Mr. Joshua Laughren, Director Marine Conservation, WWF-Canada) 14

The Government Perspective (Ms. Renée Sauvé, Senior Policy Advisor, International Coordination and Policy Analysis, Fisheries and Oceans Canada) 14

Session V: General Discussion: Issues, Policy Options, and Main Questions **15**

General Themes 15

Discussion in Response to Workshop Questions Distributed 17

Appendix I: Workshop Agenda *21*

Appendix II: List of Workshop Participants *23*

Appendix III: Discussion Questions *24*

Appendix IV: Presentation by Dr. Boris Worm *26*

Appendix V: Main Background Documents *27*

LIST OF ACRONYMS

BBNJ	Biodiversity Beyond National Jurisdictions
CBD	Convention on Biological Diversity (1992)
CCAMLR	Convention for the Conservation of Antarctic Marine Living Resources
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
EEZ	Exclusive Economic Zone
ENGO	Environmental Non-Governmental Organisation
IMO	International Maritime Organization
IUU Fishing	Illegal, Unregulated, and Unreported (fishing)
MARPOL	The International Convention for the Prevention of Pollution of Ships (1973/1978)
MERMO	Marine Ecosystem and Resource Management Organization
MPA	Marine Protected Area
NAFO	Northwest Atlantic Fisheries Organization
NEAFC	Northeast Atlantic Fisheries Commission
NGO	Non-Governmental Organization
RFMO	Regional Fisheries Management Organization
ROMO	Regional Ocean Management Organization
UNCLOS	1982 United Nations Convention on the Law of the Sea
UNFA	1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory
UNGA	United Nations General Assembly
UNICPOLOS	United Nations Open-ended Informal Consultative Process on Ocean Affairs
VMS	Vessel Monitoring System

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OVERVIEW (DR. MOIRA L. MCCONNELL AND DR. DAVID VANDERZWAAG)

On January 17, 2006 the Marine & Environmental Law Institute based at Dalhousie Law School organized and hosted a one-day Workshop on the issue of Marine Biodiversity Beyond National Jurisdiction (BBNJ). The Workshop was organized with the financial support and cooperation of the Department of Foreign Affairs, in particular the Oceans and Environmental Law Division, in cooperation with Fisheries and Oceans Canada (International Coordination and Policy Analysis) and Environment Canada (Biodiversity Convention Office).

The Workshop was specifically designed as an informal workshop with a number of invited "Lead Commentators" drawn from academia, ENGOs, industry and government, but with no formal papers or presentations (with one exception, see Appendix III). Instead, a summary of the Lead Commentators' observations and the ensuing discussion is provided in this Report.

The Workshop had two primary objectives:

- to provide additional information and identify issues to assist in the formulation of a "Canadian view" on the issue of BBNJ for the interagency delegation that would be attending the first meeting (February 13-17, 2006) of the Ad Hoc Open-ended Informal Working Group on conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction created pursuant to UN resolution (59/24) which was passed in November, 2004 at the 59th UN General Assembly.

- to provide an opportunity for the exchange of information and a forum for informal discussion among science, law and policy researchers, ENGOs and industry and relevant government departments with the view to further exchanges.

The Workshop Agenda was organized into three substantive/descriptive sessions aimed at providing information on the issue of high seas biodiversity and, specifically, high seas fisheries and bioprospecting and genetic resources of the seabed, and current policy and legal issues and responses. This was followed by a fourth session exploring potential approaches and options at the international level to these issues. The Workshop culminated in a facilitated discussion which considered, *inter alia*, a number of questions on issues raised in the earlier sessions, with a particular emphasis on policy options (a copy of the "questions for discussion" is found in Appendix V).

A copy of the Agenda is found in Appendix I. A list of participants that attended the Workshop is found in Appendix II. Copies of the main background documents for the Workshop are found in Appendix IV. As indicated above, the following Report provides a brief summary of the key points made by the Lead Commentators for each of the four sessions and summarises the resulting discussion on the topics.

SUMMARY OF THE WORKSHOP SESSIONS

Overview & Introduction: "Setting the context"

Following welcoming remarks from the Co-Chair Professor Moira McConnell (Director, Marine & Environmental Law Institute, Dalhousie Law School), and Richard Ballhorn (Director General of the Legal Affairs Bureau of the Department of Foreign Affairs), Professor David VanderZwaag, Co-Chair (Canada Research Chair in Ocean Law & Governance, Dalhousie Law School), provided opening remarks and a substantive overview of the issue for the Workshop under the title "Setting the context".

Governance of the high seas and biodiversity beyond national jurisdiction is a topic that involves significant challenges. Dr. VanderZwaag described some of those challenges as follows:

Tempestuous Sea
There is a major clash of political viewpoints. While some countries take the position that bioprospecting should be guided by UNCLOS, and an open access, first-come-first-serve approach, others believe in our common heritage as a governing construct and focus on notions of equity, especially with regard to developing countries' abilities to benefit. We are also seeing ethical clashes between those with an ecocentric view of the world versus those with more of a utilitarian view (e.g. resource exploitation).

Swirling Currents
There is a swirling array of international discussions, such as those of the World Trade forums, the Convention on Biological Diversity Working Group, the United Nations General Assembly, review of the United Nations Fish Stock Agreement, etc.

Murky Waters/Muddy Waters
There is no clear vision as to whether new institutions should be established and if so what those mechanisms should be. There is also no clear picture of the legal route to bolster oceans beyond national jurisdiction.

Hazy Horizons
The types and categories of high seas uses that should be controlled remains hazy, such as high seas fishing and bioprospecting.

Just Leaving Port
We have spent centuries working out the jurisdictional rights and claims to the uses of the oceans. More recently we have been struggling with the responsibilities, but this voyage has hardly begun. Many people in the management field feel that the principles, such as the precautionary approach, public participation, etc. for governing resources are not clear. What do these mean at national and international levels?

Deluge of Documents
We are experiencing an onslaught of papers, articles, books, etc. all trying to explain various issues, and gaps. We need to come out from under these mounds of paper to putting our ideas into action.

Session I: The Context – Science and Law with a Focus on High Seas Fisheries and Marine Biodiversity

Lead Commentators

- High Seas Fish Stocks and Marine Biodiversity (Professor Boris Worm, Dalhousie University)
- Deep Sea Corals (Professor Martin Willison, Dalhousie University)
- The Legal Regime (Dean Phillip Saunders, Dalhousie Law School)

High Seas Fish Stocks and Marine Biodiversity *(*Professor Boris Worm, Dalhousie University – *Dr. Worm's PowerPoint presentation can be found in Appendix III.)*

The high seas and deep ocean are often considered to be the "last frontier", and a sense of common rights has prevailed, and the use of extraction methods that are considered to be unacceptable inshore and that are technologically advanced is common. This approach to the use of the high seas and deep ocean has led to a startling decline in species abundance, richness, and diversity. Not only has this decline reached 90% in some cases, but the rate of decline has been significant as well, with most species being lost or diminished within the last 20 years. In so doing, the very structure of the high seas and deep ocean have been disrupted to the point where ocean functions may be significantly altered (e.g. ocean production).

The challenges with regard to scientific data, such as a general lack of data, particularly data that is regionally relevant was also noted. Data is also not shared, nor is it necessarily reliable when looking at conservation needs, as much data may be from commercial sources, may not be complete, and may be based upon shifting baselines. It was suggested that a higher degree of observer data, particularly in connection with fisheries, would be greatly valued, as would an international body to manage the accumulation and dissemination of data worldwide that might be set to comparable standards.

It was suggested that for conservation purposes a regional approach to management of the high seas and deep ocean would not be effective as the approaches were seen to be fragmented and the potential for conflict is considered to be high. Given that the use of the high seas and deep ocean is global in nature, a global approach was considered necessary. It was also suggested in connection with high seas species that some attention should be paid to restoring biodiversity rather than simply protecting it, as historical data suggests that we are already experiencing a significant decrease in and loss of biological diversity.

Deep Sea Corals (Professor Martin Willison, Dalhousie University)

Dr. Willison brought an example of part of a deep sea coral and noted the impact of fishing gear on the coral. In his view this illustrated the immediate need to protect deep sea environments. Deep sea corals, which feed by sitting in the ocean's current, exist in areas that are characterised by strong currents, such as seamounts. In such environments the corals may be abundant, but they are also very localised. It is not by coincidence that fish also congregate in such areas as the corals provide habitat and both are indicative of an environment that is conducive to high levels of biodiversity. As such, fishing efforts directed at these areas are common and fishing practices, such as trawling, produce rewarding catches, but also damage, for example, corals. In many cases species in these environments are slow growing, are unique, or may be base species upon which the local ecosystem may depend. This is of

particular concern around seamounts which are especially vulnerable given the high degree of endoism within a relatively small physical area. As such, it was felt that extraordinarily strong conservation measures are needed, and should be developed as a first priority.

The Legal Regime (Dean Phillip Saunders, Dalhousie Law School)

One of the key challenges of managing the high seas and deep ocean is working within the existing legal structure, which has as a primary consideration the rights of sovereign states. That said, there are several instruments which provide the legal framework for these areas. In particular, the 1982 *United Nations Convention on the Law of the Sea (UNCLOS)* includes several provisions upon which states party to the Convention base their use of the high seas and deep ocean. UNCLOS has defined the high seas in *Article 86* as

> *"…all parts of the sea that are not included in the exclusive economic zone, in the territorial sea or in the internal waters of a State, or in the archipelagic waters of an archipelagic State."*

In addition, the Convention provides that all states may invoke the freedoms of the high seas, which by *Article 87* include: navigation; overflight; laying of submarine cables and pipelines; construction of artificial islands and other installations; fishing; and scientific research. The article also states that,

> *"These freedoms shall be exercised by all States with due regard for the interests of other States in their exercise of the freedom of the high seas, and also with due regard for the rights under this Convention with respect to activities in the Area."*

Specifically within the context of living resources, several articles outline the associated responsibilities. In a general sense *Articles 192* and *194* delineate the obligations of states to, "protect and preserve the marine environment," and to "prevent, reduce, and control pollution of the marine environment." *Articles 117 to 119* respectively provide for the, "duty of states to adopt with respect to their nationals measures for the conservation of the living resources of the high seas", for the, "cooperation of states in the conservation and management of living resources," and for the, "conservation of the living resources of the high seas…[so as]...to maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield."

Article 64 refers specifically to the need for states to cooperate in, "ensuring conservation and promoting the objective of optimum utilization [of highly migratory species]," while *Article 65* provides for the prohibiting, limiting and/or regulating of the exploitation of marine mammals, including those in the high seas. Both these articles require states to seek to agree on measures directly, or through other organisations.

In addition, *Article 66 and 67* address anadromous and catadromous stocks respectively, with the responsibility for the management of anadromous stocks lying primarily with the state of origin, but cooperation with other states is also emphasized. Similarly, catadromous species are primarily subject to the jurisdiction of the state within whose EEZ they spend the greater part of their life cycle.

With regard to navigation, responsibility is generally laid upon flag states to administer and control vessels flying its flag, including effectively exercising jurisdiction and control; maintaining a register; ensuring safety, proper surveys and training; adopting laws for prevention, reduction and control of marine pollution; and to ensure compliance with international rules and to provide for enforcement. Without an international legal structure responsibility falls back to flag states, which is problematic flag state obligation is difficult to enforce, particularly in the case of flag of convenience arrangements. There is a difference between an obligation to behave in a certain way and the fact that another state does not have the ability to enforce those obligations. The degree to which the Convention relies upon flag state responsibility and the duty of states to cooperate is problematic without a means to enforce them, or even define them (i.e. what constitutes a failure to cooperate?).

Various other tools exist including bilateral and multilateral agreements, regional seas agreements, area based management areas, restricted activities of nationals, and various conventions. Although these legal tools include provisions that are notable, they are nonetheless broad and rely on the good faith of states to cooperate. These include:

- the United Nations Fish Agreement (UNFA) of 1995, which imposes new obligations on parties on the high seas, including management principles, observance of Regional Fisheries Management Organisation (RFMO) measures, flag state responsibility, and some high seas enforcement powers. UNFA also demands cooperation, and restricts access to various species;
- the FAO Compliance Agreement of 1993, which outlines obligations with regard to cooperation and flag state responsibilities (including the obligation not to authorize high seas fishing unless it can be effectively controlled);
- the FAO Code of Conduct for Responsible Fishing of 1995, which is a voluntary code that establishes principles and standards for the conservation, management and development of fisheries;
- various RFMO agreements, which now have more significance with UNFA;
- the International Convention for the Prevention of Pollution of Ships (MARPOL) of 1973;
- the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);
- the Convention on Biological Diversity (CBD);
- other various instruments that address ballast water, and the dumping of wastes at sea;
- port state control;
- the establishment of particularly sensitive sea areas and high seas marine protected areas; and
- others.

Although progress has been made, high seas freedoms are the default position under international law as it pertains to activities (other than seabed mining for certain minerals in the "Area") and flag state enforcement is a real problem. It was suggested that the greatest progress has been sectoral in nature (for example, UNFA), or where conflicts exist that force states to negotiate (e.g. with regard to national jurisdiction), and that new institutional arrangements dealing with the concept of "biodiversity" would be too amorphous. It was felt that definitions are required of, for example, what biodiversity is, and what exactly would be managed before progress can be made. More needs to be learned and defined with respect to issues such as bioprospecting – e.g. is there actually much occurring and how harmful is it? - before firm and binding legal arrangements can be negotiated and still be effective in the long term. The way forward was seen to be probable though sectoral agreements and arrangements, although it was thought that there is room for broadening the scope of organisations and

agreements (e.g. NEAFC and CCAMLR). Focussing on the regional level could also produce a higher degree of common interest. It was also felt that there should be focus on implementing the agreements that already exist before delving into renegotiation of the current legal regime, or developing new agreements.

Session II: Canadian Government Perspectives

Lead Commentators

- The UN Working Group: How We Got There and What We Can Expect (Mr. Louis Simard, Director, Oceans and Environmental Law Division, Department of Foreign Affairs)
- The UN Working Group and the International Oceans Governance Agenda (Mrs. Lori Ridgeway, Director General, International Coordination and Policy Analysis, Fisheries and Oceans Canada)

The UN Working Group: How We Got There and What We Can Expect (Mr. Louis Simard, Director, Oceans and Environmental Law Division, Department of Foreign Affairs)

At the 59th General Assembly in 2004 an Ad Hoc Open-ended Informal Working Group was established to, "study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction." This group is open to participation by all UN members, and NGOs and international organisations are welcomed as observers, although there could be closed sessions that would exclude observers

The issue of biological diversity has been emerging in various *fora*. It has been of particular interest to the International Seabed Authority (ISA), which has jurisdiction to protect the environment from exploration and exploitation activities of minerals (e.g. polymetallic sulfides and ferromanganese-rich crusts) located on vents or seamounts. These are biodiversity rich areas where the relationship between the minerals and living resources is strong. It has been suggested at ISA meetings that it could be a logical step for it to consider managing the genetic resources of these areas, as a common heritage of mankind, in addition to its role with regard to mineral resources.

This issue of biological diversity has also been raised within UNCLOS. At the United Nations Open-ended Informal Consultative Process on Ocean Affairs (UNICPOLOS) and the United Nations General Assembly (UNGA) more specific aspects were pointed out, such as the protection of vulnerable seabed areas, bottom trawling, and MPAs. These issues were also being discussed at the CBD, in RFMOs, and at the International Maritime Organisation (IMO).

The UN Working Group was developed to bring these discussions together in one forum and will address two main sets of questions: (1) the emerging debate over the exploration for and exploitation of genetic resources (i.e. with regard to bioprospecting and commercial uses), and (2) the protection of marine biodiversity, particularly that found in vulnerable areas of the seabed and areas beyond national jurisdiction (i.e. how can all activities be governed in a way that achieves the greatest long term sustainable use benefits, and integrated oceans management at a global or regional level?). It was suggested that the first issue would initially be the prime focus of the WG meeting as it is more tangible for many. The second issue was thought to be a considerable challenge, with none of the same economic and political resonance as the first.

The UN Working Group and the International Oceans Governance Agenda (Mrs. Lori Ridgeway, Director General, International Coordination and Policy Analysis, Fisheries and Oceans Canada)

Views of the International Oceans Governance Agenda:

- *The oceans agenda is fragmented.* There are multiple, converging, overlapping, duplicating fora, institutions, and tools. The views can be partial when fragmented, and this is inefficient.

- *Instead of being cooperative, the agenda is competitive and builds silos.* Many countries play differently in different fora, and conservation approaches are sometimes in competition with sectoral approaches.

The agenda is obviously interdisciplinary in nature, but we need to learn how to bring them together.

- *It is difficult to find an opportunity to bring these issues together.* We need to learn how to cooperate, and how to build integrated management tool kits.

- *There are major knowledge, and policy and analysis gaps*, yet the international community has adopted targets that seem to assume we can go directly to implementation. Commitments are being made to deliver mature systems (e.g. MPA networks), but when the basic framework and understanding of how these systems work is lacking, credibility is lost.

What is needed:

1. Actual cooperation, trust, and joining up, and mechanisms to do this;
2. Intragovernmental and intergovernmental coherence;
3. Integrated approaches;
4. Shared understanding;
5. Regional approaches (global approaches can be unrealistic);
6. A better and broader understanding of what we do and do not know, and how to close those gaps;
7. Options to move forward, including emulating or learning from best practices (e.g. new RFMO in the South Pacific);
8. Capacity building (especially, but not exclusively for developing states);
9. Practical, pragmatic, forward looking, enforceable, implementable practices that balance sustainable use with conservation, and that allow states to balance their interests and needs; and
10. Clarity on where scarce resources should be spent.

The General Assembly has set some parameters for the discussion, such as:

- To survey the past and present activities of the United Nations and other relevant international organisations;
- To examine the range of aspects of these issues;
- To identify key gaps in the information and research; and
- To indicate possible options and approaches for moving forward.

The Working Group will be looking for practical answers so that realistic achievements can be made. One of the main issues that the Group is identifying is that of cross cutting foundations in science and law. They are aware of where there are gaps, but there is a need to get an

integrated picture, to find a way to make the science useful to decision-makers, and to find a way to balance independent science with science that is needed for policy decisions. With respect to the legal framework, debate is growing as to whether there is a need to create a new agreement under UNCLOS, but resources may be better spent elsewhere

Another issue is that of governance. It is clear that biodiversity and ecosystem issues are gluing the system together, and integrated management is the practical glue to address issues of multidimensional use and the potential for conflict. This means that there is a need to develop shared objectives, and to develop strong sectoral regulation that is clearly linked to ecosystem based approaches. Integrated management is not possible without strong and enforced sectoral regulation. There is also a need for a mechanism for cooperation, for performance monitoring and accountability, and for compatibility with national approaches.

A third issue is that of the role of economic instruments. Incentives are necessary for regional and international cooperation as well as for self-regulation. Similarly, disincentives have a significant role to play. The value of economic instruments is a practicality, and therefore, the use of market measures is critical in the short term.

All these debates are necessary for closing the implementation gap.

Session III: Genetic Resources of the Seabed

Lead Commentators

- The Scientific Perspective (Professor Kim Juniper, University du Quebec a Montreal)
- The Interest of the Biotechnology Sector (Dr. Adam Burja, Principal Research Scientist, Metabolic Eng. & Fermentation Group Leader, Ocean Nutrition Canada)
- Government Perspective (Mr. Andrew Hurst, Policy Advisor, Biodiversity Convention Office, Environment Canada)

The Scientific Perspective (Professor Kim Juniper, University du Quebec a Montreal)

Undiscovered Biodiversity
There is a huge potential for discovering new species on the seabed, particularly around hot spots that are associated with various geological features, such as hydrothermal vents, manganese nodules, seamounts, and cobalt-rich manganese crusts. In these areas there is a high degree of species richness and/or novelty.

Scientific Interest
First of all, there is an aim to improve basic knowledge and understanding of how organisms evolve and adapt to their environment, and the history of life on earth. Second, there is an interest in conservation research, such as how environmental controls affect biodiversity, cataloguing species prior to assessing the impacts of various activities (e.g. mining), investigating whether climate change is, for example, affecting the productivity of the ocean and the amount of food available to organisms living on the seafloor, and looking at ecosystem stability and resiliency and its relationship to biodiversity. Third, there is an interest in bioprospecting and biotechnology. Enzymes, biopolymers, secondary metabolites may have medical and industrial applications. It was pointed out that bioprospecting is not the same as mining or large scale biomass removal as there are many ways to collect material, such as bioharvesting (e.g. seaweed). Currently, the primary interest is in micro-organisms, and for this there would be no bulk extraction as in most cases small samples are obtained and taken to a laboratory for further study. However, there is an interest to piggy back on deep sea mining operations, which remove large quantities of material off the seabed floor, as it would make economic sense to use some of that material for testing.

Bioprospecting and Marine Scientific Research Impacts on Biodiversity
In some cases bioprospecting involves bulk harvesting and extraction of compounds, while in other cases small samples are used to create a genetic library. There is concern about the effects of research on very small areas (e.g. seamounts). This is partly an issue of multiple use and degree of traffic in the area as some scientific interests take large samples, while others simply observe. Furthermore, sampling of species can affect species abundance and patterns of biological succession (i.e. if a key species is removed, the natural course of events for that ecosystem may be altered). Due to this concern work is being done on developing a code of conduct for scientific research in sensitive areas such as these. Many scientists go to the deep sea to conduct research partly because there are no regulations there, but controls may be key to providing continued opportunities for research (e.g. on the role of a target species in an ecosystem function within an MPA).

The Interest of the Biotechnology Sector (Dr. Adam Burja, Principal Research Scientist, Metabolic Eng. & Fermentation Group Leader, Ocean Nutrition Canada)

Many organisms that live in extreme environments such as the deep sea develop ways to adapt to extreme conditions. They also need to develop ways to incorporate antioxidant compounds. These compounds have been found to be useful in the pharmaceutical sector for producing, for example, anti-cancer, anti-HIV, antibacterial, immunosuppressive, etc. drugs. A common practice is to "mine" the organism itself by letting the organism produce the compound, or by taking the genes and putting them into another organism.

There are many problems with the current state of law with regard to exploitation as there is a lack of transparency in how a country or body deals with people who are bioprospecting in seabed areas, or in international waters. There is also a lack of understanding of what bioprospecting is. There is no policy framework, so it is often simply not allowed.

It is not likely that bioprospecting would develop into a large scale activity as most of what is being found in the deep sea would simply be around discovering a genetic code to be used later. In addition, each organism will likely only contain a tiny amount of the material (e.g. in one case 670 tons of material was harvested to produce only five grams of the compound for phase two testing). It is therefore not practical, or economical to harvest such organisms in the long run. In many cases these compounds are derived from microbes, so simply by identifying the microbe one can reproduce the compound. Furthermore, the trend would move away from harvesting for the sake of predictability and the ability to lock down the process of production in a laboratory environment as there is a high degree of fluctuation in the deep sea-derived samples.

Government Perspective (Mr. Andrew Hurst, Policy Advisor, Biodiversity Convention Office, Environment Canada)

Bioprospecting became an issue because people began to do it, and then those countries without the capacity to do the research and to reap the benefits became concerned about the consequences. The CBD has three objectives: (1) the conservation of biological diversity, (2) the sustainable use of its components, and (3) equitable sharing of the benefits arising out of the utilization of genetic resources. Developing countries tend to focus on second and third objectives, and the issue of equity has been raised in several *fora*. There are two general groupings of those countries with an interest in bioprospecting: developed countries that have the capacity to conduct research and reap the benefits, and developing countries, of which there are two main streams – those that have biotechnology sectors, and those that do not have biotechnology sectors nor the capacity to conduct research, but who still are hold concerns with regard to equity.

When looking at other countries it is important to be aware of their context. When looking at developed countries it is important to consider two things: that a lot of countries are making heavy investments (that are largely publicly funded) in the biotechnology sector, and that there is a tradition of public science, but on the other hand that these public investments have the potential to be turned over eventually to commercial goods and knowledge, which means that there is pressure to try to realize some of the potential profits.

When looking at developing countries there is another dynamic. With the CBD came rapid closure of the terrestrial genetic commons and these environments are becoming much more

restricted. There has been a shift of interest to the marine side due both to the regulatory framework and to the fact that the availability of samples is significant.

From a Canadian point of view, we are interested in conserving biodiversity as part of the global commons, as well as scientific and commercial interests. Although more needs to be learned on the extent of those interests, there is intent to develop an integrated policy framework that involves both policies and incentives to encourage biotechnology, but to maintain a regulatory framework to ensure it is done responsibly. When looking at the governance of these resources several principles have been discussed that should inform decisions, such as: maintaining an environmental focus; ensuring equitable use; promoting economic benefits that support an environmental focus; transparency; and coherence between conservation and commercial uses such that there can be rational and beneficial use for all concerned.

Session IV: Integrated Oceans Governance and Protection of Marine Biodiversity – Issues and Directions

Lead Commentators

- Options for Improving International Protection of Marine Biodiversity Beyond National Jurisdiction (Ms. Lee Kimball, IUCN, Washington)
- The Fishing Industry's Interest (Mr. Pat McGuinness, President, Fisheries Council of Canada)
- An ENGO View (Mr. Joshua Laughren, Director Marine Conservation, WWF-Canada)
- The Government Perspective (Ms. Renée Sauvé, Senior Policy Advisor, International Coordination and Policy Analysis, Fisheries and Oceans Canada)

Options for Improving International Protection of Marine Biodiversity Beyond National Jurisdiction (Ms. Lee Kimball, IUCN, Washington)

Seven key issues were identified:

1. *High seas fisheries and marine biodiversity*
   There is a need to improve RFMOs, and work can be done at the regional level, but it will also be necessary to have a global body that can ensure that RFMOs are following the principles of UNCLOS.

2. *Seabed genetic resources (and MSR)*
   There is a need to provide for sustainable and equitable use of seabed genetic resources beyond national jurisdiction. Sustainable use could be promoted through application of environmental impact assessment provisions under UNCLOS and the CBD and as reflected in the Antarctic Treaty Resolution 7 (2005). Benefit-sharing to ensure equitable use could encompass a range of non-monetary benefits such as knowledge and beneficial products for humanity as well as the sharing of any profits from biotechnology products. Such benefits could contribute to marine conservation and/or collaborative research beyond national jurisdiction. Together with an acceptable solution on benefit-sharing, a more transparent means for advance notification and reporting of major research expeditions (no.5 below) could alleviate demands for stronger controls over MSR and access.

3. *High seas enforcement*
   It is important to recognise that illegal activity at sea has a lot of commonality (e.g. between fishing, dumping, etc.) and that systems such as vessel tracking, port state controls, flag state performance requirements, and the application of VMS can all help, but there needs to be coordinated enforcement in areas of these various regimes.

4. *Clarification of the relationship between high seas activities, in particular fishing, and a coastal state's sovereign rights over sedentary species of the continental shelf*
   We should set in motion steps to clarify how coastal states may proceed to conserve/protect sedentary species from high seas fishing activities, including the opportunity to establish specially protected/managed areas to do so either, for example, jointly with RFMO and/or in consultation with high seas fishing States, or by using provisional measures as necessary until a final delimitation of outer limits can be established.

5. *International collaboration in MSR in areas beyond national jurisdiction*
   The requirements under UNCLOS for sharing and reporting could be further developed (e.g. establishment of a website). There has also been talk of creating a fund to facilitate participation from scientists from developing countries, which should be further developed. Support was also expressed for a policy-relevant international high seas/deepsea biodiversity assessment, based on the best *available* scientific information through a process recognized as credible and legitimate by the international community as a means to draw attention to existing research findings in a policy context.

6. *Specially protected/managed areas*
   MPAs are a way to promote coordinated application of different regimes, provide for different levels of protection and for coordinated enforcement and application of different sectoral agreements, and to promote attention to a particular area. Next steps could include developing MPA guidelines, advancing scientific research so that priorities can be identified, developing ecological criteria, and developing potential for collaboration between users (e.g. cable and conservation).

7. *Linkages and integrated approaches.*
   We can begin by agreeing on certain principles that apply for the conservation and sustainable use of marine biodiversity beyond national jurisdiction, as a basis for further deliberations; and to agree to further elaborate certain principles, including: the duty to cooperate; transparency & accountability (notification and reporting); and equitable use of deep seabed genetic resources beyond national jurisdiction. Further steps toward integration could include: agreeing to incorporate and develop principles in an UNCLOS implementing agreement; agreeing that an implementing agreement will provide for MPAs/networks and will address institutional concerns; and agreeing to provide a means to review the effectiveness of steps taken to implement these principles, including coordination among relevant bodies. It would be useful to bear in mind that steps such as principles elaboration, progress to identify MPAs/networks at scientific level, and coordinated review mechanism do not require an implementing agreement as the first step.

The Fishing Industry's Interest (Mr. Pat McGuinness, President, Fisheries Council of Canada)

International fisheries law has had ten years of developing new instruments, and now it is time to focus on implementation. As such, it is essential that RFMOs modernize their mandates to include ecosystem and biodiversity issues, and it was suggested that action should be taken in areas that are unique and where highly sensitive, or ecologically or biologically significant marine ecosystems are known to exist, and where there is scientific evidence that fishing practices are having a long-term adverse effect on the ecosystem (e.g. by ensuring fishing practices conform to specific conservation requirements, by implementing seasonal or area closures, by establishing MPAs where necessary, and by monitoring for compliance and management effectiveness).

With regard to MPAs specifically, there is some concern that they are considered by some to be a panacea for fisheries management problems, and are presented as an oversimplified approach that is in danger of raising false expectations in terms of addressing conservation concerns while at the same time diverting fisheries management from other conservation tools that may have more effective remedial effects. In conjunction with other management tools, and

when implemented on a case by case basis and with careful planning and evaluation MPAs can help to achieve broad fishery and biodiversity objectives. Although the fishing industry encourages RFMOs to identify and regulate access to areas that are highly sensitive, or ecologically or biologically significant (pending the development of any additional measures), it cautions that, without proper planning and scientific knowledge, the use of MPAs as a management tool can even be detrimental (e.g. spatial displacement of effort due to MPAs resulting in stock depletion).

An ENGO View (Mr. Joshua Laughren, Director Marine Conservation, WWF-Canada)

Everyone agrees that there is a problem – the trend is clear even if the details are not. There has been a frustration with many fisheries issues in a lack of hope for quick action, and although some reform have been seen (e.g. within NAFO), such changes would likely not have happened without strong outside pressures to do so. From an ENGO perspective several changes were considered to be desirable:

- that RFMOs should work under the goal of global coverage and a global mandate, particularly when looking at fishing on the high seas, or of highly migratory species, that they should be accountable and subject to independent assessment through a formalized process, and that they need to be charged with delivery of their commitments;
- that ecological footprints should be frozen by confining high seas fishing to those areas where fishing already takes place (i.e. implementing a moratorium on *growth*), and by creating incentives and conditions for growth so that it may be sustainable and more realistic for the industry to comply;
- that we need to be cognizant of overcapacity and shifting capacity via the use of subsidies or oversized fleets (e.g. Russia and Asia);
- that better tools for controlling IUU fishing need to be developed, such as improved port state controls and the use of incentives;
- that sharing of information needs to be greatly improved;
- that economic and consumer pressures can be further developed and coordinated to have a greater impact;
- that although the establishment of MPAs can be problematic, there are areas that are clear examples where the use of MPAs could be beneficial (e.g. seamounts);
- that creating a legal framework is not useful if those laws are not implemented; and
- that long term reform should be pursued, but not at the expense of short term action.

The Government Perspective (Ms. Renée Sauvé, Senior Policy Advisor, International Coordination and Policy Analysis, Fisheries and Oceans Canada)

Biodiversity by definition is very broad and inclusive, therefore a management approach must be equally broad and inclusive. Integrated management can be expressed on a variety of levels and through various measures (e.g. area or place based, or activity based). There has been some discussion as to how integrated oceans governance can be implemented by, for example, building on existing structures and agreements, or replacing MERMOs or ROMOs. However one may view the issue, it seems clear that there is an overarching need for a regional body that could oversee an integrated approach. In addition, there is an opportunity to make the existing arrangements more binding by, for example, adjusting mandates, or developing more soft law options, such as MOUs, codes of conduct, guidelines, etc. In any case, it is always necessary to act in both the long and short terms.

Session V: General Discussion: Issues, Policy Options, and Main Questions
This session was facilitated by Mr. Louis Simard and Professor David VanderZwaag.
The following also includes a summary of key points and discussions following the Lead Commentators' observations in each of the Sessions. A set of questions used to guide this session can be found in Appendix V.

General Themes

Several topics emerged repeatedly throughout the workshop. These included the following:

Legal Regime
There was significant discussion around the question of whether current legal instruments should be adjusted or whether new ones should be created. Some saw the need for the development of global bodies that could coordinate, enforce, assess and monitor the implementation of overarching principles and management tools such as those outlined in UNCLOS. All saw the value in such bodies, but some considered this goal to be unrealistic (at least in the short tem), and believed a more practical approach would be to operate through regional bodies, such as RFMOs. It was generally agreed that the mandates of RFMOs ought to be broadened so as to enable them to adequately address issues such as, for example, bioprospecting. It was also acknowledged that RFMOs are not independent organisations, but rather that they are groups represented by countries with very real interests. Similarly, the issue of how to practically apply the principles of integrated management was raised. It was suggested that integrated management would only work with strong sectoral regulations since it is those sectors that are tasked with actual implementation of the principle.

There was also some discussion with regard to the restatement of principles, and/or development of new ones (e.g. under UNCLOS). It was agreed that a restatement of current principles (such as the need for cooperation) could be valuable; however, there was some hesitation to actually change existing principles, or to develop new ones at this point in time. It was also suggested that limited resources could be better used focussing on more practical goals for the short term.

Data and Information
It was generally agreed that there is a lack of scientific data, and particularly of data that is up-to-date, reliable, and comparable. It was acknowledge that in many cases this is due to a lack of capacity (e.g. developing countries), but that nonetheless useful scientific data is the basis upon which many policies and regulations are developed. The suggestion of creating a global body of scientific experts that could coordinate the management of data was also made. The importance of being able to share this information was also stressed.

MPAs vs. Other Management Tools
MPAs were generally acknowledged to be a valuable management tool, however, several participants cautioned against viewing them as a panacea in exclusion of other management tools. Many suggested that in order to maintain the value and credibility of MPAs, they need to be considered on a case by case basis, and in conjunction with other management tools. The point was also raised that in a terrestrial context we regulate primarily with regard to activities, not location, and that this would be a logical method for developing MPAs as well. Similarly, it was noted that those activities that are harmful should be distinguished from those that are not (which in the case of bioprospecting, for example, could be the majority). That said, some

pointed out that there are particularly vulnerable areas that could easily be designated as protected, such as seamounts.

The use of moratoriums as a management tool was also discussed. Some saw the need for moratoriums to be pressing, while others considered them to be useful in some cases, but also exceptionally difficult to enforce, and at times ineffective.

Bioprospecting

The main challenge in the issue of bioprospecting seems to be the various "unknowns". To start with, there is a lack of clear understanding of what bioprospecting entails, and how it differs from marine scientific research. It appears that bioprospecting in and of itself would often have little impact on the marine environment given that much of the process is based upon the gathering of small samples, which are then tested and reproduced in laboratory settings. It was noted that the danger of bioprospecting developing into a large-scale harvesting entity would be unlikely because of this, and that in addition bioprospectors are able to "piggy-back" on, for example, fishing vessels.

Another issue with regard to bioprospecting was that of benefits. Indeed, it appears that much of the debate surrounding bioprospecting arose due to a concern, particularly from developing countries, over the equitable sharing of benefits, which comes out of concern for the impact on high seas ecosystems and resources versus the net benefits that could be coming back to the resource owners. A lack of capacity to conduct research and therefore reap potential benefits has led to much discussion on the sharing of benefits, and the possible allocation of patents. It was also noted during the workshop that the definition of "benefits" should include non-monetary benefits such as participation of scientists in research projects, sharing of research results, transfer of technology and knowledge, arrangements for developing countries to make cheaper drugs, etc. in addition to royalties.

Incentives and Outside Pressures

The value of developing incentives was considered to be a practical and necessary means to reaching integrated management goals. Particular attention was given to economic and market incentives as these were deemed to be the most effective in a setting where economic benefits are a driving force (e.g. in high seas fishing). Emphasis was also placed on the need for outside pressures (e.g. from ENGOs) to continue to play a significant role in the moulding of policy and legal frameworks as RFMOs and individual states must act in their own best interest before they can consider the common global good.

Conservation vs. Fishing Issues

At various points during the discussion the question was raised as to whether conservation issues are in conflict with resource use issues. Several participants noted that although the two may seem to be working toward contradictory goals, they are in fact aiming for the same thing – for example, conservation and fishing interests both want renewable resources. Instead the problem was suggested to be one of overcapacity.

Discussion in Response to Workshop Questions Distributed

Genetic Resource Questions

- *Is there any Canadian activity with regard to genetic resources in the high seas? What is the involvement of the biotech industry?*

  It was indicated that little is known about the actual level of Canadian activity with regard to genetic resources in the high seas, although there is definite interest, both in terms of the scientific and commercial potential and the Canadian government was noted as having contributed significant funds toward some of this technology.

- *Does "bioprospecting" and access to genetic resources in the Area need to be regulated? How harmful is MSR/bioprospecting to vulnerable marine areas?*

  It was suggested that some of the activities of bioprospecting should be regulated, but that blanket regulation is not an ideal approach as it inhibits the discovery of potentially valuable resources (e.g. such as enzymes and microbes that might be developed for use as antiviral drugs), or may push bioprospectors to other unregulated areas. It was mentioned that the MSR regime in UNCLOS already provides a regulatory framework – the question remains whether this is a sufficient regime, and in particular whether it is enough to address the "benefit-sharing" aspect of the issue. It was explained that MSR and bioprospecting in and of themselves are not necessarily harmful to vulnerable marine areas (such as seamounts), as in most cases only small samples would be taken for later development in a laboratory setting. It was also acknowledged, however, that a high degree of interest from numerous parties can lead to the overloading of an area. Similarly, it was noted that in some cases bioprospectors or marine scientists might "piggy back" on fishing vessels, which on the one hand means the cooperation between two stakeholders, but on the other hand relies on an activity that may be considered harmful to a vulnerable marine area.

- *Is it practical to contemplate different regimes for MSR with no commercial application (i.e. pure research) and MSR that does have commercial application (i.e. applied research)?*

  This question was not addressed in detail, however, there was some commentary regarding the development of a code of conduct for marine scientific research.

- *Would the International Seabed Authority be an appropriate mechanism for regulating "bioprospecting"? If not, what alternative governance arrangements might be considered?*

  Some participants saw the ISA as a logical body to regulate bioprospecting given that it is already involved in some aspect of protecting the environment in question. However, many also suggested that this responsibility does not fall within the ISA's mandate, and that the ISA is structured to reflect mining interests.

Broader Marine Biodiversity Questions

- *Can biodiversity be protected through better implementation of existing regimes, or do we need new rules, arrangements or institutions that deal specifically with protection of biodiversity from the various activities? Are there gaps in the current regime?*

There was no consensus on this issue. There was some discussion of focusing on the implementation of the existing legal and regulatory frameworks before delving further into adaptation of those frameworks. The suggestion of developing a global body of some kind was touched upon several times, however, many participants indicated that in many cases it would be more practical to work through regional bodies (e.g. RFMOs) which more directly represent individual states' interests and capabilities. It was generally agreed that there are gaps in the protection of marine biodiversity beyond national jurisdiction, but no agreement was found on whether these gaps were more related to the implementation of the current regime, or whether they were gaps in the governance regime itself that needed to be filled through the development of new rules.

- *If we do need new rules, arrangements, institutions, what options are there to achieve integrated oceans governance and better protection of biodiversity?*

  - *Is there a need for a mechanism or mechanisms to integrate scientific advice and management in the various sectors?*

    The need for a global body to coordinate scientific advice and management in the various sectors was raised by several participants. The possibility and/or process of developing such a body, however, was not discussed in detail apart from the suggestion that the practical reality of establishing such a body would not be attainable in the near future, although there was some mention of establishing a fund of some sort to facilitate this.

    It was suggested that the Canadian model of integrated oceans management could serve as the basis for discussions of improving oceans governance in areas beyond national jurisdiction. This would involve ensuring that sectors of activities are well regulated and disciplined. In turn, these sectors would interact and develop together measures that each of them would implement in order to pursue biodiversity protection objectives for a specific ocean area.

  - *Should a "comprehensive" approach to strengthening governance arrangements for the high seas / deep seabed be considered, addressing the various gaps and weaknesses under a single umbrella (such as a Law of the Sea Implementation Agreement on the High Seas) or a more "sectoral" approach where, for example, high seas fisheries might be addressed under the UN Fish Stocks Agreement and "bioprospecting" under the Convention on Biological Diversity?*

    Although the reiteration of the principles of existing governance arrangements was considered to be desirable, and the usefulness of umbrella arrangements (such as UNCLOS) was acknowledged, there was a strong emphasis from some participants on the need to focus on a sectoral approach. The discussion did not, however, specifically cover what such an arrangement would look like.

  - *If a "comprehensive" approach is followed, what would be the best strategy for reaching a negotiated text, for example, amendment of the UN Law of the Sea Convention or an Implementation Agreement?*

    Most participants were wary of renegotiating existing text, or negotiating new text under UNCLOS, although it was generally agreed that a restatement of the

principles would be valuable. In other cases it was thought by some that the best strategy to developing a comprehensive approach would be through regional bodies, such as RFMOs.

- *Are there issues that might be addressed through UN Resolutions or other non-binding approaches*?

  Issues that were noted as needing more attention, although not specifically within the context of UN Resolutions, were those of state cooperation, port state controls and responsibilities, and flag state responsibilities.

- *How can MPAs be an effective tool? What is the role that the existing international bodies or treaty bodies could play with respect to MPAs?*

  The use of MPAs was generally thought to be an effective tool when applied in consideration of or in conjunction with other management tools, and when subjected to a rigorous process (e.g. meeting established criteria). This was regarded as important as well to ensure the credibility of MPAs as a management tool could be maintained. It was noted by several participants, however, that numerous examples exist of areas that could easily and readily be designated as MPAs (e.g. particularly vulnerable seamounts). Some participants suggested that MPAs would work well through existing international bodies, such as RFMOs, with the example of CCAMLR being raised. Of course, one of the primary challenges to managing an MPA for the high seas or deep sea is was identified as the capability for enforcement.

- *Do regional approaches to managing resources/areas beyond national jurisdiction hold promise and how might regional approaches be enhanced?*

  It was generally agreed that there has been some success in managing resources/areas beyond national jurisdiction (e.g. CCAMLR) however, it was also acknowledged that the activities of these bodies are based on the interests of their member states, and therefore there exists a real potential for conflict. It was suggested as well that a sectoral approach to management by individual states might then have the potential to lead to commonality at a larger scale. Similarly, the role of outside pressure, for example from ENGOs and through market based incentives, was considered to be essential to making regional approaches work.

- *What are the research issues and priorities surrounding high seas/deep seabed biodiversity?*

  It was noted that there is a need for a regulatory framework of some kind that is not blanketing in nature, but rather that responds to real concerns for protecting BBNJ (e.g. to regulate those activities that are determined to be harmful, rather than all activities). In particular, a priority issue was that of multiple use of and high degree of traffic to vulnerable areas. There was also some concern expressed with regard to interference with the natural progression of the ecosystem (i.e. removing key species could result in an alteration to the natural development of an ecosystem).

- *Are there other uses of the oceans that need to be regulated or better regulated?*

  This was not discussed in detail. MSR on the seabed in general was an issue of concern, with reference to possible conflict between multiple users, however, was

mentioned in addition to other commonly identified issues, such as IUU fishing on the high seas, port state responsibilities, flag state responsibilities, and the duty to cooperate as outlined in UNCLOS. It was generally thought that although these issues are touched upon in various agreements and frameworks, there would be great advantage to outlining more specifically what those responsibilities and duties incorporate.

APPENDIX I: WORKSHOP AGENDA

Marine Biodiversity Workshop
Dalhousie Law School
Dalhousie University
Halifax, NS
January 17, 2006

Location: Dalhousie Law School
Weldon Law Building
6061 University Avenue
Room 304

Phone Contact: Marine & Environmental Law Institute, 902 494 1998

08:30-09:15 Welcome, Introductions and Brief Opening Remarks

- Co-Chair, Dr. Moira McConnell (Director, Marine & Environmental Law Institute)
- Mr. Richard Ballhorn (Directeur général/Director General, Direction générale des Affaires juridiques /Legal Affairs Bureau, Ministère des Affaires étrangères /Department of Foreign Affairs)
- Co-Chair, Dr. David VanderZwaag, (Canada Research Chair in Ocean Law & Governance, Dalhousie Law School)

09:15-10:30 Session I – The Context: Science and Law with a Focus on High Seas Fisheries and Marine Biodiversity

Lead Commentators
- Professor Boris Worm, Dalhousie University – High Seas Fish Stocks and Marine Biodiversity
- Professor Martin Willison, Dalhousie University – Deep Sea Corals
- Dean Phillip Saunders, Dalhousie Law School – The Legal Regime

Discussion

10:30-11:00 Break

11:00-11:30 Session II – Government Perspectives

Lead Commentators
- Mr. Louis Simard, Directeur/Director, Direction du droit des oceans et de l'environnement/Oceans and Environmental Law Division, Ministère des Affaires étrangères, Department of Foreign Affairs – The UN Working Group: How We Got There and What We Can Expect
- Mrs. Lori Ridgeway, Director General, International Coordination and Policy Analysis, Fisheries and Oceans Canada – The UN Working Group and the International Oceans Governance Agenda

11:30-12:00 General Discussion

12:00-13:00 Lunch Break

13:00-14:00 Session III – Genetic Resources of the Seabed

Lead Commentators

- Professor Kim Juniper, University du Quebec a Montreal – The Scientific Perspective
- Dr. Adam Burja, Principal Research Scientist, Metabolic Eng. & Fermentation Group Leader, Ocean Nutrition Canada – The Interest of the Biotechnology Sector
- Mr. Andrew Hurst, Policy Advisor, Biodiversity Convention Office, Environment Canada – Government Perspective

Discussion

14:00-15:00 Session IV – Integrated Oceans Governance and Protection of Marine Biodiversity – Issues and Directions

Lead Commentators

- Ms. Lee Kimball, IUCN – Options for Improving International Protection of Marine Biodiversity Beyond National Jurisdiction
- Mr. Pat McGuinness, President, Fisheries Council of Canada – The Fishing Industry's Interest
- Mr. Joshua Laughren, Director Marine Conservation, WWF-Canada – An ENGO View
- Ms. Renée Sauvé, Senior Policy Advisor, International Coordination and Policy Analysis, Fisheries and Oceans Canada – The Government Perspective

15:00-15:30 Discussion: Questions, Issues & Policy Options

- Mr. Louis Simard and Professor David VanderZwaag

15:30-15:45 Break

15:45-16:45 Discussion: Questions, Issues & Policy Options *(Continued)*

- Mr. Louis Simard and Professor David VanderZwaag

16:45-17:00 Conclusions, Comments & Next Steps

- Professor Moira McConnell & Mr. Dick Ballhorn

APPENDIX II: LIST OF WORKSHOP PARTICIPANTS

Co-Chairs:

Moira	McConnell	Director, Marine & Environmental Law Institute, Dalhousie Law School
David	VanderZwaag	Canada Research Chair in Ocean Law & Governance

Rapporteur:

Megan	Sikaneta	Coordinator, Ocean Management Research Network

Participants:

Richard	Ballhorn	Deputy Legal Adviser and Director General, Foreign Affairs Canada
Rose Marie	Braden	Counsel, Legal Services, Fisheries and Oceans Canada
Adam	Burja	Principal Research Scientist, Metabolic Engineering & Fermentation Group Leader, Ocean Nutrition Canada
Mark	Butler	Marine Issues Committee Coordinator & EAC Internal Director
Tony	Charles	Professor Saint Mary's University, Finance & Management Science
Meinhard	Doelle	Associate Director, Marine & Environmental Law Institute, Dalhousie Law School
Pierre	Dubé	Ministère du l'Agricultures, des Pêcheries et de l'Alimentations du Québec
Paul	Glavine	Resource Policy and Development Officer, Department of Fisheries and Aquaculture
Vesna	Guzina	Legal Officer, Foreign Affairs Canada
Andrew	Hurst	Policy Advisor, Biodiversity Convention Office, Environment Canada
Kim	Juniper	Professeur, Département des sciences biologiques Faculté des sciences
Lee A.	Kimball	Advisor on Ocean Governance and International Institutions, IUCN
Daniel	Lane	Chair, Ocean Management Research Network Board
Joshua	Laughren	Director, Marine Conservation WWF-Canada
Nathalie	Lavoie	International Fisheries Officer, Atlantic Affairs Division, Fisheries and Oceans Canada
Robert	McDougall	Legal Officer, Foreign Affairs Canada
Patrick	McGuinness	President, Fisheries Council of Canada
Kerry	Newkirk	Senior Policy Coordinator, Oceans Program Development Branch, Fisheries and Oceans Canada
Bruce	Osborne	Manager of Innovations and Field Service
Jake	Rice	Director, Assessment and Peer Review, Canadian Science Advisory Secretariat, Fisheries and Oceans Canada
Lori	Ridgeway	Director General, International Coordination and Policy Analysis, Fisheries and Oceans Canada
Phillip	Saunders	Dean of Dalhousie Law School
Renée	Sauvé	Senior Policy Advisor, International Coordination and Policy Analysis, Fisheries and Oceans Canada
Louis	Simard	Director, Oceans and Environmental Law Division, Foreign Affairs Canada
Susan	Waters	Counsel, Legal Services, Environment Canada
Martin	Willison	Professor of Biology, Dalhousie University
Boris	Worm	Assistant Professor in Marine Conservation Biology , Dalhousie University

APPENDIX III: DISCUSSION QUESTIONS

Genetic Resource Questions

- Is there any Canadian activity with regard to genetic resources in the high seas? What is the involvement of the biotech industry?
- Does "bioprospecting" and access to genetic resources in the Area need to be regulated? How harmful is MSR/bioprospecting to vulnerable marine areas?
- Is it practical to contemplate different regimes for MSR with no commercial application (i.e. pure research) and MSR that does have commercial application (i.e. applied research)?
- Would the International Seabed Authority be an appropriate mechanism for regulating "bioprospecting"?
- If not, what alternative governance arrangements might be considered?

Broader Marine Biodiversity Questions

- Can biodiversity be protected through better implementation of existing regimes, or do we need new rules, arrangements or institutions that deal specifically with protection of biodiversity from the various activities? Are there gaps in the current regime?
- If we do need new rules, arrangements, institutions, what options are there to achieve integrated oceans governance and better protection of biodiversity?
    - Is there a need for a mechanism or mechanisms to integrate scientific advice and management in the various sectors?
    - Should a "comprehensive" approach to strengthening governance arrangements for the high seas / deep seabed be considered, addressing the various gaps and weaknesses under a single umbrella (such as a Law of the Sea Implementation Agreement on the High Seas) or a more "sectoral" approach where, for example, high seas fisheries might be addressed under the UN Fish Stocks Agreement and "bioprospecting" under the Convention on Biological Diversity?
    - If a "comprehensive" approach is followed, what would be the best strategy for reaching a negotiated text, for example, amendment of the Law of the Sea Convention or an Implementation Agreement?
    - Are there issues that might be addressed through UN Resolutions or other non-binding approaches?
- How can MPAs be an effective tool? What is the role that the existing international bodies or treaty bodies could play with respect to MPAs?

- Do regional approaches to managing resources/areas beyond national jurisdiction hold promise and how might regional approaches be enhanced?

- What are the research issues and priorities surrounding high seas/deep seabed biodiversity?

- Are there other uses of the oceans that need to be regulated or better regulated?

Other Questions

Are there other questions that participants wish to raise?

APPENDIX IV: PRESENTATION BY DR. BORIS WORM

High Seas Fish Stocks and Marine Biodiversity

APPENDIX V: MAIN BACKGROUND DOCUMENTS

1. *The International Legal Regime of the High Seas and the Seabed Beyond the Limits of National Jurisdiction and Options for Cooperation for the Establishment of Marine Protected Areas (MPAs) in Marine Areas Beyond the Limits of National Jurisdiction* - Ad Hoc Open-Ended Working Group On Protected Areas (First meeting, Montecatini, Italy, 13-17 June 2005).

2. *Oceans and the law of the sea: Report of the Secretary-General, Addendum* - Sixtieth session Item 76 (a) of the provisional agenda.

3. *Bioprospecting of Genetic Resources in the Deep Seabed: Scientific, Legal and Policy Aspects* -The United Nations University Institute of Advanced Studies (UNU-IAS) Report

4. *Biodiversity Beyond National Jurisdiction: Policy Overview (Preliminary Draft)* - Biodiversity Beyond National Jurisdiction (BBNJ) Interdepartmental Policy Working Group.

High Seas Fish Stocks and Marine Biodiversity

Boris Worm

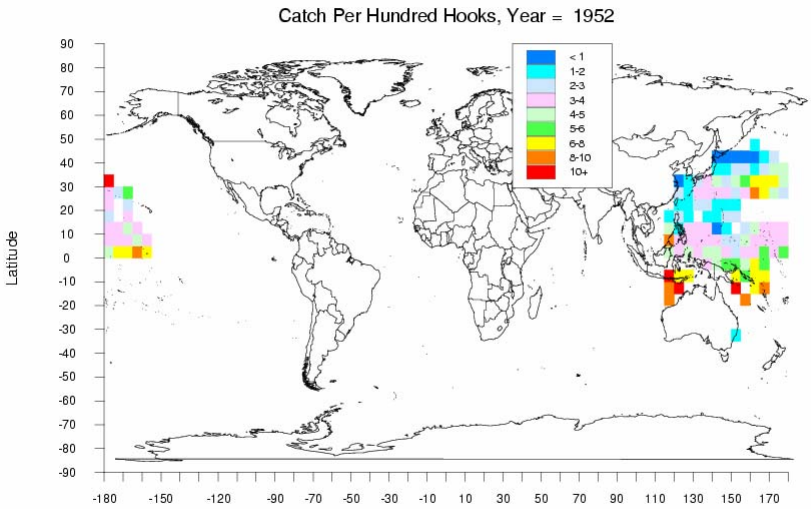
Department of Biology, Dalhousie University

Overexploitation: from land to sea

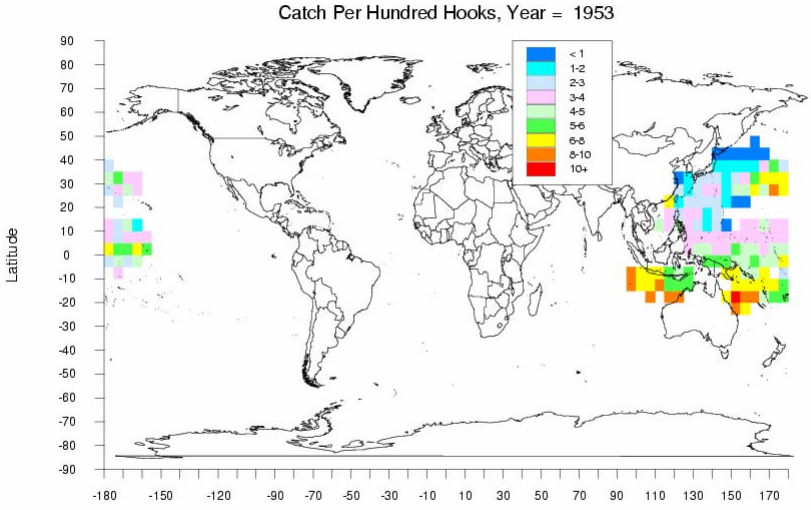
- Many large land animals threatened or lost
- Coastal waters overfished
- The open ocean: our last frontier?

Tuna

Billfish: swordfish and marlins



Source: Myers and Worm 2003.
Nature 423: 280-283



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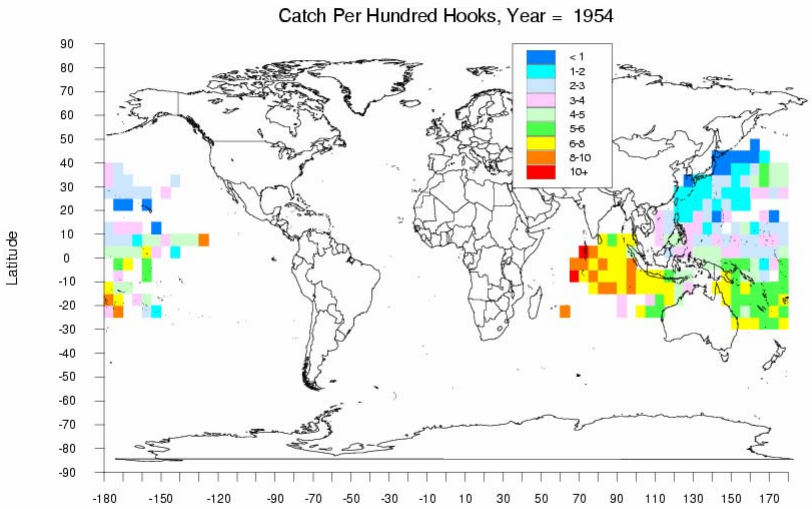
Nature 423: 280-283



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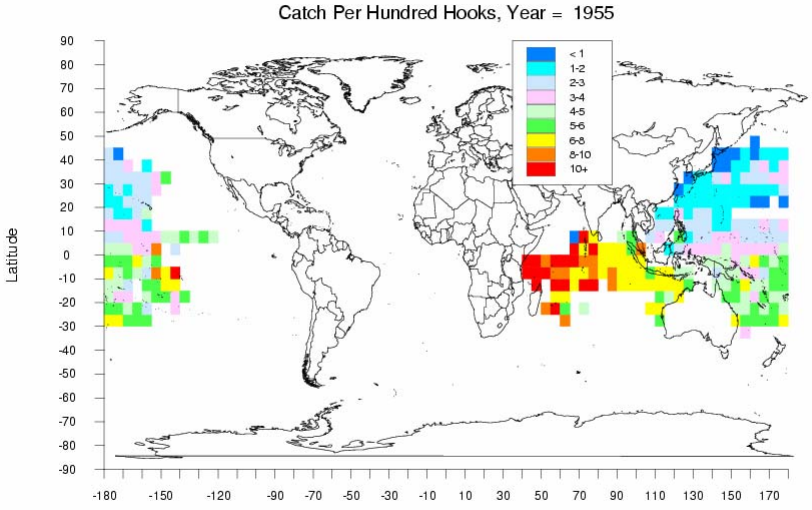
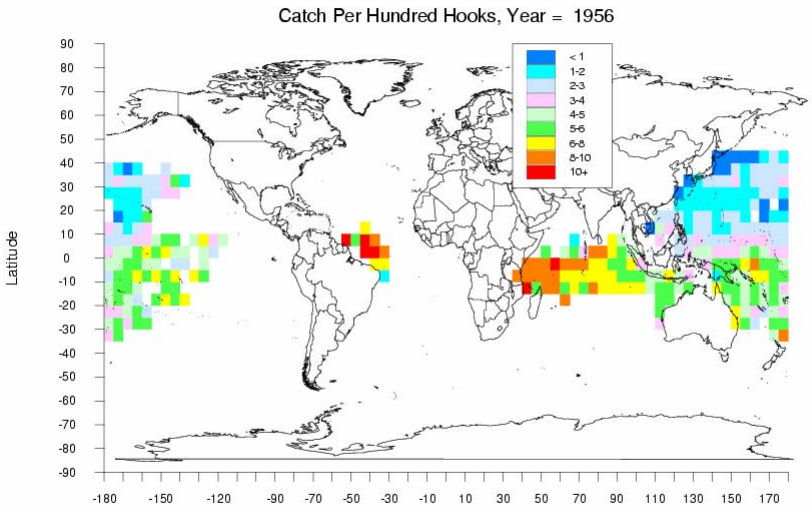
Nature 423: 280-283



Source: Myers and Worm 2003.
Nature 423: 280-283



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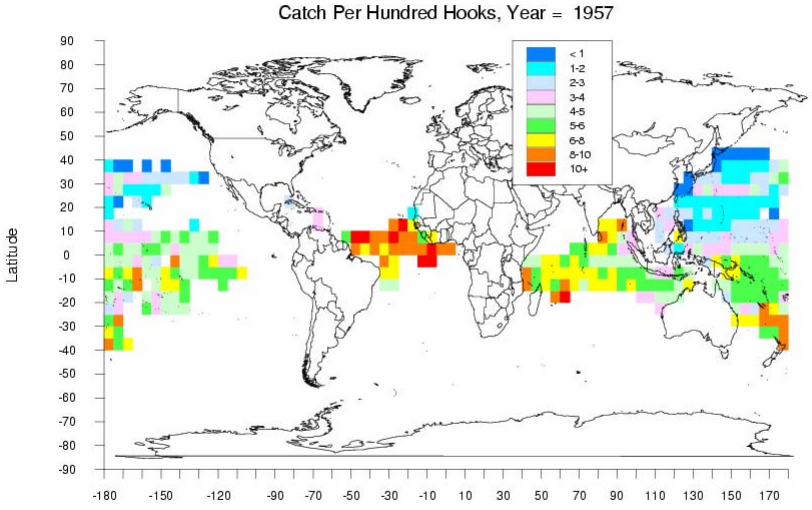

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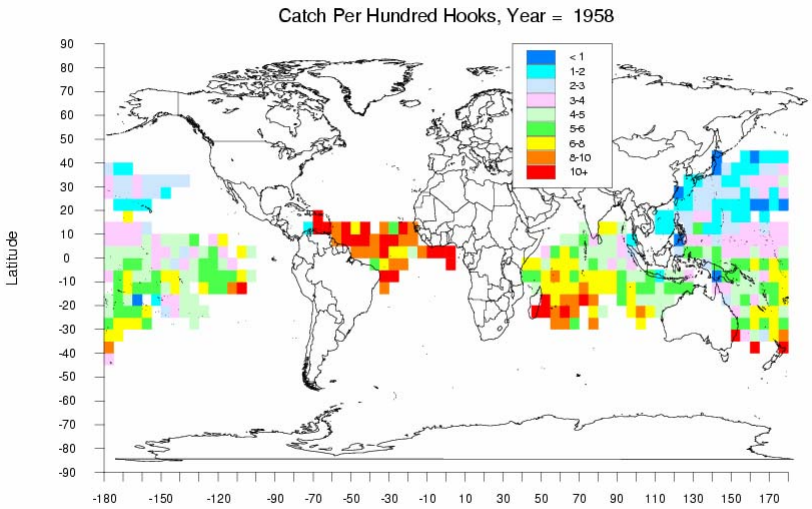
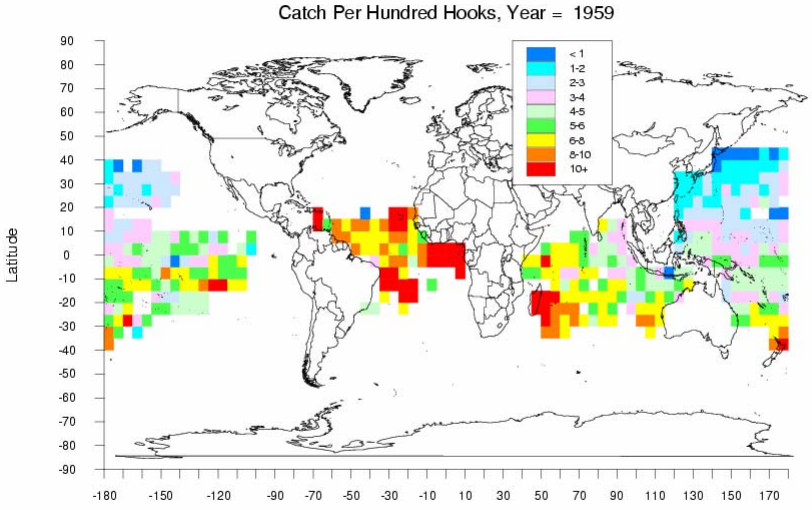
Nature 423: 280-283



Source: Myers and Worm 2003.
Nature 423: 280-283



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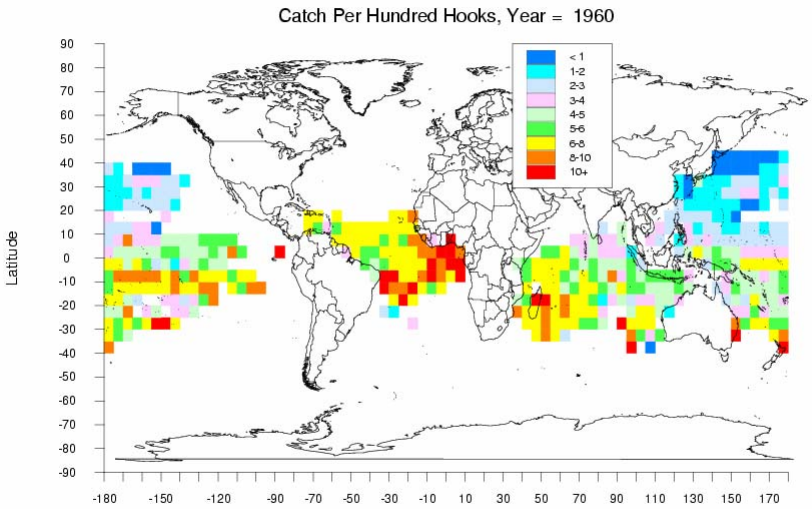

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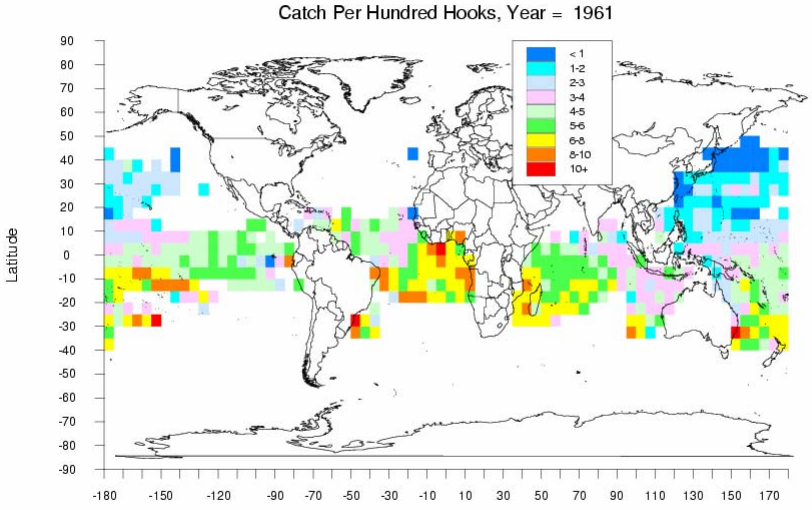

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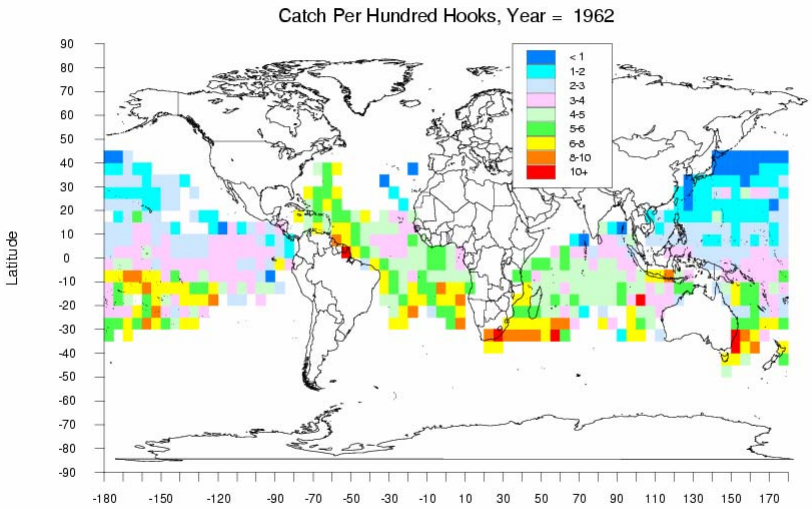

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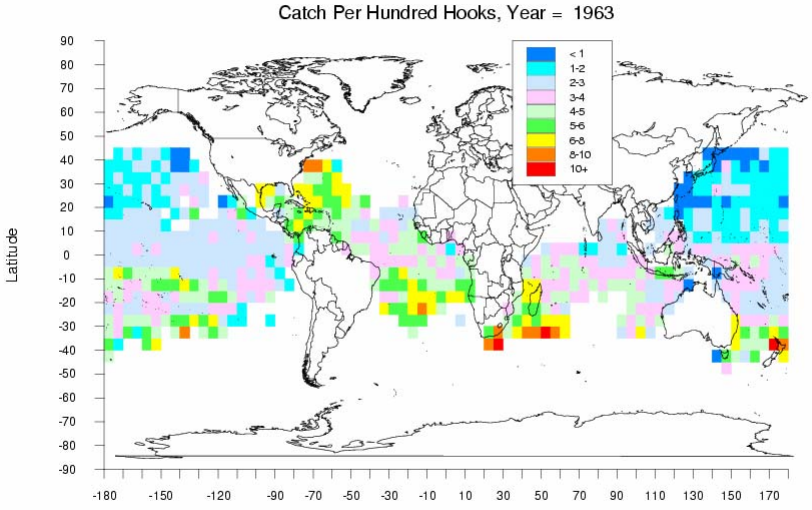

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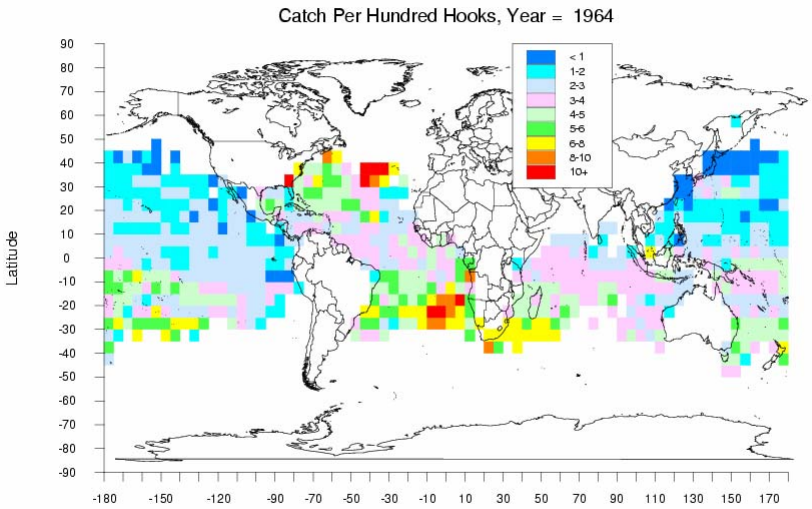

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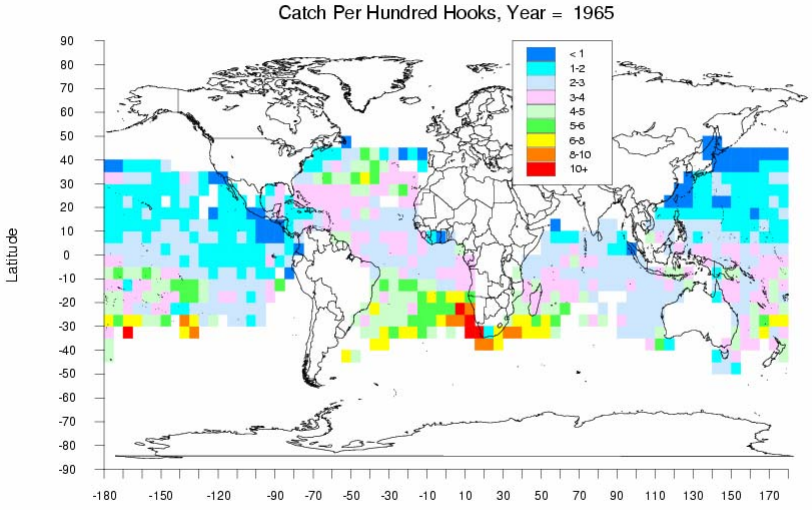

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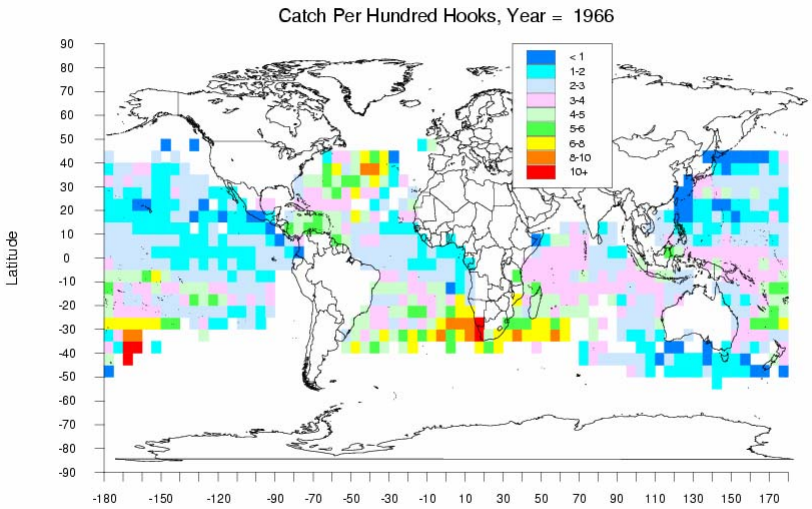

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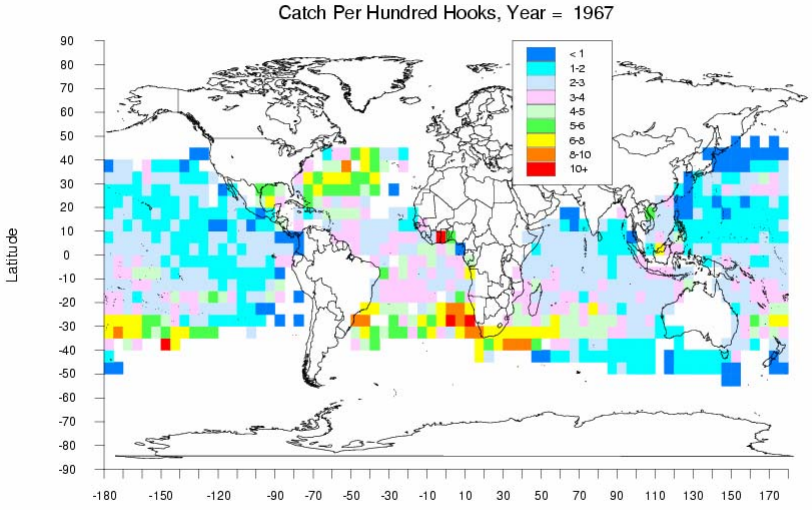

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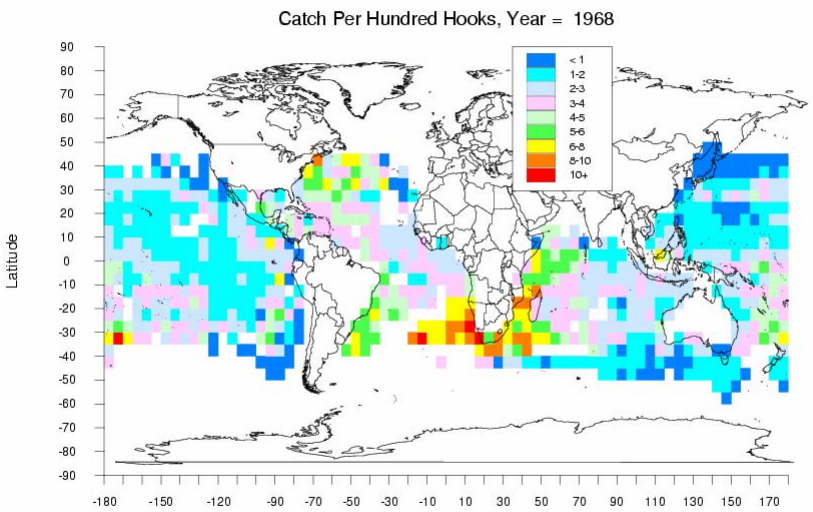

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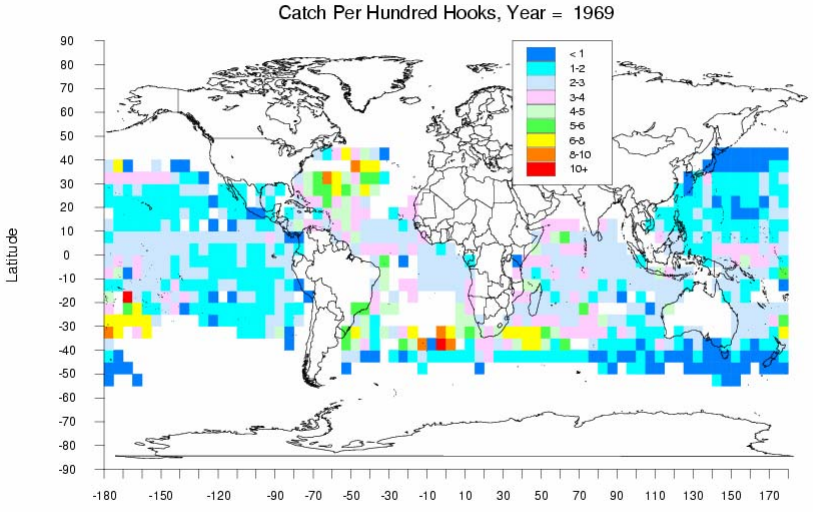

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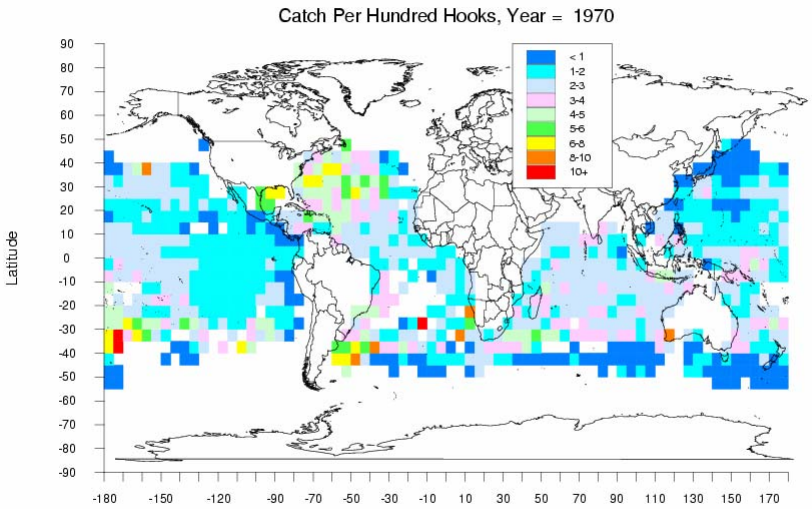

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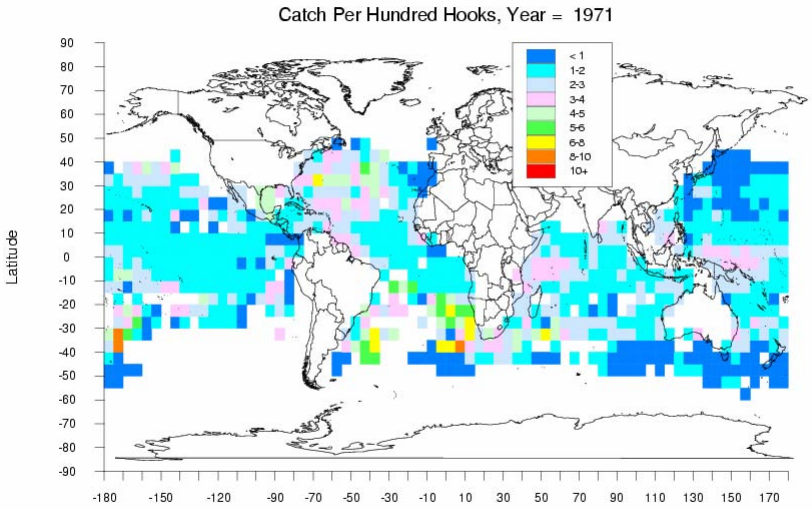

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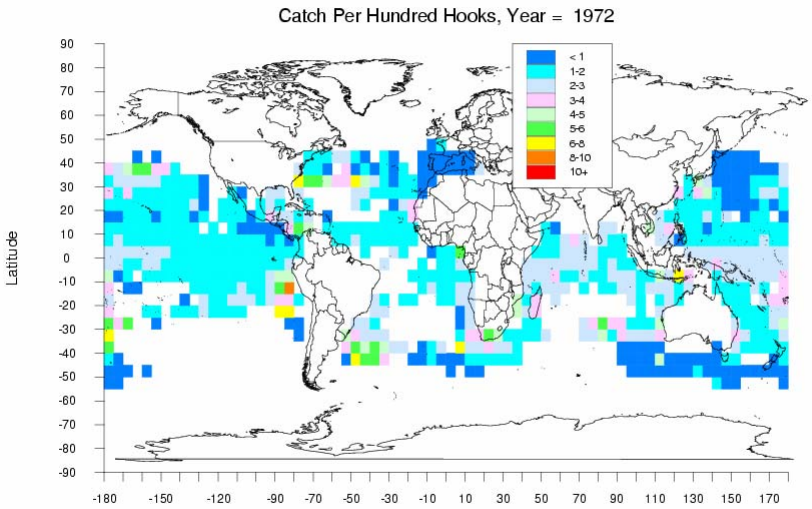

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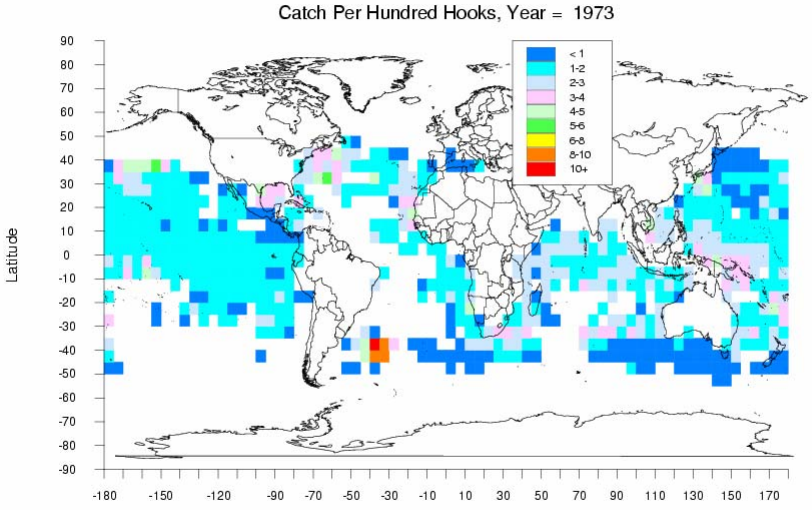

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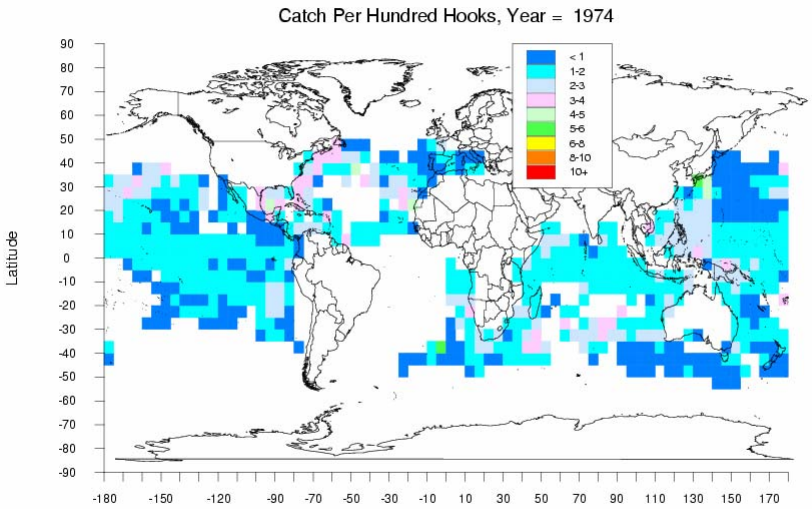

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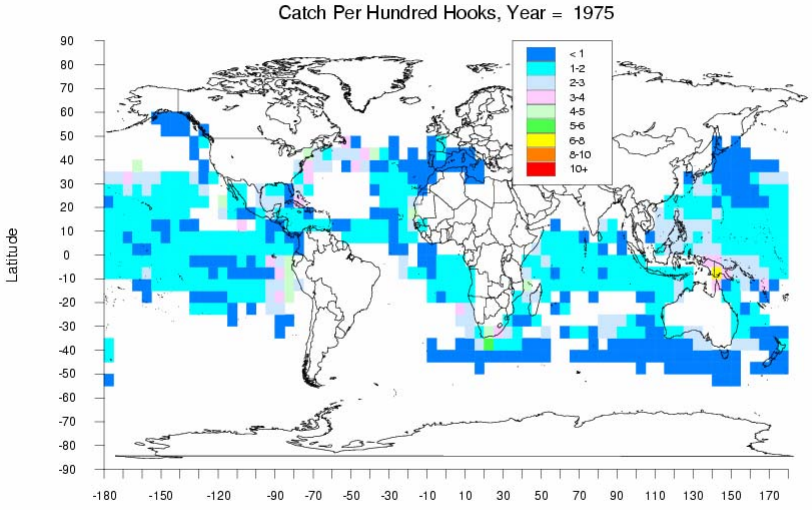

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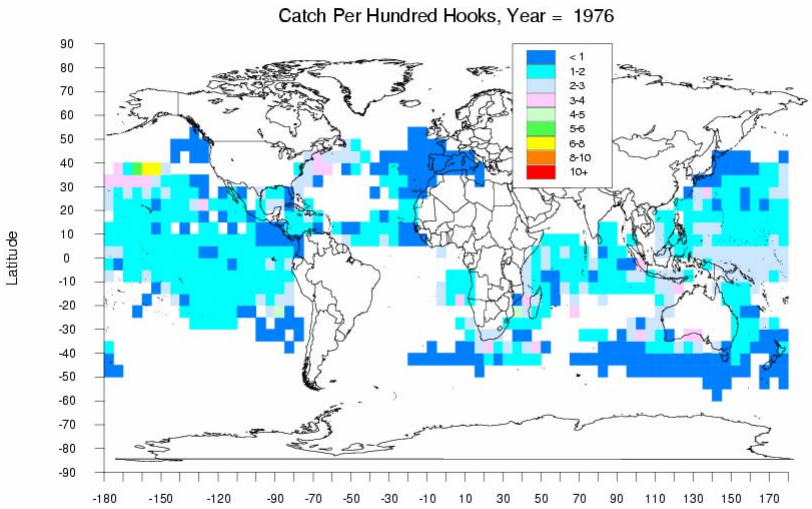

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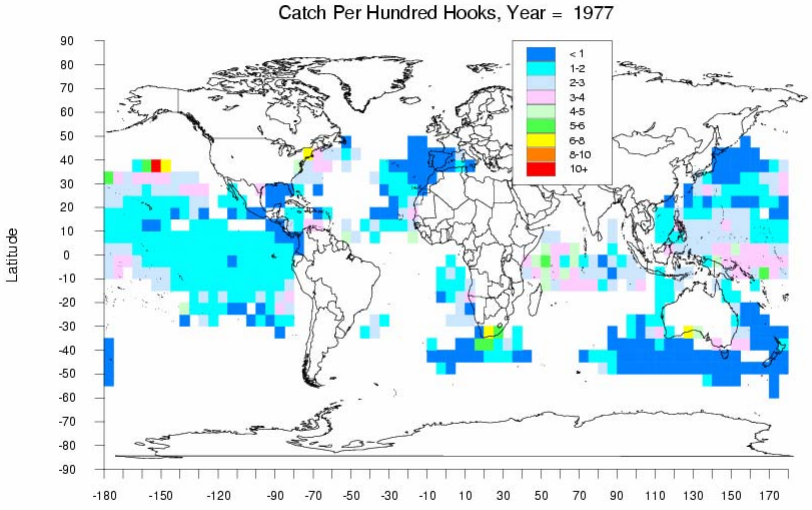

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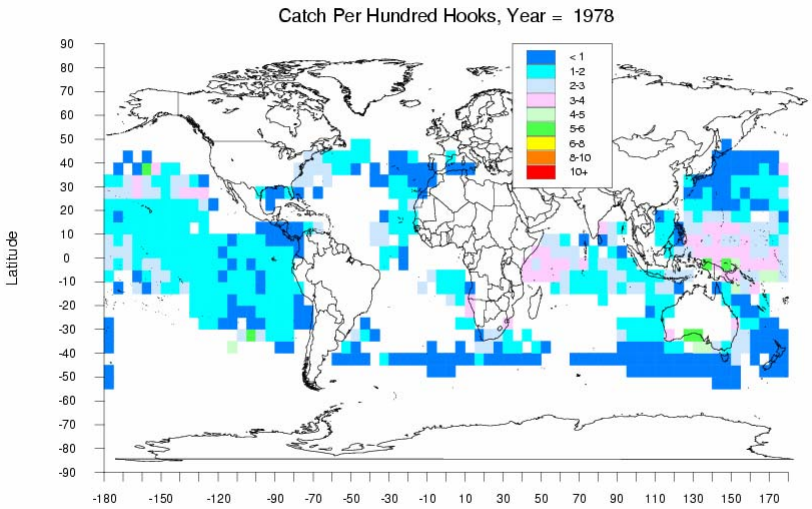

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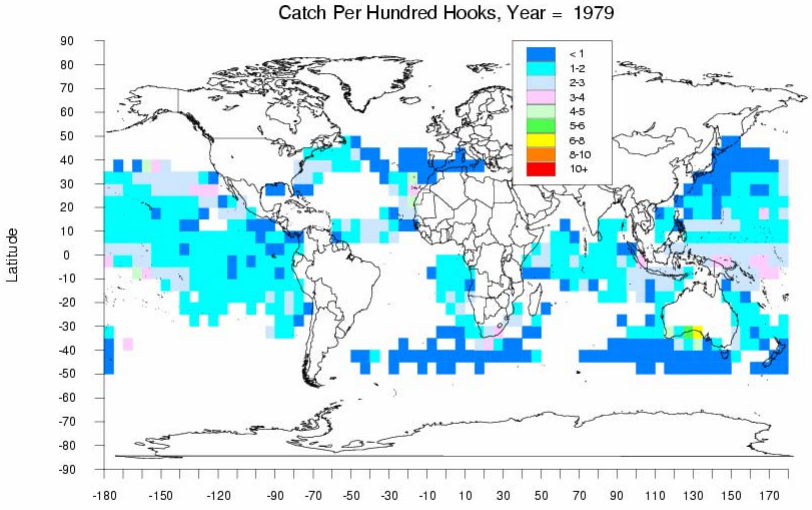

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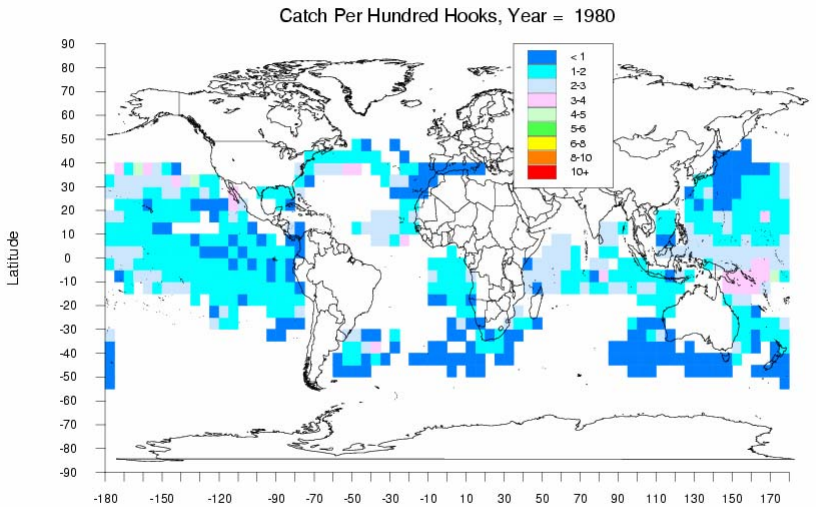

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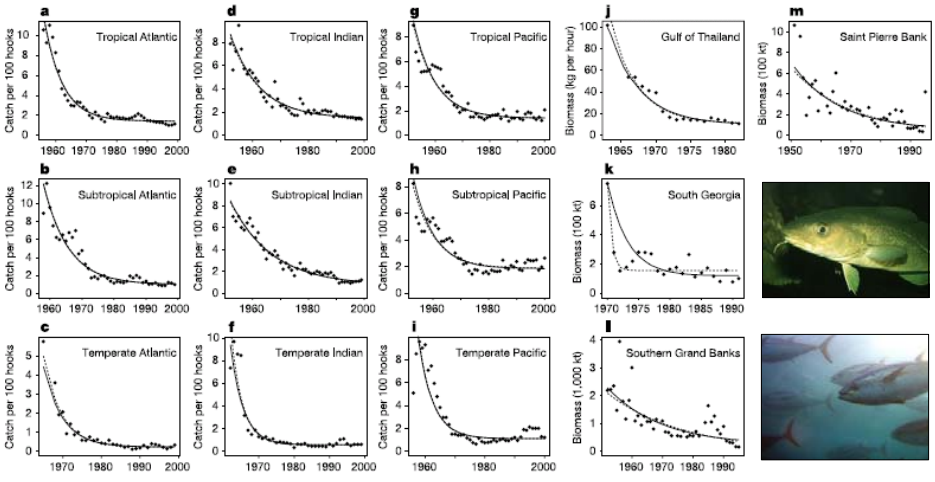
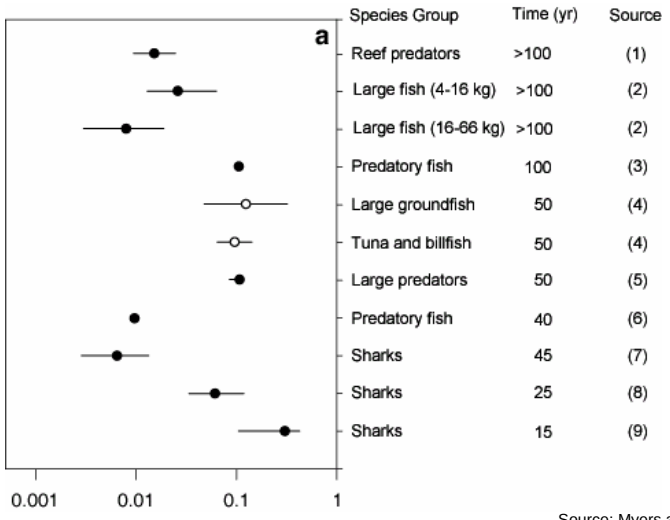
Common patterns of decline…



Source: Myers and Worm 2003.
Nature 423: 280-283

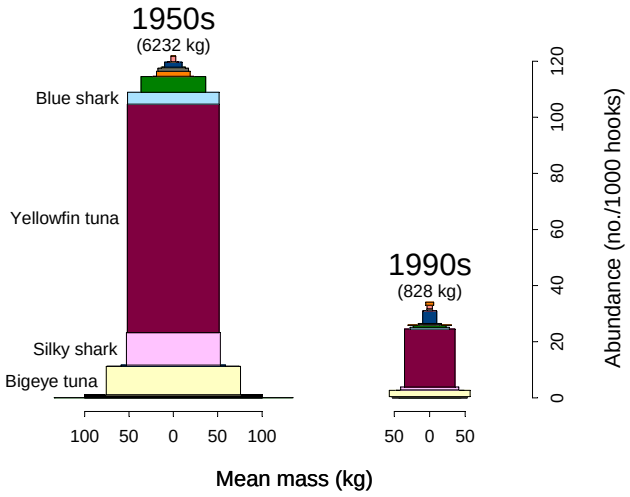
…no matter how you look at it



Source: Myers and Worm 2005.
Phil. Trans. R. Soc. Lond. B 360:13-20

Hawaiian survey data: the brave new ocean

- 87% decline in numbers
- Approx. 50% decline in size
- Large changes in species composition



Source: Ward and Myers 2005.
Ecology 86:835–847

Repeating our mistakes in the deep sea

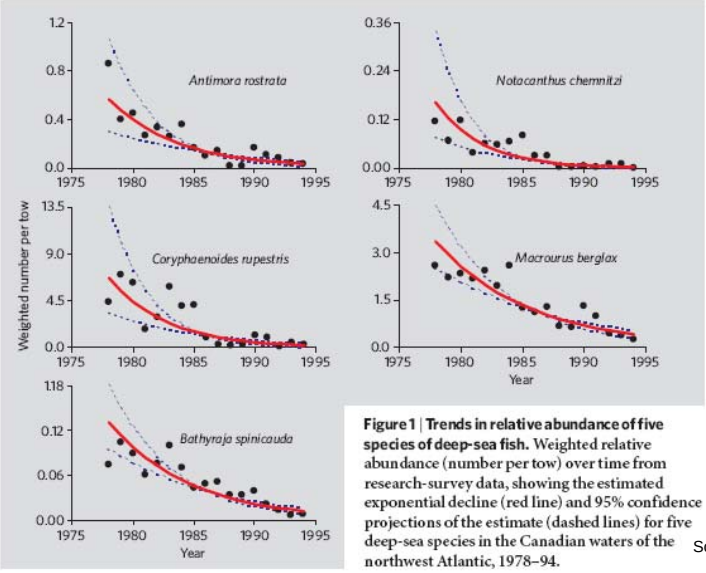


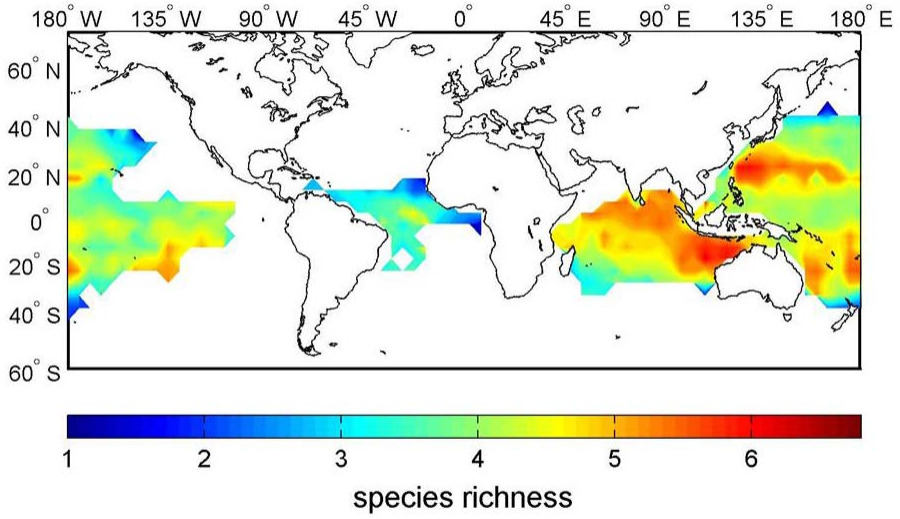
Figure 1 | Trends in relative abundance of five species of deep-sea fish. Weighted relative abundance (number per tow) over time from research-survey data, showing the estimated exponential decline (red line) and 95% confidence projections of the estimate (dashed lines) for five deep-sea species in the Canadian waters of the northwest Atlantic, 1978–94.

Source: Devine et al. (2006) Nature 439:29

Biodiversity concerns

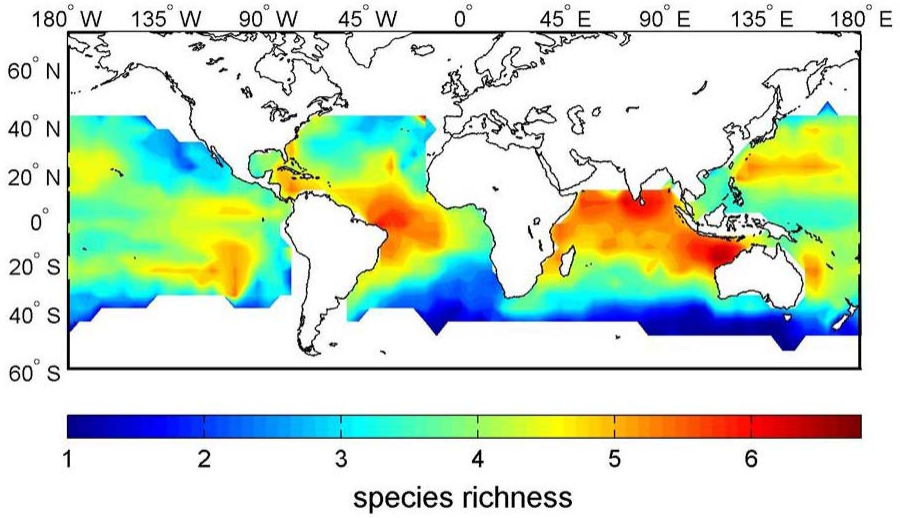
- Are species being threatened?
- Is species richness declining globally?
- Are commercial species missing from areas where they were formerly abundant?

1950s



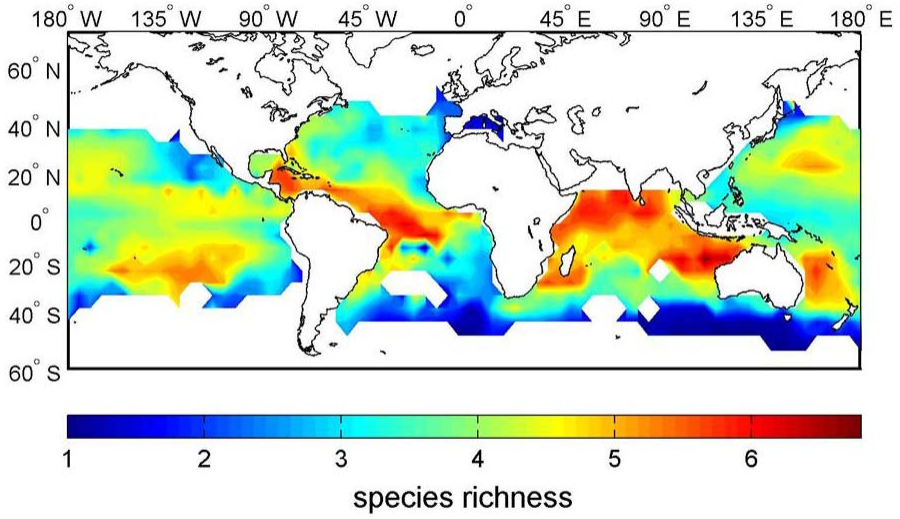
Source: Worm et al. 2005. Science 309:1365-1369

1960s



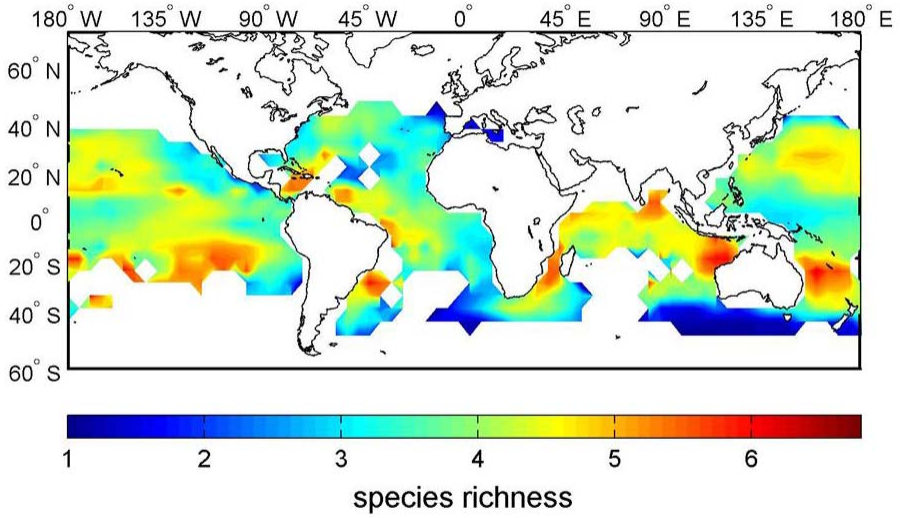
Source: Worm et al. 2005. Science 309:1365-1369

1970s



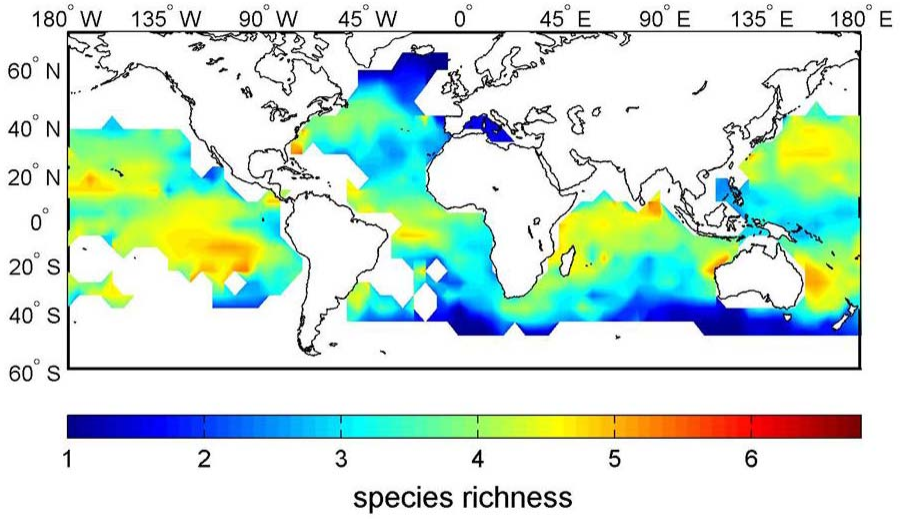
Source: Worm et al. 2005. Science 309:1365-1369

1980s



Source: Worm et al. 2005. Science 309:1365-1369

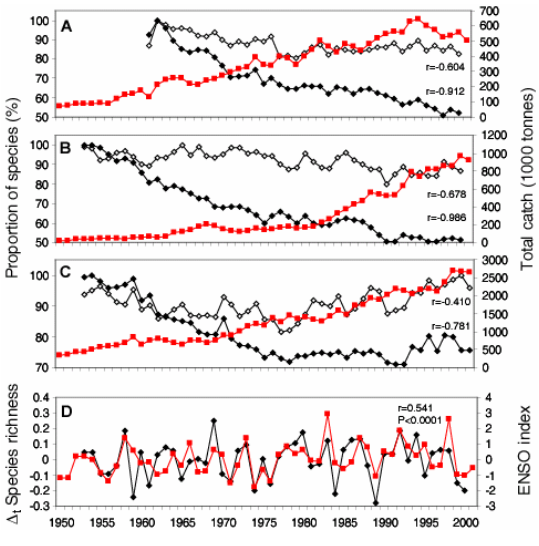
1990s



Source: Worm et al. 2005. Science 309:1365-1369

Biodiversity and catch trends over time

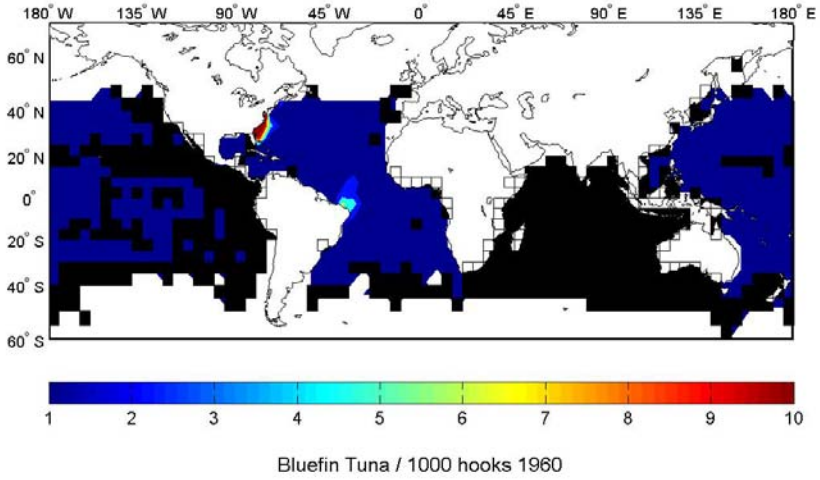
- Increasing catches
- Decreasing diversity
- Long-term decline linked to fishing
- Year-year variability linked to climate

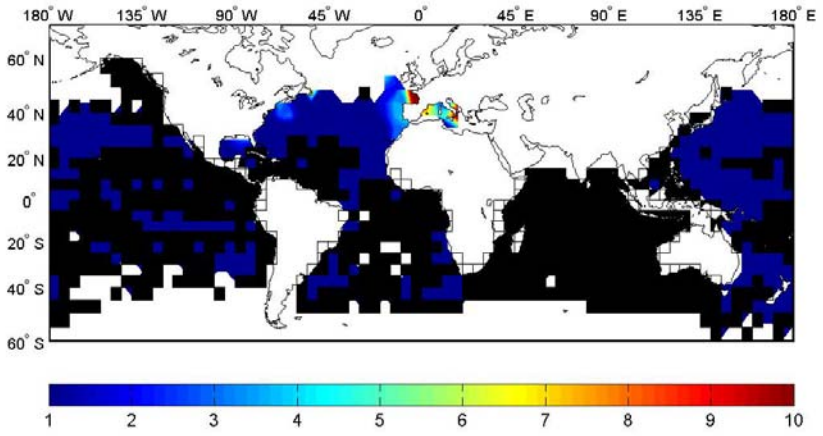


Source: Worm et al. 2005. Science 309:1365-1369

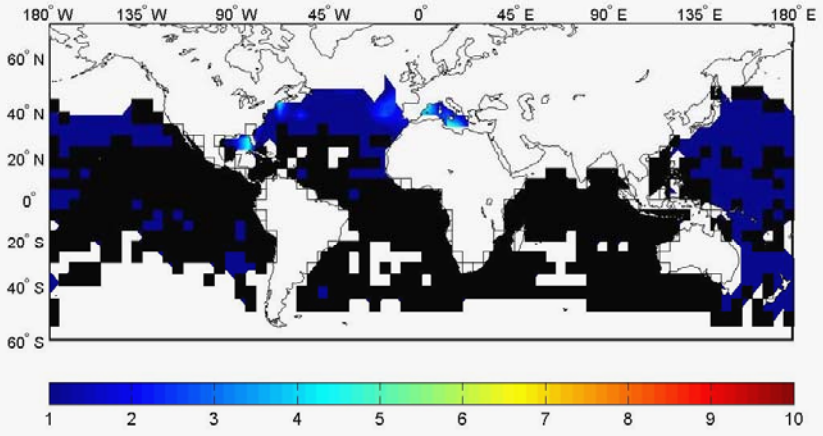
Mechanisms

- Declining density
- Contracting species ranges
- Loss of rare species

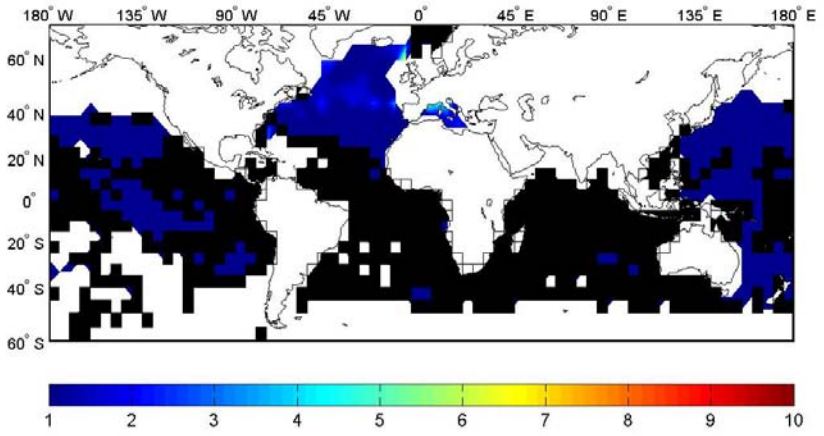




Bluefin Tuna / 1000 hooks 1970

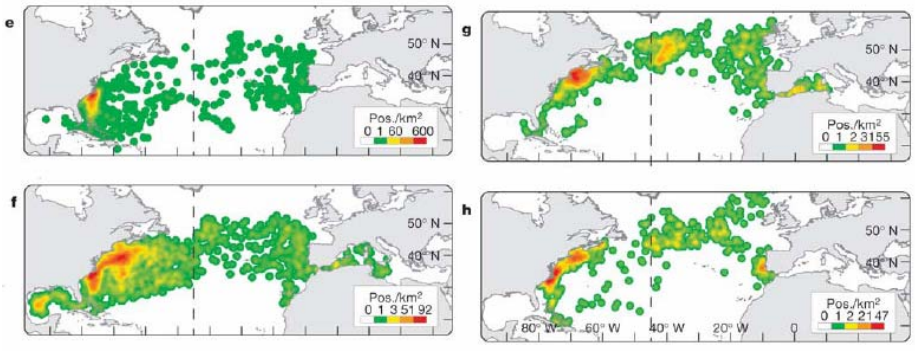


Bluefin Tuna / 1000 hooks 1980



Bluefin Tuna / 1000 hooks 1990

Tagging also shows bluefin restricted to North Atlantic



Source: Block et al. 2005. Nature 434: 1121-1127

Summary

- Many high seas fish, sharks, turtles, seabirds are threatened
- This only occurred over the last 50 years
- Economic losses are increasing
- Ecological disruption may cause significant change to ocean's function

What should we do?

- What has worked historically?
- Strong, central, international organizations
  - IWC
  - CITES
- Regional approach does not work for global conservation problems

Southern bluefin tuna (*Thunnus maccoyii*)

Loggerhead sea turtle (*Caretta caretta*)

Hammerhead shark (*Sphyrna* sp.)

Bengal tiger (*Panthera tigris*)

North atlantic right whale *(Eubalaena glacialis*)


Thank you!
• Derek Tittensor, Ransom Myers, Marcel Sandow, Andreas Oschlies, Heike Lotze
• Sloan Foundation (CoML-FMAP), Deutsche Forschungsgemeinschaft, NSERC, Pew Foundation

UNEP

CBD

CONVENTION ON BIOLOGICAL DIVERSITY

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28 April 2005

ENGLISH ONLY

AD HOC OPEN-ENDED WORKING GROUP
ON PROTECTED AREAS
First meeting
Montecatini, Italy, 13-17 June 2005

THE INTERNATIONAL LEGAL REGIME OF THE HIGH SEAS AND THE SEABED BEYOND THE LIMITS OF NATIONAL JURISDICTION AND OPTIONS FOR COOPERATION FOR THE ESTABLISHMENT OF MARINE PROTECTED AREAS (MPAs) IN MARINE AREAS BEYOND THE LIMITS OF NATIONAL JURISDICTION 1/

Note by the Executive Secretary

1. In its decision VII/5, the Conference of the Parties noted that there are increasing risks to biodiversity in marine areas beyond national jurisdiction and that marine and coastal protected areas are extremely deficient in purpose, numbers and coverage in these areas. The Conference of the Parties agreed that there is an urgent need for international cooperation and action to improve conservation and sustainable use of biodiversity in marine areas beyond the limits of national jurisdiction, including through the establishment of further marine protected areas consistent with international law and based on scientific information, including areas such as seamounts, hydrothermal vents, cold water corals and other vulnerable ecosystems (decision VII/5, paras. 29 and 30).

2. In paragraph 29 of decision VII/28, the Conference of the Parties suggested that, as one of its tasks, the Ad Hoc Open-ended Working Group should explore options for cooperation for the establishment of marine protected areas in marine areas beyond national jurisdiction, consistent with international law, including the United Nations Convention on the Law of the Sea, and based on scientific information.

3. In order to assist the Ad Hoc Open-ended Working Group with its work on this issue, the Executive Secretary commissioned the following background study on the international legal regime of the high seas and seabed beyond the limits of national jurisdiction and options for cooperation for the establishment of marine protected areas in marine areas beyond the limits of national jurisdiction. The study was undertaken with generous funding from the European Union and prepared in collaboration with the IUCN Global Marine Programme and the Task Force on High Seas Marine Protected Areas of IUCN's World Commission on Protected Areas (WCPA). It was reviewed and comments provided by United Nations Division for Ocean Affairs and the Law of the Sea (DOALOS), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), and the Secretariat of the Convention on Biological Diversity.

1/ Decision VII/5 notes the following definition adopted by the Ad Hoc Technical Expert Group on Marine and Coastal Protected Areas: "Marine and coastal protected area' means any defined area within or adjacent to the marine environment, together with its overlaying waters and associated flora, fauna and historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings."

/…

CONTENTS

I. INTRODUCTION 4
II. GLOBAL LEGAL INSTRUMENTS 5
A. The 1982 United Nations Convention on the Law of the Sea (UNCLOS) 5
1. The high seas 6
2. The Area 7
3. The continental shelf beyond 200 nautical miles 7
4. Marine environmental protection 8
5. High-seas living resources 8
6. Further development of UNCLOS provisions on marine environmental protection and conservation and management of high-seas living resources 9
7. Regime for the Area 9
B. The 1992 Convention on Biological Diversity 10
C. The 1995 United Nations Fish Stocks Agreement and the 1993 FAO Compliance Agreement 11
1. United Nations Fish Stocks Agreement 11
2. The 1993 Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas 1993 (FAO Compliance Agreement) 13
D. The 1946 International Convention on the Regulation of Whaling 13
E. Protected-species conventions 13
1. The 1979 Convention on the Conservation of Migratory Species of Wild Animals 14
2. The 1973 Convention on International Trade in Endangered Species of Wild Flora and Fauna 14
F. International Maritime Organization (IMO) instruments 15
1. Special Areas – MARPOL 73/78 15
2. Particularly Sensitive Sea Areas (PSSAs) 15
3. Ballast water and sediments 16
4. The 1972 Convention for the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) 17
G. The 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage 18
III. REGIONAL LEGAL INSTRUMENTS 18
A. Regional seas conventions 19
1. North-East Atlantic 19
2. Mediterranean Sea 20
3. South Pacific 21
4. Antarctica and the Southern Ocean 21
B. Regional fisheries management conventions 23
C. Species conventions 24
1. Agreements under the Convention on Migratory Species 24
2. The 1972 Convention for the Conservation of Antarctic Seals (CCAS) 25
IV. THE ADEQUACY OF THE EXISTING LEGAL FRAMEWORK FOR ESTABLISHMENT OF MARINE PROTECTED AREAS IN MARINE AREAS BEYOND THE LIMITS OF NATIONAL JURISDICTION 26
A. Issues relating to goals and scale 26
B. The adequacy of the legal framework 28

1. The adequacy of existing protections vis-à-vis different human activities: existing competence to regulate and existing regulations and their coverage of vulnerable areas and threats 29
2. The adequacy of geographic coverage 30
3. The adequacy of scope: a specialized and/or integrated approach to marine protected areas 31
4. Participation by relevant States and high-seas freedoms: coordination between relevant international institutions 31
5. The adequacy of high-seas enforcement 32
6. The gaps 33

V. COVERAGE OF EXISTING LEGAL INSTRUMENTS IN RELATION TO IDENTIFIED PRIORITY BIODIVERSITY AREAS 34
A. Global instruments 34
B. Regional instruments 34
C. The gaps 36

VI. OPTIONS FOR COOPERATION FOR THE ESTABLISHMENT OF MARINE PROTECTED AREAS IN MARINE AREAS BEYOND THE LIMITS OF NATIONAL JURISDICTION 36
A. Options for cooperation under existing instruments: further use and improvement 37
1. International shipping 37
2. Fisheries conservation and management 37
3. Regional seas agreements 38
4. Area activities and scientific research 39
5. Environmental impact assessment 39
6. Collaborative initiatives among like-minded States 39
7. Voluntary arrangements among private actors 40
8. Emerging compliance and enforcement tools 40
B. Integration and coordination among existing instruments 41
1. Between international instruments and bodies 41
2. At the interface between national and international areas 42
C. New mechanisms and instruments 43
1. High Seas fisheries 43
2. Integrated Approaches to marine protected areas and networks and a biogeographic approach 43

Annex I. MAJOR GLOBAL CONVENTIONS AND STATE PARTICIPATION 47

Annex II. MAJOR NON-BINDING GLOBAL LEGAL INSTRUMENTS THAT REINFORCE OR SUPPLEMENT THE BINDING INTERNATIONAL LEGAL REGIME FOR MARINE AREAS BEYOND THE LIMITS OF NATIONAL JURISDICTION 48

Annex III. REGIONAL LEGAL AGREEMENTS APPLICABLE TO MARINE AREAS BEYOND NATIONAL JURISDICTION 49
A. Regional Seas Agreements 49
B. Regional fisheries management organizations (RFMOs) and the conventions establishing them 50
C. Convention on Migratory Species – Agreements - www.cms.int 51
D. Other relevant regional agreements 51

I. INTRODUCTION 2/

1. The international legal regime for marine areas beyond national jurisdiction is made up of a number of global and regional legal instruments. The comprehensive legal framework for all these instruments is the United Nations Convention on the Law of the Sea (UNCLOS). As an umbrella treaty covering all ocean uses, the Convention was designed to serve as a unifying framework for a growing number of more detailed international agreements that address one or more particular ocean use. That is, the zones it defines, and the principles, rights and obligations it specifies, provide the basic framework for these more detailed agreements, and the latter are complementary to the Convention and further develop and elaborate it. Most of the provisions of the Convention are considered to reflect customary international law, which applies to all States.

2. During the last half-century, more intensive human use of the oceans has produced numerous specialized international agreements applicable to one or another use. Many apply to areas both within and beyond national jurisdiction. In areas beyond national jurisdiction, specialized conventions for the most part cover international shipping, fisheries, and the deliberate disposal of wastes at sea (dumping). Underwater cultural heritage is also addressed. These and other agreements are considered below. They do not, either through their general provisions or those on protected marine areas beyond national jurisdiction, have a binding effect on non-parties to the agreement, except as specifically noted below. Many other human activities (table 1) are not yet the subject of more detailed, internationally agreed measures that apply in marine areas beyond national jurisdiction.

3. The term "marine protected area" in this study is not used to refer to any particular category or type of marine protected area. Rather, it refers to provisions in a variety of international agreements that, for a defined geographic marine area beyond national jurisdiction, have the effect that its biodiversity enjoys a higher level of protection than in the waters and/or seabed around the area. This is consistent with the definition noted in decision VII/5 of the Conference of the Parties to the Convention on Biological Diversity. 3/ Provisions of this type are currently found at the global level in agreements that govern a single activity (e.g., international shipping, mineral resources extraction in the seabed beyond national jurisdiction, and fishing).

2/ This study has been prepared in collaboration with IUCN's Global Marine Programme and the Task Force on High Seas Marine Protected Areas of IUCN's World Commission on Protected Areas (WCPA) by Lee A. Kimball, with special thanks to other members of the WCPA Task Force's international law sub-group: Charlotte Breide, John Croxall, Kristina Gjerde, Susie Grant, Andrew Hurd, Sian Pullen, Tullio Scovazzi, and Dorothy Zbicz. Comments on the study received from the UN Division for Ocean Affairs and the Law of the Sea (DOALOS), the UN Food and Agriculture Organization (FAO), the UN Environment Programme (UNEP), and the Secretariat of the Convention on Biological Diversity were taken into account. This study is also informed by the following earlier reports on MPAs beyond national jurisdiction: D. Czybulka & P. Kersandt, *Legal Regulations, Legal Instruments and Competent Authorities with Relevance for Marine Protected Areas (MPAs) in the Exclusive Economic Zone (EEZ) and the High Seas of the OSPAR Maritime Area,* Federal Agency for Nature Conservation, Germany (BfN 2000); *Managing Risks to Biodiversity and the Environment on the High Sea, Including Tools such as MPAs – Scientific Requirements and Legal Aspects*, eds. H.Thiel & J.A. Koslow, Proceedings of the Expert Workshop held at the International Academy for Nature Conservation, Isle of Vilm, Germany, 27 Feb. – 4 March 2001 (BfN 2001) and, specifically, "MPAs Beyond National Jurisdiction – Existing Legal Principles and Future Legal Frameworks" by R. Warner; K.M. Gjerde, "Current Legal Development: High Seas MPAs," 16 *IJMCL* 515 (2001); L.A. Kimball, *International Ocean Governance: Using International Law and Organizations to Manage Marine Resources Sustainably* (IUCN, 2001, 2003); *Towards a Strategy for High Seas MPAs*, eds. K.M. Gjerde and C. Breide, Proceedings of the IUCN, WCPA and WWF Experts Workshop on High Seas MPAs, 15-17 January 2003, Malaga, Spain (IUCN 2003) and, specifically, its draft action plan at annex 5; *Proceedings of the Workshop on the Governance of High Seas Biodiversity Conservation,*16-19 June 2003, Cairns Australia, and, specifically, "A Framework for Identifying and Responding to Gaps" by L.A. Kimball; T. Scovazzi, "MPAs on the High Seas: Some Legal and Policy Considerations," 19 *IJMCL* 1 (2004).

3/ See footnote 1 above.

4. There is no global framework agreement for addressing threats posed by multiple activities to geographically-defined priority biodiversity areas 4/ apart from the general requirements under the United Nations Convention on the Law of the Sea for protection and preservation of the marine environment (see below). Nor is there a global agreement for identifying such areas on a scientific basis. At the regional level, some binding legal agreements provide for multiple-use marine protected areas beyond national jurisdiction, while ensuring that the regulation of particular activities is consistent with high-seas freedoms under the United Nations Convention on the Law of the Sea (see below).

5. This study outlines the UNCLOS framework and its application to marine areas beyond national jurisdiction, together with specific provisions in UNCLOS and other global and regional agreements that offer options for establishing marine protected areas in these areas (sections II and III). It then reviews the adequacy of the existing legal regime for establishing marine protected areas beyond national jurisdiction (section IV) and considers its adequacy with respect to the priority high seas areas identified in the scientific background paper, *Patterns of species richness in the high seas* (section V). The final section suggests further options for cooperation in establishing marine protected areas beyond national jurisdiction (section VI).

6. In addressing the adequacy of the existing legal regime, section IV first considers some issues relating to the goals and scale of protection required to maintain the structure and functioning of the full range of marine ecosystems, as called for in decision VII/5. Before concluding with a summary of the major gaps, it then reviews:

(a) The adequacy of existing protections vis-à-vis different human activities: existing competence to regulate and existing regulations and their coverage of vulnerable areas and threats;

(b) The adequacy of the geographic coverage of existing protective arrangements;

(c) The adequacy of the scope of existing protective arrangements;

(d) The adequacy of participation by all relevant States and coordination between relevant international institutions; and

(e) The adequacy of high seas enforcement.

7. The options in section VI are arranged into sub-sections on (i) cooperation under existing instruments: further use and improvement; (ii) integration and coordination among existing instruments and bodies, including at the interface between national and international waters; and (iii) new mechanisms and instruments. Each section contains specific references to the priority high seas areas identified in section V of the study.

8. Annex I to this study lists the major conventions considered in this study and the number of States parties. Annex II identifies the major non-binding global legal instruments that reinforce or supplement binding legal agreements. Annex III lists regional legal agreements applicable to marine areas beyond national jurisdiction and the number of Parties.

II. GLOBAL LEGAL INSTRUMENTS

A. The 1982 United Nations Convention on the Law of the Sea (UNCLOS)

9. The United Nations Convention on the Law of the Sea lays down a comprehensive legal regime for the world's oceans and seas, establishing rules governing all uses of the oceans and ocean resources. The Convention divides marine space into a number of zones, both within and beyond the limits of

4/ The phrase “biodiversity hotspots” is used in this paper as a convenient shorthand to refer to the marine areas beyond national jurisdiction ultimately identified where biodiversity warrants a higher level of protection than in surrounding areas. The term “priority biodiversity area” is also used towards the same purpose. The values and criteria that may be used to identify these areas have not yet been agreed.

national jurisdiction. The limits of these zones are measured from baselines extending along the coast. The areas within national jurisdiction include: internal waters, archipelagic waters, the territorial sea, the contiguous zone, the exclusive economic zone (EEZ), and the continental shelf. UNCLOS sets out States' rights and responsibilities both in these defined zones subject to coastal State sovereignty (internal waters, archipelagic waters, territorial sea) and jurisdiction (namely, the EEZ and the continental shelf) and in areas beyond national jurisdiction.

10. UNCLOS is supplemented and elaborated by two implementing agreements, the 1994 Agreement relating to Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (the "1994 Part XI Agreement"), and the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (the "United Nations Fish Stocks Agreement" or "UNFSA"). They are considered below.

11. UNCLOS provides that the areas beyond the limits of national jurisdiction include: (i) the water column beyond the EEZ, or beyond the territorial sea where no EEZ has been declared, called the "high seas" (article 86); and (ii) the seabed which lies beyond the limits of the continental shelf, established in conformity with article 76 of the Convention, designated as "the Area" (article 1 para.1). Parts VII and XI of the Convention, provide the legal framework for the high seas and the Area, respectively.

12. A number of institutions are created under UNCLOS for its implementation. These include the International Tribunal for the Law of the Sea, the Commission on the Limits of the Continental Shelf, and the International Seabed Authority. Furthermore, the United Nations General Assembly each year holds a debate on the question of ocean affairs and the law of the sea, including through the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea. 5/

1. The high seas

13. UNCLOS provides that the high seas are open to all States; that is, all States are free to use them with due regard for other States' interests. High seas freedoms include navigation, fishing, marine scientific research, laying of undersea cables and pipelines, construction of artificial islands and other installations permitted under international law, 6/ and other unspecified activities (e.g., deployment of undersea vessel tracking and intelligence gathering devices). High seas freedoms are not a license for unrestrained use; they must be exercised under conditions laid down by the Convention, including general obligations to protect and preserve the marine environment (Part XII) and to conserve and manage high seas living resources (Part VII, Section 2), and other rules of international law. As considered below, numerous international conventions associated with UNCLOS set out more detailed conditions for international shipping and fishing exercized as high seas freedoms.

14. The enforcement of international legal regimes on the high seas is primarily the responsibility of the flag State vis-à-vis ships flying its flag. Under UNCLOS, flag States have exclusive jurisdiction over vessels flying their flag on the high seas, save in exceptional cases expressly provided for in international treaties. The duties of the flag State concerning ships flying its flag are spelled out in UNCLOS. 7/ Nevertheless, some flag States do not exert effective control over ships flying their flag ("flag of convenience" States); that is, they do not, as required by UNCLOS, take measures in conformity with generally accepted international regulations, procedures and practices nor take the steps necessary to secure observance of these measures by their flag ships. In view of this, UNCLOS provides for certain investigation and enforcement action by "port States" when a vessel is voluntarily within a port or at an

5/ General Assembly resolution 49/28.

6/ Article 87.

7/ Articles 91-92, 94, 216-17.

offshore terminal of the State – in relation to pollution discharges outside that State's jurisdiction, or the seaworthiness of the vessel, in violation of applicable international standards. 8/

15. Evolving regional and global arrangements strengthen the role of port States in promoting compliance with international shipping, fisheries, and labour-standards instruments. These include regional memoranda of understanding (MOUs) on port State control and efforts through the International Maritime Organization (IMO) and the Food and Agriculture Organization of the United Nations (FAO) to facilitate their effective application. 9/ Certain supplementary agreements have also been developed, especially in the area of international fisheries, which allow States other than the flag State to verify compliance with agreed international rules and, in some cases, take enforcement action on the high seas (section II.C).

2. The Area

16. As regards the seabed beyond the limits of national jurisdiction, Part XI of UNCLOS, as elaborated by the 1994 Part XI Agreement, provides that the Area and its resources (defined in article 133 as all solid, liquid or gaseous mineral resources *in situ* in the Area at or beneath the seabed, including polymetallic nodules) are the common heritage of humankind. The International Seabed Authority (ISA) is the organization through which States organize and control activities in the Area, particularly with a view to administering the resources of the Area and to sharing the benefits arising from activities thereof. Activities in the Area include all activities of exploration for and exploitation of the resources of the Area (article 1.3). The Authority exercises control over activities in the Area for the purpose of securing compliance with Part XI and the 1994 Part XI Agreement, while States parties are responsible for taking all necessary measures to ensure compliance by those subject to their jurisdiction or control. The Authority is further charged with establishing a staff of inspectors to determine compliance. 10/ (Additional information on the regime of the Area is provided below.)

3. The continental shelf beyond 200 nautical miles

17. It is important to note that where a coastal State's continental shelf (defined by the Convention to include the physical continental shelf, slope and rise together comprising the continental margin) extends beyond 200 nautical miles, the coastal State has sovereign and exclusive rights to explore and exploit the natural resources in these portions of the shelf, including living organisms belonging to sedentary species. 11/ Sovereign rights to conserve these resources are not expressly included. In these cases, the seabed beyond national jurisdiction (i.e., the Area) begins at the outer limit of the shelf, sometimes well beyond 200 nautical miles. The water column above this extended shelf is high seas, since the high seas normally begin at the edge of the 200-nautical-mile EEZ. Thus, the water column beyond national jurisdiction may commence at a different distance from shore than the Area. (Where the coastal State has not claimed a 200-nautical-mile EEZ, the high seas may begin closer to shore, at the edge of the 12-nautical-mile territorial sea, as is the case, for example, in many parts of the Mediterranean.)

8/ Articles 218-219.

9/ See, for example, Kimball, International Ocean Governance, note 1 at 14-15; D. Anderson, "Port States and Environmental Protection," International Law and Sustainable Development (Oxford University Press 1999); Report of the Expert Consultation to Review Port State Measures to Combat IUU Fishing, 4-6 November 2002, FAO Fisheries Report No. 692.

10/ Articles 139, 153(4), 162(2)(z).

11/ Articles 76-77. The rights of the coastal State over the continental shelf are inherent and do not require any express proclamation, as does the EEZ; but the outer limit must be determined in accordance with article 76. Article 77.4 defines sedentary species as "organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil".

4. Marine environmental protection

18. The United Nations Convention on the Law of the Sea provides the legal framework for the protection and preservation of the marine environment. It contains a general obligation for States to protect and preserve the marine environment, which applies both within and beyond national jurisdiction (article 192). States must take, individually or jointly as appropriate, all necessary measures to prevent, reduce and control pollution from any source, including land-based sources, pollution from or through the atmosphere, pollution from vessels, pollution by dumping, and pollution from installations and devices used in exploration or exploitation of the natural resources of the seabed and subsoil and other installations and devices operating in the marine environment. Also covered is pollution resulting from the use of technologies, and the intentional or accidental introduction of species that are alien or new to a particular part of the marine environment, which may cause significant and harmful changes thereto. 12/ While the Convention does not explicitly call for establishment of marine protected areas, the measures States include required to take are those necessary to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened, or endangered species and other forms of marine life (article 194, para.5).

19. The Convention also covers responsibility and liability for damage caused by pollution of the marine environment, including in areas beyond national jurisdiction, and that caused by marine scientific research. 13/ In addition, it provides for monitoring and environmental assessment. In particular, States are required to monitor the risks or effects of marine pollution and publish resulting reports, and to assess the potential effects of planned activities under their jurisdiction or control that may cause substantial pollution or significant and harmful changes to the marine environment, and report on assessment results. 14/

5. High-seas living resources

20. The freedom of fishing on the high seas is qualified by the Convention's provisions on the conservation and management of high-seas living resources (Part VII, section 2). These require all States to take such measures for their nationals as may be necessary to conserve high-seas living resources. Furthermore, States must cooperate in the conservation and management of these resources; in particular, States whose nationals exploit the same living resources, or different living resources in the same area, must enter into negotiations with a view to taking the measures necessary for the conservation of the resources concerned. To this end, they must cooperate to establish subregional or regional fisheries organizations.

21. The conservation measures envisaged must be designed on the basis of the best scientific evidence available. They reflect knowledge emerging during the 1970s on inter-species and environmental relationships, subsequently refined as the more comprehensive ecosystem approach. That is, in determining the allowable catch and establishing other conservation measures for high seas living resources, the measures taken are to maintain or restore populations of harvested species at levels that can produce the maximum sustainable yield, as qualified by relevant environmental and economic factors and taking into account, *inter alia*, the interdependence of stocks. In addition, in determining the allowable catch and establishing other conservation measures, States must take into consideration the effects upon species associated with or dependent upon harvested species with a view to maintaining or restoring populations of such species above levels at which their reproduction may become seriously threatened. 15/ By implication, conservation measures contemplate a suite of options that include regulations on seasons

12/ Articles 194-96, 207-212.

13/ Articles 139, 235, 263.

14/ Articles 204-06.

15/ Article 119. See also The *Ecosystem Approach to Fisheries*. FAO Technical Guidelines for Responsible Fisheries No. 4, Suppl. 2. Rome, FAO (2003).

and areas for fishing. 16/ The Convention also provides for stricter measures to prohibit, limit, or regulate the exploitation of marine mammals, adopted through a competent international organization. 17/

6. Further development of UNCLOS provisions on marine environmental protection and conservation and management of high-seas living resources

22. Both for marine environmental protection and high seas living resources, the Convention contemplates that further global and regional standards, rules and/or recommended practices and procedures will be adopted through other bodies, and it builds on earlier agreements. 18/ Moreover, it obliges States to cooperate with each other and through appropriate global and regional organizations in formulating and elaborating these international measures. 19/ Regarding pollution from land-based sources and seabed activities subject to national jurisdiction, States are to endeavour to harmonize their policies at the appropriate regional level. 20/ As more detailed measures are progressively developed, the Convention incorporates them by reference, and its framework obligations may be interpreted and applied in light of this evolving body of law. In some cases, international measures adopted through other bodies set minimum international standards for UNCLOS parties. 21/

7. Regime for the Area

23. The regime of the Area is set forth in UNCLOS (Part XI) and the 1994 Part XI Agreement. The latter is to be applied and interpreted together with UNCLOS as a single instrument. This regime expressly governs exploration and exploitation ("activities in the Area") regarding Area resources (as defined in the Convention), 22/ including related environmental impacts and marine scientific research in the Area. 23/ In addition to general rules of international law applicable to the conduct of all States, several other principles apply to the Area. These include that the Area and its resources are the common heritage of mankind and that no State may claim or exercise sovereignty or sovereign rights over any part of the Area or its resources, nor may any part be appropriated by a State or natural or juridical person. All rights in the resources are vested in humankind as a whole. Moreover, all humankind is to benefit from activities in the Area, from marine scientific research carried out in the Area, and from objects of an archaeological and historical nature found in the Area. Additional principles call for necessary measures to ensure protection of the marine environment from harmful effects of these activities and liability for damage from activities in the Area. High-seas freedoms must be exercised with due regard for rights under the Convention with respect to activities in the Area, and, conversely, activities in the Area are to be carried out with reasonable regard for other activities in the marine environment. 24/

16/ Specific conservation measures are not listed in articles 116-119. Nevertheless, article 62.4 contains a list of items to which national EEZ measures may relate, including (c) "regulating seasons and areas of fishing".

17/ Article 120, with reference to article 65.

18/ Article 237 addresses the relationship between UNCLOS and obligations under other conventions related to protection and preservation of the marine environment.

19/ Articles 197, 207.4, 208.5, 209.1, 210.4, 211.1, 212.3, and 117-118. In enclosed and semi-enclosed seas like the Mediterranean, special emphasis is placed on cooperation among states bordering these areas, including in relation to living resources conservation, environmental protection, and scientific research. Articles 122-23.

20/ Articles 207.3 and 208.4.

21/ For vessel-source pollution, dumping, and activities in the Area, national laws and regulations must be as effective as international rules and standards adopted under the IMO Conventions, London Convention, and by the International Seabed Authority, respectively. Articles 211.2, 210.6, and 209.2.

22/ "Activities in the Area" means all activities of exploration for, and exploitation of, the resources of the Area (article 1.3), with "resources" subject to Part XI (and the 1994 Part XI Agreement) further defined as all solid, liquid or gaseous mineral resources *in situ* in the Area at or beneath the seabed (Article 133.a).

23/ Articles 143, 145.

24/ Articles 136-149, 87.

24. The Convention establishes the International Seabed Authority (ISA) as the organization through which States parties to the Convention organize and control activities in the Area, particularly with a view to administering the resources of the Area. Where the Convention sets out the framework and principles, the Authority through its Council and Assembly gives effect to them. It adopts general policies and detailed rules and regulations governing activities in the Area and oversees their implementation and enforcement. Thus, it is the responsibility of the International Seabed Authority to adopt the necessary measures on environmental protection such as rules, regulations and procedures *inter alia* to prevent, reduce and control pollution, to protect and conserve the natural resources of the Area, and to prevent damage to the flora and fauna of the marine environment. 25/

25. The Authority has completed rules and regulations governing prospecting and exploration for polymetallic nodules and is currently considering draft regulations for prospecting and exploration of polymetallic sulphide and cobalt-rich crust deposits. Sulphide deposits are found at hydrothermal vent sites, while crusts normally occur on seamounts. Commercial activities in the Area are not yet viable, but some initial prospecting and exploration has taken place and research is ongoing in order to assess potential environmental impacts.

26. Among the rules and regulations called for in the Convention, and reflected in the rules and regulations so far adopted, is a requirement that the Authority disapprove areas for minerals exploitation "in cases where substantial evidence indicates the risk of serious harm to the marine environment". 26/ The rules and regulations on polymetallic nodules require that when a contractor applies for exploitation rights, it must propose areas to be set aside and used exclusively as "preservation reference zones" in which no mining shall occur, so that representative and stable biota of the seabed remain in order to assess any changes in the flora and fauna of the marine environment due to mining. 27/ Furthermore, contractors are required to gather environmental baseline data, to establish environmental baselines against which to assess the likely effects of their activities on the marine environment, and to establish a programme to monitor and report on such effects. 28/ Similar provisions are under consideration in the draft regulations for sulphide and cobalt-crust deposits. 29/

B. The 1992 Convention on Biological Diversity

27. The Convention on Biological Diversity and UNCLOS are complementary instruments with respect to the conservation and sustainable use of marine biodiversity. UNCLOS sets out the general framework for all ocean uses and resources, and Parties to the Convention on Biological Diversity are required to implement that Convention consistently with the rights and obligations of States under the law of the sea. In areas beyond national jurisdiction, the provisions of the Convention on Biological Diversity apply only to processes and activities carried out under a Party's jurisdiction or control which may have adverse impact on biodiversity. They do not apply to the components of biodiversity *per se,* as they do within national jurisdiction. For this reason, the Convention on Biological Diversity underlines the need for cooperation among Parties in respect of areas beyond national jurisdiction for the conservation and sustainable use of biodiversity, either directly or through competent international organizations. 30/ This

25/ Article 145.

26/ Article 162.2.x.

27/ Regulation 31.7, Regulations for Prospecting and Exploration for Polymetallic Nodules in the Area, 19 July 2000. See Document ISBA/6/A/18 for official text. This regulation also requires the contractor to set aside an "impact reference zone," representative of the environmental characteristics of the Area, to be used for assessing the effect of that contractor's activities in the Area on the marine environment. Available at www.isa.org.

28/ Regulation 31.4, Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area, note 24. In 2001, the Authority's Legal and Technical Commission adopted recommendations for the guidance of the contractors for the assessment of the possible environmental impacts arising from exploration for polymetallic nodules in the Area, Document ISBA/7/LTC/1/Rev.1, 13 February 2002.

29/ Regulation 33, ISBA/10/C/WP.1, 24 May 2004, available at www.isa.org.

30/ Articles 3-5.

is reinforced in paragraph 30 of decision VII/5 of the Conference of the Parties to the Convention on Biological Diversity, which addresses protected areas in marine areas beyond national jurisdiction and expresses an agreement that there is an urgent need for international cooperation and action to improve conservation and sustainable use of biodiversity in these areas.

28. Thus, each Party to the Convention on Biological Diversity is responsible for applying Convention provisions to processes and activities undertaken by its nationals (or other entities under its jurisdiction or control) that may adversely impact biodiversity in areas beyond national jurisdiction. This includes identification and monitoring of these processes and activities (including activities within national jurisdiction that may have impacts beyond) as well as environmental impact assessment of proposed projects likely to have significant adverse impacts on biodiversity. This is explicitly recognized in paragraph 56 of decision VII/5, which invites States to identify activities and processes under their jurisdiction or control which may have significant adverse impact on deep seabed ecosystems and species beyond national jurisdiction. In addition, States are responsible for ensuring that activities within their jurisdiction or control do not cause damage to the environment of areas beyond the limits of national jurisdiction. To this end, the Parties are to promote reciprocal arrangements for notification, exchange of information, and consultation on any activities likely to have significant adverse effects on biodiversity in areas beyond national jurisdiction and to notify potentially affected States in cases of imminent or grave danger. 31/ These provisions on monitoring and assessment and State responsibility complement those of UNCLOS and supplement them in highlighting specific effects on biodiversity.

C. The 1995 United Nations Fish Stocks Agreement and the 1993 FAO Compliance Agreement

1. United Nations Fish Stocks Agreement

29. The 1995 United Nations Fish Stocks Agreement (UNFSA), as noted above, is an implementing agreement of UNCLOS. It is to be interpreted and applied in the context of UNCLOS and consistent with it. It applies to two types of fish stocks identified in UNCLOS (straddling fish stocks and highly migratory fish stocks), and it applies primarily beyond national jurisdiction although certain key provisions also apply within areas under national jurisdiction (general principles, precautionary approach, compatibility of measures within national jurisdiction and on the adjacent high seas). 32/ The objective of the United Nations Fish Stocks Agreement is to ensure the long-term conservation and sustainable use of these stocks. Like UNCLOS, it envisages cooperation through regional (including subregional) fisheries management organizations or arrangements as the primary mechanism for implementing its provisions. Nevertheless, its general principles and the precautionary approach govern all States parties fishing for straddling stocks and highly migratory stocks on the high seas.

30. The United Nations Fish Stocks Agreement strengthens in particular two aspects of UNCLOS: it requires fisheries management to be based on precautionary and ecosystem approaches, and it enhances means for monitoring, control, and enforcement both by flag States and through international cooperation, especially at the regional level.

31. With respect to fisheries management, the approaches specified in the United Nations Fish Stocks Agreement draw on the full suite of principles and measures provided in UNCLOS, which have been further elaborated through a number of regional fisheries management organizations (RFMOs). These include the obligation to cooperate in the conservation and management of high-seas living resources, the requirement of best scientific evidence available, and the importance of exchanging scientific information. They also include measures such as catch and effort requirements, closed areas/seasons, selective gear, and controls over new or exploratory fisheries. Although the United Nations Fish Stocks Agreement does not refer explicitly to the ecosystem approach, its article 5 on general principles requires that States:

31/ Articles 7.c and 14.1.a-d.

32/ Articles 5-7.

(a) Take into account the interdependence of stocks in conservation and management measures;

(b) Assess the impacts of fishing, other human activities and environmental factors on target stocks and species belonging to the same ecosystem or associated with or dependent upon target stocks;

(c) Adopt, where necessary, conservation and management measures for species related to target stocks;

(d) Minimize pollution, waste, discards, catch by lost or abandoned gear, catch of non-target species (both fish and non-fish) and impacts on associated or dependent species, in particular endangered species; and

(e) Protect biodiversity in the marine environment.

32. In implementing the precautionary approach set out in article 6, the United Nations Fish Stocks Agreement requires States to develop data collection and research programmes to assess the impact of fishing on non-target and associated or dependent species and their environment, and to adopt plans necessary to ensure the conservation of such species and to protect habitats of special concern. 33/

33. In relation to monitoring, control, and enforcement, the United Nations Fish Stocks Agreement provides several innovative approaches: 34/

(a) First, it requires States fishing in the area of a regional fisheries management organization, even if they are not a party to the arrangement, to cooperate in observing the conservation and management measures established by that body (for straddling fish stocks and highly migratory fish stocks); otherwise, they may not authorize vessels flying their flag to fish for stocks covered by these measures.

(b) Second, it provides for at-sea boarding and inspection arrangements in areas covered by the regional fisheries management organization to verify compliance with the its conservation and management measures. While the vessel undertaking the inspection must be a member of the organization, the vessel inspected need not be, although it must be a party to the United Nations Fish Stocks Agreement. Further provisions of the United Nations Fish Stocks Agreement require the flag State either to investigate and, if warranted, take enforcement action, or to authorize the inspecting State to take further actions while informing the flag State of all developments. Moreover the United Nations Fish Stocks Agreement requires States to establish through regional fisheries management organizations boarding and inspection procedures in accordance with its provisions. If they have not done so, by default the provisions in the United Nations Fish Stocks Agreement apply (among parties to the United Nations Fish Stocks Agreement);

(c) Third, the United Nations Fish Stocks Agreement provides for port State inspection of fishing vessels. If the port State establishes that the catch on a vessel has been taken in a manner undermining the effectiveness of regional or global measures for high seas conservation and management, and if authorized by national legislation, the port State may prohibit landings and transshipments of the catch.

34. In addition, the United Nations Fish Stocks Agreement complements the FAO Compliance Agreement in setting forth duties of the flag State to ensure that vessels flying its flag comply with conservation and management measures adopted at the regional level and do not undermine the effectiveness of such measures.

33/ Article 6.3.d. Guidelines for application of the precautionary approach are set out in Annex II of the United Nations Fish Stocks Agreement.

34/ Articles 17-23.

2. The 1993 Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas 1993 (FAO Compliance Agreement)

35. Improved monitoring, control and enforcement by flag States is one of the main purposes of the FAO Compliance Agreement, which applies to all fishing vessels that are used or intended for fishing on the high seas. It sets out flag State responsibilities to ensure that a fishing vessel flying its flag and engaged in high seas fishing complies with international conservation and management measures. The flag State must authorize its vessels to fish on the high seas and it may only do so if it can effectively exercise its responsibilities under the Agreement. Restrictions are placed on issuing an authorization for high-seas fishing to any vessel that has undermined international conservation and management measures. The Agreement also provides for arrangements whereby port States may take investigatory measures to establish whether a fishing vessel voluntarily in its ports has violated the Agreement's provisions. 35/

36. Each flag State must maintain a record of vessels entitled to fly its flag and authorized by it to fish on the high seas, and this information must be made available to FAO which shall circulate it to all Parties. The Agreement also requires States Parties to cooperate in exchanging information on fishing vessel activities in order to assist flag States to identify any of their vessels engaged in activities that undermine international conservation and management measures. 36/ FAO has established a High Seas Vessel Authorization Record in order to develop a comprehensive, centralized database on vessels authorized to fish on the high seas.

D. The 1946 International Convention on the Regulation of Whaling

37. The purpose of the International Convention on the Regulation of Whaling is to ensure proper and effective conservation and development of whale stocks. It applies to factory ships, land stations, and whale catchers under the jurisdiction of Parties to the Convention, and to all waters in which whaling is prosecuted. The International Whaling Commission (IWC) established by the Convention and composed of States parties, may organize scientific studies and investigations related to whales and whaling and collect, analyse and disseminate relevant statistical and other information. The Commission is also charged with amending the "Schedule" of applicable regulations. It can fix the limits of open and closed waters, including the designation of sanctuary areas, as well as prescribe seasons, catch and effort limits, and prohibited methods of capture for particular whale species. 37/ A moratorium on whaling established by the Commission took effect in 1985/86.

38. The Commission has established two large-scale high-seas sanctuaries where commercial whaling is prohibited -- in the Indian Ocean in 1979 and the Southern Ocean in 1994. Both prohibitions were established for ten years, subject to review. The Indian Ocean Sanctuary was extended indefinitely in 1992, and the Southern Ocean Sanctuary was extended for another ten years in 2004. There is no ongoing commercial whaling in these areas, although the taking of whales for purposes of scientific research is permitted under conditions specified in the Convention. 38/ These sanctuary measures are of course only applicable to States Parties to the Convention.

E. Protected-species conventions

39. This section covers briefly two global conventions, the Convention on the Conservation of Migratory Species of Wild Animals, and the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). Their relevance to the international legal regime for marine areas beyond national jurisdiction stems primarily from the Parties' obligations to protect and conserve listed marine

35/ Articles II, III, V.

36/ Articles IV-VI.

37/ Article V.1.

38/ Article VIII.

species found in these areas, with particular reference to their habitat under the Convention on Migratory Species. These conventions elaborate general obligations under UNCLOS on high seas living resources as well as UNCLOS article 194.5 on rare or fragile ecosystems and the habitat of depleted, threatened, or endangered species.

1. The 1979 Convention on the Conservation of Migratory Species of Wild Animals

40. A number of migratory marine species are listed in one or both of the appendices to the Convention on Migratory Species. These include migratory seabirds, small cetaceans, and marine turtles. The Parties agree to take, individually or in cooperation, appropriate and necessary steps to conserve migratory species and their habitat. For species in danger of extinction throughout all or a significant portion of their range (appendix I), the "range States" must take immediate action to protect them. For species in unfavorable conservation status (appendix II), range States are urged to conclude binding Agreements on the full range of threats in order to improve unfavorable status. The Convention provides guidelines for the Agreements and serves as an umbrella mechanism for their review. 39/ Several Agreements on marine species have been concluded at the regional level (see section III.Cbelow).

41. Regarding areas beyond national jurisdiction, the Convention defines "range States" to include States whose vessels are engaged in taking the species beyond the limits of national jurisdiction and requires them to prohibit the taking of appendix I species. Moreover, to the extent that activities undertaken within national jurisdiction may endanger the species beyond national jurisdiction (e.g., chronic or accidental pollution from offshore oil rigs, introduction of alien species), the range States should control these effects. In addition, appendix I range States are to conserve and restore important habitats, prevent and remove obstacles to migration, and prevent and control factors that may endanger the species, including introduction of alien species. Agreements on appendix II species should encompass habitat protections and provide for maintaining a network of suitable habitats appropriately disposed in relation to the species' migration routes. 40/

2. The 1973 Convention on International Trade in Endangered Species of Wild Flora and Fauna

42. CITES concentrates on measures to curtail global trade in threatened and endangered species listed in three appendices. Among the marine listings are many species of cetaceans, marine turtles, and corals. In 2002, for the first time, the Parties agreed to list (appendix II) 30 important commercial marine fish species – basking sharks, whale sharks and all 28 species of seahorses. 41/ At the 13th conference of the parties in October 2004, the Parties decided to list two additional fish species on appendix II: the great white shark and the humphead wrasse, both of substantial commercial value. 42/

43. For appendix II marine species subject to an earlier treaty than CITES, the trade restrictions in CITES do not apply if the species is taken in conformity with the relevant convention by flag ships of a State party to both. 43/

44. Regarding marine areas beyond national jurisdiction, the CITES provisions on "introduction from the sea" cover transportation into a State of any species taken in the marine environment outside the jurisdiction of any State. 44/ This entails prior grant of approval by the State into which a species listed either in appendix I or II is introduced, subject to certain conditions.

39/ Articles II, III, IV, V, VI, VII.

40/ Article I.1.h, III.4, and V.4.e, f, g, i.

41/ The specific listings referred to may be found at the CITES' secretariat website (http://www.cites.org/eng/cop/index.shtml; click "Amendments to Appendices I and II adopted at COP 12"), and its species database (http://www.cites.org/eng/resources/species.html).

42/ A/60/63, para. 153.

43/ Articles XIV.4 and 5.

44/ Articles I.e, III.5, and IV.6 and 7.

45. The recent designations of certain fish species, and proposals that others be included in the CITES appendices, have led to two expert consultations convened by FAO in May and June 2004 on the relationship between CITES and regional fisheries. At the thirteenth meeting to the Conference of the Parties to CITES, in October 2004, there was no agreement on proposals to clarify Convention provisions on "introduction from the sea", including the role of decisions of regional fisheries management organizations, 45/ and the Parties agreed to undertake a further workshop on this issue.

F. International Maritime Organization (IMO) instruments

46. The shipping instruments are generally global, because uniformity of international measures facilitates navigation and ensures a level playing field for worldwide shipping. They are developed under the auspices of the International Maritime Organization (IMO), whose mandate is to ensure "safe, secure and efficient shipping on clean oceans". Its rules and standards are widely recognized as minimum standards applicable to all States' vessels both within and beyond national jurisdiction. IMO is considered the competent international body to establish special protective measures in defined areas where shipping presents a risk. These apply uniformly to all ships (non-discriminatory) and include routing and discharge restrictions and reporting requirements.

1. Special Areas – MARPOL 73/78

47. Discharges from ships, both accidental and intentional, are regulated by the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). MARPOL 73/78 regulates vessel design, equipment, and operational discharges from all ships both within and beyond national jurisdiction. It also provides for the designation of "Special Areas" where more stringent discharge rules apply in respect of oil, noxious liquid substances, and garbage (marine debris), 46/ and for defined SO_x emission control areas for air pollution. 47/ Special Areas are defined as "areas in which, for technical reasons relating to their oceanographical and ecological condition and to their sea traffic, the adoption of special mandatory methods for the prevention of sea pollution is required." Proposals for Special Areas are strengthened if the States concerned are taking or intend to take measures to curtail pollution from sources other than shipping that contribute to stress in the area; and/or if there is an active regime to manage the area's resources. Two sea areas that include areas beyond national jurisdiction have already been designated as Special Areas: the Antarctic and Southern Ocean (south of latitude 60 degrees south) and the Mediterranean. That in the Mediterranean has not yet taken effect due to lack of adequate waste reception facilities.

2. Particularly Sensitive Sea Areas (PSSAs)

48. In addition to Special Areas, the IMO has adopted a resolution providing for the designation of "Particularly Sensitive Sea Areas" (PSSAs). 48/ They are defined as "areas which need special protection through action by IMO because of their significance for recognized ecological, socio-economic or scientific reasons, and which may be vulnerable to damage by maritime activities". The process of

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45/ See CITESdocument CoP13 Doc. 41.

46/ It is now widely recognized that offshore and high seas discharges can give rise to mass concentrations of marine debris in oceanographic "sink" areas, such as gyres, eddies or convergence zones (e.g. the equatorial convergence zone). In some such areas, rafts of assorted debris, including various plastics, ropes, fishing nets, cargo-associated wastes like dunnage, pallets, wires and plastic covers, drums and shipping containers along with accumulated slicks of various oils, often extend for many kilometers. There are also some areas (e.g. parts of the Northern Atlantic and Northern Pacific) where the volume and frequency of shipping is such that there is virtually a continuous presence of concentrations of ships, thereby constituting a potentially chronic source of pollution. "Maritime Transport & High Seas Governance—Regulation, Risks and the IMO Regime", S. Raaymakers, Cairns Workshop, note 1, at 4 and 9.

47/ IMO Guidelines for the Designation of Special Areas under MARPOL 73/78, IMO Assembly Resolution A. 927 (22), Annex I, 29 November 2001. These detail the criteria and procedures for acceptance of Special Area status.

48/ IMO Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas, IMO Assembly Resolution A. 927 (22), Annex II.

designating a PSSA offers a means for IMO and the States proposing the designation to select the most appropriate mechanisms available through IMO instruments to reduce or eliminate risks posed by shipping to the area or a specific portion thereof.

49. As the PSSA guidelines do not contain any restrictions on the marine areas where a PSSA may be designated, a PSSA could therefore include areas of the high seas. 49/ A proposal for a PSSA must fulfil three conditions: the area must (i) meet at least one of the ecological, socio-economic and scientific criteria contained in the PSSA guidelines; (ii) be at risk from international shipping; and (iii) need protective measures that are within the competence of IMO to adopt or approve.

50. There are currently seven PSSAs, all of which lie within national jurisdiction. Their associated protective measures include ships' routeing measures, such as areas to be avoided, traffic separation schemes, and no anchoring areas; mandatory reporting requirements; special discharge restrictions consistent with those applicable in Special Areas; and compulsory pilotage. With the exception of compulsory pilotage, these measures are available either under the International Convention for the Safety of Life at Sea (SOLAS 1974) or MARPOL 73/78, and each PSSA protective measure must be approved in accordance with the procedure specified in the relevant convention. 50/ Compulsory pilotage schemes are suggested as a possible measure under the PSSA guidelines. 51/

51. A proposed PSSA may include within its boundaries a buffer zone; that is, an area contiguous to the site-specific feature (core area) for which specific protection from shipping is sought. "Consideration should also be given to the potential for the area to be listed on the World Heritage List, declared a Biosphere Reserve, or included on a list of areas of international, regional, or national importance, or if the area is already the subject of such international, regional, or national conservation action or agreements." 52/

52. PSSAs are an interesting mechanism for protecting particular areas beyond national jurisdiction. They have no separate legal status; rather, their value lies in a combination of the international recognition of the designated area's values and the adoption of protective measures associated with the site based on existing IMO conventions or other IMO competencies and consistent with UNCLOS. As considered in section VI below, a PSSA could serve as a geographic reference point for the application of binding and recommended measures provided for under existing IMO instruments and, possibly, other agreements. 53/

53. It should be noted that the PSSA guidelines are currently under review within the IMO Marine Environmental Protection Committee (MEPC). A correspondence group is actively considering proposals to clarify and, where appropriate, strengthen them, for example, regarding criteria, size and roles. This issue will be taken up again at the 53rd session of the MEPC, to be held from 18 to 22 July 2005.

3. Ballast water and sediments

54. The goals of the recent International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004, not yet in force) are to prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens due to ballast water exchange. It requires ships to

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49/ Article VIII.

50/ Routing measures and mandatory reporting are approved under SOLAS, chapter 5, Regulations 8 and 8-1; discharge restrictions are approved under MARPOL 73/78, which must be consistent with Special Area standards and operational procedures.

51/ To date compulsory pilotage has been applied in the territorial sea, pursuant to UNCLOS, Article 21.1.

52/ IMO Resolution A.927 (22), 29 November 2001 at para. 6.2. As noted in Section VI of this paper, inscription of an area beyond national jurisdiction on the World Heritage List under the Convention Concerning the Protection of the World Cultural and Natural Heritage (1972) would require amendment of that Convention.

53/ L. de La Fayette, "The Marine Environment Protection Committee: The Conjunction of the Law of the Sea and International Environmental Law," in 16 IJMCL 158 (2001).

conduct exchanges at least 200-nautical-mile from the nearest land and in waters deeper than 200 metres, wherever possible. 54/ If a party or parties determine that additional measures are necessary in certain areas, they may require ships to meet a specified standard or requirement consistent with international law; if such party(ies) intend the measure to apply in areas beyond national jurisdiction to ships other than their own, IMO approval would be necessary. 55/ Current awareness of marine debris as a vector for transporting non-indigenous species from one area to another, and studies in the north Atlantic that indicate more frequent occurrence of mid-ocean algae blooms in areas where open ocean exchange takes place, 56/ suggest that concentrating ballast water discharges beyond national jurisdiction may result in a growing number of introductions harmful to high-seas species and ecosystems.

4. The 1972 Convention for the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention)

55. The purpose of the London Convention is to prevent marine pollution caused by the deliberate disposal of wastes or other matter at sea, including in areas beyond national jurisdiction. 57/ It will be replaced by a 1996 Protocol, expected to enter into force in 2005. Although the Protocol is much more restrictive than the earlier Convention, historical dumping under the Convention and before it was concluded has created a substantial wastes legacy in areas beyond national jurisdiction, including various chemicals and nuclear wastes. Scientific study and monitoring of historic dump sites could increase knowledge of impacts in deep-sea areas. 58/

56. The 1996 Protocol strives to eliminate pollution caused by dumping or incineration of wastes at sea, requires Parties to apply a precautionary approach, and encourages "polluter pays" implementation. Unlike the "black- and grey-list" approach 59/ of the 1972 Convention, the 1996 Protocol adopts a much more restrictive "reverse list" whereby all wastes dumping is prohibited except for materials listed in annex I, which requires a special permit. In addition, the Protocol prohibits waste storage in the seabed and the export of wastes for the purpose of dumping or incineration at sea.

57. Before a permit for annex I materials can be issued, the responsible State must undertake an assessment provided for in annex II. This must include specified information on the selected dump site (water column and seabed), including amenities, values and other uses, and indicate the scale and duration of potential effects. Environmental monitoring plans are required. If the assessment reveals that adequate information is not available to determine the likely effects of the proposed disposal option, then it should not be considered further.

58. In order to enforce restrictions on dumping, including in areas beyond national jurisdiction, the 1996 Protocol, like the earlier Convention, requires each Party to implement its provisions for: (i) all vessels and aircraft registered in its territory or flying its flag (wherever located); (ii) all vessels and aircraft loading wastes or other matter in its territory which are to be dumped or incinerated at sea; and (iii) all vessels, aircraft and platforms or other man-made structures believed to be engaged in dumping or incineration at sea in areas within which the Party is entitled to exercise jurisdiction in accordance with international law. 60/

54/ Regulation B-4, Annex "Regulations for the Control and Management of Ships' Ballast Water and Sediments".

55/ Regulation C-1.3.3, Annex.

56/ S. Raaymakers, note 44 at 12.

57/ This includes any deliberate disposal at sea of vessels, aircraft, platforms or other man-made structures.

58/ S. Raaymakers, note 44 at 12, citing IAEA 1999.

59/ This approach classifies waste materials according to the hazard they present to the environment. It prohibits dumping of blacklist materials, requires a special permit for greylist materials from a designated national authority under strict controls and provided certain conditions are met, and requires issuance of a general permit for dumping of all other materials or substances.

60/ Article 10.1; see also UNCLOS, Article 216.

G. The 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage

59. The UNESCO Convention on the Protection of the Underwater Cultural Heritage covers underwater cultural heritage both within and beyond national jurisdiction and gives preference to preserving such heritage on site. 61/ Though not in force, it is meant to further develop UNCLOS and strengthen the protection of underwater cultural heritage. (The positions of States on this Convention differ, with some States strongly opposed to it.) 62/

60. It should be noted that the definition of "marine and coastal protected area" noted in decision VII/5 of the Conference of the Parties to the Convention on Biological Diversity, states that the area may include historical and cultural features, with the effect that the area's biodiversity enjoys a higher level of protection than its surroundings. It is also useful to recall that shipwrecks and other "introduced" objects of a historical or cultural nature serve to attract the settlement of species and can lead to the development of high biodiversity areas.

61. For underwater cultural heritage found in the Area, under UNCLOS these objects are to be preserved or disposed of for the benefit of mankind as a whole, with particular regard for the preferential rights of the State(s) of origin, of cultural origin, or of historical and archaeological origin. 63/ Under the UNESCO Convention, when such objects are found, notifications must go to the Director-General of UNESCO and the Secretary-General of the International Seabed Authority. The Director-General notifies States parties to the UNESCO Convention. States with a verifiable link to the heritage are to be consulted on how to ensure its effective protection. The Director-General of UNESCO invites these States Parties to consult, and to appoint one Party to coordinate the consultations, in which the International Seabed Authority may also participate. 64/ The coordinating State is responsible for implementing agreed measures of protection, including issuing all necessary authorizations. That State is also responsible for conducting any necessary preliminary research on the heritage, reporting to the Director-General of UNESCO on research results, and acting for the benefit of humanity as a whole. An annex contains rules concerning activities directed at underwater cultural heritage, but the application of these rules to objects found in the Area is not explicit. The rules require study of the environmental characteristics of the site, and an environmental policy "adequate to ensure that the seabed and marine life are not unduly disturbed". 65/

III. REGIONAL LEGAL INSTRUMENTS

62. The regional agreements considered below are incorporated by and elaborate and supplement the UNCLOS regime in their respective regions. On a relatively large scale, each establishes a series of conservation and/or environmental protection measures for defined geographic areas beyond national jurisdiction. The regional seas agreements and regional fisheries management organizations also provide for special areas where a higher level of protection can be established, while the Agreements under the Convention on Migratory Species specifically call for habitat protection. The regional rationale for both the regional fisheries management organizations and the Agreements is the geographic range of the stocks or species concerned. For the regional-seas arrangements, the geographic rationale originally reflected some combination of proximity, land/sea configuration and political affinity. Today, they increasingly strive to incorporate ecosystem parameters into their programming at large and small scales.

61/ Article 2.5; Rule 1, Annex "Rules concerning activities directed at underwater cultural heritage".

62/ Some States dispute that the UNESCO Convention is fully consistent with UNCLOS. To date only three countries have ratified it, and twenty ratifications are necessary for it to enter into force.

63/ Articles 149 and 303.

64/ Articles 11, 12.

65/ Rules 10(a) and (l); 14, 15 and 29, annex.

A. Regional seas conventions

63. Many of the regional-seas agreements have been established under the auspices of the United Nations Environment Programme (UNEP). Others have their origins in agreements that preceded the establishment of UNEP, as in the North-East Atlantic and the Antarctic. In a few regions, non-binding action plans form the basis of cooperation, whereas most regions have adopted a binding framework convention. These conventions are usually supplemented by protocols and annexes addressing different sources of marine degradation, such as land-based activities or offshore oil and gas development. Several have protocols on specially protected areas and wildlife and/or biodiversity. There is substantial variation from region to region in the degree of specific and detailed commitments agreed by governments. Only four of these regional conventions explicitly cover areas beyond national jurisdiction and are considered here. The non-binding arrangements are not considered in this paper. Of these, it appears that only the Arctic Environmental Protection Strategy (AEPS 1991) covers areas beyond national jurisdiction.

64. The regional protocols/annexes on marine protected areas typically specify the types of activities subject to regulation and that establishment of protected areas shall not affect the rights of other Parties or third States under international law; that is, measures taken by the coastal State(s) Parties to the regional instrument must be consistent with high-seas freedoms under UNCLOS in areas beyond national jurisdiction. 66/ As considered in sections IV.A.4 and VI.B below, this may be undertaken through coordination with other relevant international bodies and/or by encouraging non-regional States active in the region to accede to the agreement. The more recent of the protocols on marine protected areas(specifically, in the North-East Atlantic and the Mediterranean) incorporate many elements from the Convention on Biological Diversity, thus effectively serving as a regional vehicle for implementing the Convention on Biological Diversity in respect of marine and coastal biodiversity.

1. North-East Atlantic

65. The 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention) applies throughout the "OSPAR Maritime Area". This extends from the shores of its contracting Parties to a substantial adjacent high seas area and includes the seabed. The 1992 Convention constitutes a major update of earlier regional agreements on dumping and controlling marine pollution from land-based sources.

66. Annex V on ecosystems and biodiversity conservation was adopted in 1998. It calls for Parties, individually and jointly, to take the necessary measures to protect and conserve the ecosystems and biological diversity of the maritime area, which are, or could be, affected as a result of human activities, and to restore, where practicable, marine areas which have been adversely affected. Annex V also specifies that no measures relating to fisheries management may be adopted pursuant to it. In relation both to fisheries and maritime transport, it calls for drawing attention to relevant actions needed in the competent international fisheries body or IMO. The Sintra Ministerial Declaration, also adopted in 1998, specifically calls for the establishment of a network of marine protected areas to ensure the sustainable use, protection and conservation of marine biological diversity and ecosystems.

67. In a joint ministerial declaration of June 2003, the parties to the OSPAR Convention, together with the Parties to the regional convention on the Baltic Sea, recommended the establishment of a network of well managed and ecologically coherent marine protected areas by 2010 for the purpose of protecting and conserving species, habitats, ecosystems or ecological processes of the marine environment. The elements of a network strategy were also agreed in 2003, together with guidelines for

66/ Marine protected areas within national jurisdiction must also respect high-seas freedoms consistent with the rights and obligations of coastal States and other States as set forth in UNCLOS.

identifying and selecting sites, and for managing marine protected areas. 67/ The strategy calls for consultation with the competent international organizations on how to achieve protections in the OSPAR area beyond national jurisdiction. Under the guidelines, identification is based on ecological criteria, and priority for designation is based on status or importance of species or habitat, its condition, and practical considerations. The management guidelines contain useful elements for a marine-protected-areas site-management plan, including ways to track human activities and impacts that may need to be regulated in order to achieve the objectives of protection through marine protected areas.

68. In 2004, at the annual meeting of the OSPAR Working Group on Marine Protected Areas, Species and Habitats, the Government of the United Kingdom reported on the results of a scoping study on how protection of high seas and deep oceans biodiversity could best be achieved. The study recognized that measures to designate marine protected areas on the high seas under instruments such as the Convention on Biological Diversity and regional conventions would take considerable time to develop. It recommended that in the shorter term, in order to enable action to reduce impacts, attention would best be focused on supporting the identification of locations of important biodiversity on the high seas, identifying their sensitivity and vulnerability to human-induced impacts, and necessary management measures, including possible revisions to the mandates of relevant authorities. The OSPAR parties were invited to consider, before the group's next meeting in late 2005, which high seas areas should be proposed to the OSPAR Commission for inclusion in the OSPAR network of marine protected areas. It was noted that proposals from Parties or non-governmental organizations for high-seas protected areas should ideally seek the agreement of all Parties on the proposal.

69. Under its work in relation to the protection of coral reefs within the OSPAR area (i.e., cold-water corals), the OSPAR Commission has written to the North East Atlantic Fisheries Commission (NEAFC) drawing attention to the need to protect the biodiversity of cold-water coral reefs on the western slopes of the Rockall Bank (see sections III.B and V.B below for further information on NEAFC). In addition, the OSPAR parties agreed to provide data on the distribution of lophelia reefs, in order to produce an up-to-date distribution of these habitats in the OSPAR region, and to provide this map to fisheries management authorities.

2. Mediterranean Sea

70. The high seas of the Mediterranean generally begin at the edge of the 12-nautical-mile territorial sea, since most coastal States have not declared exclusive economic zones due to the many maritime boundaries yet to be settled between opposite and adjacent States. 68/ Four coastal States (Algeria, Malta, Spain, and Tunisia) have established exclusive zones for the conservation and management of marine living resources that extend beyond the territorial sea but fall well short of 200 nautical miles. 69/ As for the seabed of the Mediterranean, all areas lie within national jurisdiction; that is, because the legal continental shelf under the United Nations Convention on the Law of the Sea extends to a distance of 200 nautical miles the rights of the coastal State over the continental shelf do not depend on any express proclamation, as noted above, and there is no point in the Mediterranean that is located more than 200 nautical miles from the nearest land or island. 70/

71. The Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean 1976, amended in 1995, applies throughout the Mediterranean Sea. Its protocol concerning specially protected areas and biological diversity is applicable not only to all the sea but includes also the

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67/ 2003 Strategies of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic (Reference number: 2003-21); Guidelines for the Identification and Selection of MPAs in the OSPAR Maritime Area (Reference number: 2003-17),and Guidelines for the Management of MPAs in the OSPAR Maritime Area (Reference number: 2003-18). Available at www.ospar.org.

68/ Morocco (1981), Egypt (1983), Syria (2003) and Cyprus (2004) have established EEZs in the Mediterranean.

69/ C. Chevalier, *Governance in the Mediterranean Sea: Legal Regime and Prospectives,* IUCN 2004.

70/ UNCLOS, articles 76-77.

seabed and subsoil. It specifically distinguishes "specially protected areas" in areas subject to national jurisdiction from the establishment of a list of specially protected areas of Mediterranean interest (SPAMI list). The SPAMI list may include sites that "are of importance for conserving the components of biological diversity in the Mediterranean; contain ecosystems specific to the Mediterranean area or the habitats of endangered species; or are of special interest at the scientific, aesthetic, cultural or educational levels". 71/ The procedures for establishment and listing of SPAMIs are specified in detail. For areas located partly or wholly on the high seas, the proposal must be made by two or more neighboring Parties concerned, and the decision to include the area in the SPAMI list is taken by consensus among the Parties.

72. Once an area is included in the SPAMI list, all Parties to the Protocol agree to recognize the particular importance of the area for the Mediterranean. They must comply with measures applicable to the SPAMI and neither authorize or undertake any activities that might be contrary to the objectives for which the SPAMI was established. Annex I to the protocol sets out common criteria for the choice of protected marine and coastal areas that could be included in the SPAMI list. With respect to the relationship with third countries, the Parties shall "invite States that are not Parties to the Protocol and international organizations to cooperate in [its] implementation." 72/ There is currently one SPAMI that includes international waters, the Pelagos Sanctuary for marine mammals (approximately 53 per cent of its 87,000 km^2 lies in international waters). Initially established by a tripartite agreement among France, Italy and Monaco in 1999, it was accepted as a SPAMI in 2001. 73/

3. South Pacific

73. The 1986 Convention for the Protection of Natural Resources and Environment of the South Pacific Region includes certain areas beyond national jurisdiction that are completely enclosed by 200-nautical-mile exclusive economic zone. While no protocol on protected areas has been adopted, the Convention itself provides for establishment of specially protected areas and protection of wild flora and fauna, either individually or jointly by the Parties. Parties are to prohibit or regulate any activity likely to have adverse effects on the species, ecosystems or biological processes that such areas are designed to protect. 74/

4. Antarctica and the Southern Ocean

74. The 1959 Antarctic Treaty comprises a vast area of ice-covered continent and surrounding seas south of latitude 60 degrees south. Some States parties claim Antarctic territory (and offshore zones) and other States parties do not recognize these claims, but under the Antarctic Treaty decisions taken by the Parties do not prejudice either view. Thus, different parties hold different views as to the extent of marine areas beyond national jurisdiction, with some believing that these begin at the edge of the continent and its ice shelves. States essentially deal with activities on a flag-State basis, with oversight by meetings of the Parties.

75. A Protocol on Environmental Protection was adopted in 1991, which is supplemented by five annexes. Annex I establishes environmental impact assessment procedures applicable to each Party's activities under the Antarctic Treaty, such as scientific research, tourism, and related logistic support. If the activity is deemed likely to have more than a minor or transitory impact, a comprehensive environmental evaluation is subject to review at a meeting of the Parties before the activity may proceed. Annex II deals with conservation of Antarctic fauna and flora.

71/ Article 8.2.

72/ Article 28.1.

73/ T. Scovazzi, note 1 at 10-15; G.N. di Sciara, T. Scovazzi & P. van Klaveren, "The International Sanctuary for Mediterranean Marine Mammals," *Towards a Strategy for High Seas MPAs*, note 1 at annex 6.

74/ Article 14.

76. The system of protected areas in Antarctica, initiated by the 1964Agreed Measures for the Conservation of Antarctic Fauna and Flora, was consolidated and expanded in annex V (Area Protection and Management). Provisions for establishing *marine* protected areas were first agreed in 1987 75/ and form part of this system. Annex V provides for two categories of protected areas, Antarctic "specially protected areas" (ASPAs) to protect outstanding environmental, scientific, historic, aesthetic or wilderness values, or ongoing or planned scientific research; and Antarctic "specially managed areas" (ASMAs), to assist in the planning and coordination of activities in congested areas where conflicts of use may arise, or to minimize cumulative environmental impacts. ASMAs may contain one or more ASPA. Marine areas may be included in either category, but no marine area may be designated without the prior approval of the Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR), the decision-making body under the Antarctic regional fisheries management organization. (The Commission may also propose areas for either protected status.) A management plan approved by the parties sets out the area description and objectives of designation, and it identifies zones within the area in which activities are to be prohibited, restricted, or managed in order to achieve the objectives.

77. Annex V lays the groundwork for a comprehensive system of marine protected areas, including baseline preservation areas, representative areas, scientific research sites, unique habitats, and other areas with outstanding values. According to article 3.2, Parties are to seek to identify, within a systematic environmental-geographical framework, and to include in a series of ASPAs:

(a) Areas kept inviolate from human interference;

(b) Representative examples of major terrestrial and marine ecosystems;

(c) Areas with important or unusual assemblages of species, including major colonies of breeding native birds or mammals;

(d) The type, locality or only known habitat of any species; and

(e) Other areas of outstanding value or of particular interest to ongoing or planned scientific research, and examples of outstanding geological, glaciological or geomorphological features.

78. To date, six ASPAs have been established that are fully marine. In addition there are ten partially marine ASPAs and one partially marine ASMA. One partially marine site and a second marine site are also protected by CCAMLR conservation measures and form part of CCAMLR's ecosystem monitoring program. Of the fully marine ASPAs, the two largest are in Western Bransfield Strait (900 km^2) and Eastern Dallman Bay (580 km2). Both these sites have benthic fauna of particular scientific interest that are accessible to scientists for benthic trawling. 76/ Further study of the management plan for each area would be needed to analyse the specific protections applied.

79. As noted above, the Antarctic and Southern Ocean has been designated a Special Area under MARPOL 73/78. Annex IV of the Protocol incorporates the more stringent discharge restrictions of Special Area designation with respect to pollution from oil, noxious liquid substances, and plastics and garbage. The Parties to the Protocol are committed to ensuring consistency with MARPOL 73/78 as it is amended or new regulations are adopted. Annex IV governs not only ships flying the flags of States Parties to the Protocol but also, through the Parties, any other ship engaged in or supporting the Antarctic operations of a Party while that ship is operating in the Treaty area. In addition, annex III contains strict requirements regarding waste disposal at sea in the Antarctic Treaty area, prohibiting disposal of certain materials that must be removed from the Treaty area.

75/ ATCM Recommendation XIV-6.

76/ S. Grant, "Summary Table of Current and Proposed Antarctic Marine Protected Areas," Scott Polar Research Institute, University of Cambridge, January 2004, smg40@cam.ac.uk. An additional multiple use planning area in the Palmer Archipelago adopted voluntarily in 1991 (app. 1532 km2) has no current status as a protected area.

B. Regional fisheries management conventions

80. The regional fisheries management conventions generally establish a commission or organization of States parties to administer the agreement, known as regional fisheries management organizations (RFMOs). 77/ There are 15 regional fisheries management organizations with full responsibility to agree on binding conservation and management measures (see annex III below). 78/ Most cover only areas beyond national jurisdiction, although a few cover also areas within national jurisdiction, and three cover only areas within national jurisdiction. Five of these bodies have competence over most or all living marine resources within their area of application, while the others have competence only with respect to particular species like tuna or salmon. In some high-seas areas where fisheries take place there is no regional fisheries management organization (e.g., the South-Western Indian Ocean).

81. The scope of each regional fisheries management organization's conservation responsibility varies with the terms of the corresponding agreement; that is, where some are mandated to develop measures based on an ecosystem approach (e.g., CCAMLR 79/), others focus more narrowly on managing target fishery resources without express concern for effects on non-target species or habitat or for other stresses on the resources. The more recently concluded agreements like those for highly migratory species of the western and central Pacific and for the South-East Atlantic tend to reflect the forward-looking ecosystem and precautionary approaches of the United Nation Fish Stock Agreement. The Convention for the Establishment of an Inter-American Tropical Tuna Commission (IATTC) was revised in 2003 to incorporate many of the principles and the precautionary approach of the United Nations Fish Stock Agreement for the Establishment of the General Fisheries Commission for the Mediterranean, revised in 1997, also provides for application of the precautionary approach of the United Nations Fish Stocks Agreement. Other early agreements predate UNCLOS and do not even reflect its incipient ecosystem approach, let alone the ecosystem and precautionary approaches of the United Nations Fish Stocks Agreement.

82. A full summary of the specific conservation and management measures adopted by each regional fisheries management organization is beyond the scope of this paper, but several points should be highlighted:

(a) Most regional fisheries management organizations are subdivided into smaller geographic zones (fisheries management units) for purposes of regulation, which means that requirements, for example, to use or prohibit certain types of gear, to restrict harvesting at certain depths, or to undertake carefully managed exploratory fishing (see below) may be confined to these subdivisions and thus, *de facto*, protect particular marine areas from certain types of fishing activities;

(b) Conservation measures available to regional fisheries management organizations include closed areas and seasons; that is, areas placed off limits to fishing ("no-take") on a permanent or temporary basis, or off limits either for particular target species or for all target species. Some measures may be temporary until, for example, further surveys are carried out and scientific advice is received, or

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77/ There are some 30 regional fishery bodies, some of which have been established under the FAO Constitution and others independently by States Parties. Some of these agree on conservation and management measures, while others provide scientific and management advice only. The FAO bodies may be established either under Article VI or Article XIV of the FAO Constitution.

78/ General obligations for the conservation and management of marine living resources under UNCLOS and the United Nations Fish Stocks Agreement are also binding, but it can be difficult to challenge national measures as inadequate without reference to more specific measures such as catch and gear restrictions.

79/ Article II.3 of CCAMLR establishes certain principles with which any harvesting and associated activities within the Convention area must accord. These include maintaining ecological relationships between harvested, dependent and related populations of Antarctic marine living resources; restoration of depleted populations to defined levels; and preventing changes or minimizing the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades, taking into account the state of available knowledge of the direct and indirect impact of harvesting, the effect of the introduction of alien species, the effects of associated activities on the marine ecosystem, and the effects of environmental changes.

to allow stock recovery. Others may be long-term, for example to protect fish spawning grounds and/or juvenile life-history stages. Under CCAMLR, closed seasons/areas have also been used to avoid by-catch of seabirds 80/ or fish 81/ by particular fisheries, including "move on" rules - when vessels have to leave a particular small-scale research unit within a larger area once they reach a specified fish by-catch limit;

(c) Some regional fisheries management organizations, for example CCAMLR, provide more explicitly for the designation of special areas for protection and scientific study. 82/ As noted in the discussion of the Antarctic Treaty's protected areas system, two marine sites have been designated as part of the CCAMLR ecosystem monitoring programme;

(d) A number of regional fisheries management organizations in recent years have adopted measures to avoid incidental impacts on seabirds, marine turtles, marine mammals, and non-target fish species. These include CCAMLR requirements that longlines be set at night or offal discharge prohibited during line-setting because it attracts seabirds, the IATTC Agreement to reduce and ultimately eliminate dolphin bycatch in purse seine fisheries, as well as bycatch measures to protect sharks and marine turtles; and ICCAT measures regarding bycatch of seabirds and sea turtles;

(e) In order to protect seafloor ecosystems, CCAMLR has prohibited use of bottom trawls in certain demersal fisheries. In November 2004, the NEAFC closed five seamounts and a section of an oceanic ridge on the high seas to bottom trawling and other types of bottom fishing for three years, in order to protect vulnerable deepsea habitats; 83/

(f) CCAMLR pioneered the concept of new and exploratory fisheries. The goal is to carefully design and monitor these fisheries so that they develop gradually and only as sufficient information becomes available to make well-founded judgments about potential sustainable yield and the potential impacts of the fishery on other ecosystem components. Such fisheries are authorized pursuant to a detailed data-collection plan prepared by the Scientific Committee, which identifies information necessary for well-founded advice on appropriate catch and effort limits and any gear restrictions. A precautionary catch limit is set that is not substantially above that necessary to obtain the required information, and a scientific observer is required on each vessel. Restrictions may be placed on catch, fishing location and fishing effort, and the fishery may be controlled to test different fishing models like particular gear and practices or closed areas and seasons. 84/ In order to develop information on seafloor species, the data collection plan may specify that samples be taken in the vicinity of the commercial trawl track; and in order to reduce seafloor impacts it may limit the total number of bottom trawls, the number per location, and the distance separating bottom-trawl locations. 85/

C. Species conventions

1. Agreements under the Convention on Migratory Species

83. Four of the regional Agreements developed under the Convention on Migratory Species (CMS) cover areas beyond national jurisdiction. Two focus on small cetaceans and the other two on migratory waterbirds and seabirds, respectively. Two additional non-binding memoranda of understanding (MOUs) cover marine turtles but are not considered here (see annex III below).

80/ For example, CCAMLR Conservation Measures 41-02 and 41-09 (2002), available at www.ccamlr.org.

81/ For example, CCAMLR Conservation Measures 33-01 (1995) and 33-02 and 33-03 (2002), all for toothfish fisheries.

82/ Article IX.2.g.

83/ NEAFC Press Release, 15 November 2004, available at www.neafc.org.

84/ Conservation Measure 21-02 (2002), first adopted in 1993 as Measure 65/XII.

85/ Conservation Measure 43-04 (2003), as referenced in M. Gianni, *High Seas Bottom Trawl Fisheries and Their Impacts On the Biodiversity of Vulnerable Deep-Sea Ecosystems, (WWF, CI, NRDC, IUCN, 2004)* at note 221, available at www.iucn.org/themes/marine.

84. The general scope of these Agreements is described in the section above on global legal instruments. In terms of protecting marine areas beyond national jurisdiction, their value lies in the obligations of range States to protect any high seas habitat of the migratory species concerned. This is likely to be relevant primarily for small cetaceans and seabirds, as waterbird habitat is generally closer to shore, within national jurisdiction. For this reason, and because its habitat obligations refer to areas within national territory, the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is not considered further in this study.

85. In decision VII/28, annex, activity 1.3.7 of the programme of work on protected areas under the Convention on Biological Diversity suggests that the Executive Secretary should review the potential for regional cooperation under the Convention on Migratory Species with a view to linking protected area networks across international boundaries and potentially beyond national jurisdiction through establishment of migratory corridors.

86. ASCOBANS: The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) covers some areas beyond national jurisdiction in the North Sea. The Parties agree to cooperate to achieve and maintain a favourable conservation status for small cetaceans in the region. An annex contains the conservation, research, and management measures to be applied by Parties, in conjunction with other competent international bodies. These include investigations to locate areas of special importance to the breeding and feeding of small cetaceans, study of habitat requirements and interactions with other species, and studies of the effects of pollution, disturbance, and interactions with fisheries and means to reduce such interactions. 86/

87. ACCOBAMS: The Parties to the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) undertake to adopt measures prohibiting large-scale driftnets on their fishing vessels. This effectively bans Parties from using this equipment in the whole of the regional area to which the Agreement applies. The Parties must also endeavour to establish and manage specially protected areas that serve as habitat or provide important food resources for cetaceans. These should be established with the framework of the Mediterranean Regional Sea agreement and protocol (see section III.A above) or other appropriate instruments. 87/

88. ACAP: Under the Agreement on the Conservation of Albatrosses and Petrels (ACAP), both foraging and migratory habitat is to be conserved in support of the species, including ensuring the sustainability of marine living resources that are their food sources and avoiding harmful pollution (and debris) from ships and other sources in these areas. 88/ The Agreement is meant to cover 25 range States of the Pacific and Southern oceans.

2. The 1972 Convention for the Conservation of Antarctic Seals (CCAS)

89. Although sealing does not currently take place in the Antarctic Treaty area, the 1972 Convention for the Conservation of Antarctic Seas governs sealing there and provides for closed seasons, closing of six zones during the sealing season, and establishment of three seal reserves off limits to any sealing because they are breeding areas or the site of long-term scientific research. 89/

86/ Annex (Conservation and Management Plan).

87/ Annex 2 (Conservation Plan).

88/ Annex 2 (Action Plan).

89/ Annex to the Convention, articles 4 and 5.

IV. THE ADEQUACY OF THE EXISTING LEGAL FRAMEWORK FOR ESTABLISHMENT OF MARINE PROTECTED AREAS IN MARINE AREAS BEYOND THE LIMITS OF NATIONAL JURISDICTION

90. In considering the adequacy of the existing legal framework for establishing marine protected areas beyond national jurisdiction, it is useful to put this in the context of decision VII/5 of the Convention on Biological Diversity. This calls for effectively managed and ecologically based marine protected areas that contribute to a global network, building on national and regional systems. The marine protected areas are to include different levels of protection where human activities are managed through national legislation, regional programmes and policies and international agreements. Their purpose is to maintain the structure and functioning of the full range of marine and coastal ecosystems. Specifically in relation to marine protected areas in areas beyond national jurisdiction, the Conference of the Parties, in paragraphs 29-31 of that decision:

(a) Noted that there are increasing risks to biodiversity in marine areas beyond national jurisdiction and that marine protected areas are extremely deficient in purpose, numbers and coverage in these areas;

(b) Agreed that there is an urgent need for international cooperation and action to improve conservation and sustainable use of biodiversity in these areas, including establishment of further marine protected areas consistent with international law, and based on scientific information, including areas such as seamounts, hydrothermal vents, cold-water corals and other vulnerable ecosystems; and

(c) Recognized that the law of the sea provides a legal framework for regulating activities in marine areas beyond national jurisdiction and requests the Executive Secretary of the Convention on Biological Diversity to support any work of the United Nations General Assembly in identifying appropriate mechanisms for the future establishment and effective management of marine protected areas beyond national jurisdiction.

91. It is recognized that marine protected areas are a tool to help achieve conservation and sustainable use of biodiversity in marine areas beyond national jurisdiction, and that in any decision to establish marine protected areas their utility would first have to be evaluated in relation to other available tools.

92. In view of the recognition by the Parties to the Convention on Biological Diversity that marine protected areas beyond national jurisdiction are extremely deficient in purpose, numbers and coverage, the present section first raises certain questions relating to goals and scale that may need to be considered in establishing marine protected areas and networks beyond national jurisdiction. It then reviews the adequacy of the legal framework for their establishment.

A. Issues relating to goals and scale

93. The goal of marine protected areas is generally to conserve the biological diversity and productivity (including ecological life support systems) of the oceans. Effectively managed marine protected areas contribute to the protection of biodiversity, especially critical habitat and genetic diversity. They are generally viewed as an important component in an ecosystem approach to fisheries. In addition, marine protected areas can safeguard representative types of marine ecosystems of adequate size to ensure their long-term viability. They can also contribute to increased knowledge through scientific research and help protect cultural diversity.

94. The term “marine protected area” in the present study, as noted in the introduction, conforms with the definition referenced in paragraph 10 of decision VII/5 of the Conference of the Parties to the Convention on Biological Diversity and reproduced in footnote 1 above. It refers to provisions in a variety of global and regional agreements that, for a defined geographic marine area beyond national jurisdiction, afford a higher level of protection to its biodiversity than in the waters and/or seabed surrounding the area. The protection may be in relation to one particular type of threat such as fishing, or in relation to more than one type of threat. Decision VII/5 also notes that this definition incorporates all

of the IUCN categories of protected areas, which provide for different levels of protection and represent a continuum from stricter protection to regimes designed for sustainable resources use. These are:

- Category Ia – Strict nature reserve (managed mainly for science);
- Category Ib – Wilderness area (managed for wilderness protection);
- Category II – National park (managed mainly for ecosystem protection and recreation);
- Category III – Natural monument (managed mainly for conservation of specific natural or cultural features);
- Category IV – Habitat/species management area (managed mainly for conservation through management intervention);
- Category V – Protected landscape/seascape (managed mainly for landscape/seascape conservation and recreation); and
- Category VI – Managed resource protected area (managed mainly for sustainable use of ecosystems).

95. The definition noted in decision VII/5 also refers to a marine area, together with its overlying waters and associated flora, fauna, and historical and cultural features. It may be reserved by legislation or other effective means, including custom. 90/ This means that the marine protected area should cover not only the seabed but also at least some of the water column above with its flora and fauna, and that marine protected areas are not just relevant for natural features but may also protect cultural features such as wrecks and their associated biodiversity. Moreover, while a marine protected area usually has some form of legal protection, there are other options such as custom. 91/

96. The scale of designations of marine protected areas is affected by two challenges arising from their aquatic environment. The first is the mobility of threats; that is, pollution or other threats arising from activities outside the marine protected area may have harmful effects within it. For marine protected areas beyond national jurisdiction, these effects may arise from: (i) activities within national jurisdiction subject to coastal state authority, including activities on the continental shelf beyond 200 nautical miles (e.g, oil development); (ii) the exercise of certain high-seas freedoms by all States within zones subject to coastal State jurisdiction (e.g., pollution from ships); 92/ or (iii) activities beyond national jurisdiction.

97. The second challenge is the mobility of marine species. While some species like sea turtles, marine mammals and certain fish are highly migratory, others may disperse larvae at a certain stage of their life cycle that range far from later feeding and breeding areas. Both require a systematic approach to habitat protection throughout their range, linking different habitat areas into networks and corridors of larger, often regional scale. 93/ For many species found beyond national jurisdiction, this will involve also areas within national jurisdiction.

98. In moving from individual marine protected areas to establishing networks of such areas, two approaches have been suggested within national jurisdiction, both of which are meant to occur within an effective programme of ecosystem management. Networks may comprise either many relatively small

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90/ This draws on an IUCN definition of an MPA as "any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment". See *Guidelines for Protected Area Management Categories.* IUCN Commission on National Parks and Protected Areas with the assistance of the World Conservation Monitoring Centre, IUCN (1994), Cambridge, UK and Gland, Switzerland. See also IUCN General Assembly Resolutions 17.38 (1988) and 19.46 (1994).

91/ See also *Guidelines for Marine Protected Areas*, G. Kelleher, ed., IUCN, Gland, Switzerland, and Cambridge, UK, WCPA (1999) at xviii.

92/ In the EEZ, all States enjoy freedoms of navigation and overflight, the laying of submarine cables and pipelines, and other internationally lawful uses of the sea related to these freedoms; subject, of course, to the relevant provisions of UNCLOS (UNCLOS, Article 58).

93/ C.V. Barber, Action Guide to the COP-7 Programme of Work on Protected Areas (Draft for Comment), November 2004, available at www.biodiv.org/doc/reports/pow-guide-draft-en.pdf.

sites, each strictly protected; or fewer large-scale multiple-use areas encompassing a complete marine ecosystem or a large part thereof and containing strictly protected areas within them. Thus, different degrees of protection may be provided within a single area; indeed, most large marine protected areas are of necessity zoned into areas of different impact and usage. In addition, in view of the inter-connectivity of the oceans and land/sea linkages, marine protected areas should be integrated within other management regimes that deal with all human activities affecting marine life. 94/ The ecosystem approach provides a framework for integrating marine protected areas into broader surrounding seascapes and regulatory environment(s), including in areas beyond national jurisdiction.

99. Several questions arise in contemplating the establishment of systems and networks of marine protected areas beyond national jurisdiction:

(a) First, in considering the risks to marine biodiversity in areas beyond national jurisdiction, what criteria and procedures are in place to evaluate which are the most appropriate tools and mechanisms for the conservation and sustainable use of biodiversity in these areas and to determine priorities?

(b) Are the goals of marine protected areas for areas beyond national jurisdiction adequately defined? What is the biogeographic framework within which marine protected area designations should take place? A single articulation of goals for marine protected areas beyond national jurisdiction is likely to facilitate their establishment -- through the existing legal framework and any new developments. Goals and criteria established for the Mediterranean SPAMIs or under OSPAR may already be sufficient, 95/ but there may be some benefit in developing an agreed set of goals and criteria for marine protected areas beyond national jurisdiction at the global level;

(c) Does the definition of a marine protected area need to be refined to better encompass open ocean areas and the deep seabed often miles below the surface; for example, in what circumstances may it be appropriate to designate areas where protections may apply solely to the seabed, solely to the water column, or solely to the water column to a certain depth? For example, within national jurisdiction Australia has closed specific seamount areas to fishing below a certain depth. The General Fisheries Commission for the Mediterranean decided in February 2005 to permanently close the Mediterranean and Black seas below 1000 metres to bottom trawling, effective June 2005. Most of the closure applies to Mediterranean high seas; 96/

(d) Should these goals be accomplished through numerous small-scale designations, fewer large-scale designations, or a combination of the two?

(e) Should temporal protection apply? That is, may protective measures be applied on a seasonal basis, or for defined periods of time subject to renewal, if that adequately accomplishes defined goals? Can dynamic marine protected areas, whose boundaries shift with the movement of oceanographic features or migratory species, be feasibly designed, monitored, and protected?

(f) How could the IUCN categories contribute to the development of marine protected area systems beyond national jurisdiction that build on national and regional systems?

B. The adequacy of the legal framework

100. In order to develop options for cooperation for the establishment of marine protected areas in marine areas beyond national jurisdiction that realize the goals of decision VII/5 for effectively managed and ecologically based marine protected areas that contribute to a global network, building on national and regional systems, it is first necessary to identify gaps and inadequacies.

101. The present section considers:

94/ G. Kelleher, G., note 96 at xi.

95/ Guidelines and criteria for the evaluation and establishment of MPAs developed under regional conventions that do not cover high seas areas, or under non-binding arrangements, may also be useful for the development of an agreed set for MPAs beyond national jurisdiction; for example, guidelines developed for the Caribbean, OSPAR region or the Arctic.

96/ *MPA News*, Vol. 6, No. 9 (April 2005) at 4.

(a) The adequacy of existing protections vis-à-vis different human activities: existing competence to regulate and existing regulations and their coverage of vulnerable areas and threats;

(b) The adequacy of the geographic coverage of existing protective arrangements;

(c) The adequacy of the scope of existing protective arrangements;

(d) The adequacy of participation by all relevant States and coordination between relevant international institutions; and

(e) The adequacy of high seas enforcement.

102. It concludes with a summary of the major gaps.

1. The adequacy of existing protections vis-à-vis different human activities: existing competence to regulate and existing regulations and their coverage of vulnerable areas and threats

103. The adequacy of existing instruments for identifying and protecting priority biodiversity areas may be considered: (i) vis-à-vis current human activities/threats and (ii) vis-à-vis emerging human uses and new activities. Moreover, as considered in the preceding sections, while the mandate to identify and protect such areas generally exists in some form under these instruments, effective measures to give effect to this mandate in areas beyond national jurisdiction are limited. In most cases, protected-area designations have been reactive rather than proactive; that is, the effort to identify priority biodiversity areas beyond national jurisdiction, and the scientific means to do so, are relatively recent. At the same time, growing concern over impacts on the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction has only emerged during the last few years.

104. Existing protected areas in marine areas beyond national jurisdiction, as discussed in the preceding sections, cover specific activities. They are limited to two whaling sanctuaries in the Indian and Southern oceans under the International Whaling Convention; with respect to vessel-source pollution, two Special Areas under MARPOL 73/78 in the Southern Ocean and the Mediterranean (although the Mediterranean Special Area is not in effect); one SPAMI serving as a marine mammal sanctuary under the Mediterranean regional seas convention; six fully marine protected areas under the Antarctic Treaty (and, in some cases, CCAMLR) and additional sites that are partially marine; three seal reserves under the Antarctic Seals Convention and additional seasonal closings; and an unknown number of closed areas and seasonal closures, as well as other types of area-based conservation measures, under various of the regional fisheries management organizations.

105. Regarding mandates, of the list of activities in the table on page 46 below, international shipping, whaling, and activities in the Area 97/ are already covered by detailed global instruments. There is also a global Convention on the Protection of the Underwater Cultural Heritage (not yet in force). All provide for a higher level of protection in particular, defined geographic areas. This does not mean that steps taken to identify and protect vulnerable areas and ensure the conservation and sustainable use of biodiversity in marine areas beyond national jurisdiction are adequate, just that legal frameworks and mechanisms exist. With respect to fisheries, although detailed global and regional instruments exist, there are also certain gaps, as noted below.

106. The mandate of the International Seabed Authority is noted above. It must adopt appropriate rules and regulations before activities in the Area proceed. This includes regulations to control pollution and to protect and conserve natural resources of the Area and prevent damage to flora and fauna of the marine environment from minerals activities. Whether the regulations already adopted will be effective in these respects has not yet been adequately tested.

97/ Even though the International Seabed Authority has not yet adopted rules and regulations for the exploitation phase of minerals activities, or for all types of minerals activities, it has the mandate to do so if and when interest emerges in their development.

107. High seas freedoms like fishing or shipping may proceed in the absence of any regulations; the activities only become subject to conservation and management or environmental protection measures as these are agreed internationally (or are imposed by flag State authorities on ships flying their flag). As discussed in section III.B above, regional fisheries management organizations have not yet been established in certain high seas areas where fisheries take place, so no agreed conservation and management measures are in place. Moreover, the measures adopted by certain existing regional fisheries management organizations do not yet reflect a broader ecosystem approach. In addition, there is growing awareness of discrete high seas fish stocks associated, for example, with seamounts. This was not well known when UNCLOS and the United Nations Fish Stocks Agreement were concluded. While all high-seas living resources are covered by UNCLOS provisions, the United Nations Fish Stocks Agreement covers only straddling stocks and highly migratory stocks, not discrete stocks. 98/

108. The new IMO Convention on ballast water and sediments (see section II.F.3 above), by concentrating ballast water discharges in areas beyond national jurisdiction, may increase alien species introductions harmful to high-seas species and ecosystems. Further initiatives may be needed in order to identify and protect priority biodiversity areas before potentially damaging activities proceed.

109. Cultural heritage locations beyond national jurisdiction remain subject only to the general obligations of UNCLOS until the UNESCO Convention enters into force. 99/ According to deep-sea explorer Robert Ballard, "The deep sea is a museum. It contains more history than all of the museums of the world combined and yet there's no laws covering a vast majority of it….We need…international cooperation to preserve …the cultural history of our cultures through time." 100/

110. Potential threats posed by anthropogenic noise, marine scientific research, the laying of undersea cables, and bioprospecting have not yet been addressed at the global level except under the general UNCLOS obligations to protect and preserve the marine environment. Because these emerging activities are not yet subject to more detailed regulation in areas beyond national jurisdiction, there is no agreed means for establishing special protections for defined geographic areas from these activities. 101/ Some emerging threats, such as noise pollution from ships, may fall within the regulatory competence of an existing organization (IMO); 102/ for others, the competent international organization is not clear. Any consideration of measures to address these activities should take into account the time frame in which they are likely to intensify and the relative magnitude of the threats and risks posed by each.

2. The adequacy of geographic coverage

111. The instruments governing shipping and activities in the Area are applicable to all areas beyond national jurisdiction. To date there have been few actual designations of protected marine areas beyond national jurisdiction under the shipping instruments, and none by the International Seabed Authority because exploitation activities have not yet commenced.

112. The regional-seas agreements cover very limited areas beyond national jurisdiction. As noted above, there have been a few marine protected area designations in the Antarctic Treaty area and one in the Mediterranean that include areas beyond national jurisdiction.

98/ The non-applicability of the United Nations Fish Stocks Agreement to discrete high seas fish stocks is noted in a recent FAO paper on Deep Sea Fisheries (COFI/2005/6) at para. 23.

99/ See note 58 above.

100/ NOAA Media Briefing at G8 Summit, World Oceans Day, Savannah, Georgia at http://fpc.state.gov/33310pf.htm.

101/ Under the 2003 OSPAR Strategy for Protection of the Marine Environment, note 66, the section on biological diversity and ecosystems calls for assessment of the placement of cables and pipelines, including "an assessment of the scope for action under other international laws" (I.2.2.d.vi).

102/ IUCN's Third World Conservation Congress in November 2004 adopted Resolution 53 calling for IMO members to work through MARPOL 73/78 and other relevant instruments to develop mechanisms for the control of undersea noise.

113. As for regional fisheries management organizations, while together they cover large areas beyond national jurisdiction, much of this coverage is limited to particular target species like tuna and salmon. Only five conventions cover all or most species within their geographic area, which excludes the Pacific and Indian oceans and a large section of the southern Atlantic Ocean. As noted, many of these instruments do not provide for non-target species and associated habitat conservation based on an ecosystem approach. While a complete study of the regional fisheries management organizations' conservation and management measures is beyond the scope of this study, it appears that even where a broader mandate exists, few measures have been adopted to give effect to it. A survey of closed areas/seasons and their many uses, and the extent of their geographic coverage, remains to be done. A further geographically-based analysis of area-based restrictions on fishing activities would be useful.

3. The adequacy of scope: a specialized and/or integrated approach to marine protected areas

114. At the global level, the existing legal framework for conserving biodiversity in defined geographic areas beyond national jurisdiction is restricted to specialized agreements that address specific activities such as shipping, fishing, or activities in the Area. Beyond the general mandate of UNCLOS, there is no global agreement encompassing the broader concept of protecting these vulnerable marine areas *per se* in order to achieve the marine protected area and network goals 103/ noted above. Nor, outside the general obligations of UNCLOS, is there a means to identify and assess potential threats to these areas from high seas activities (as opposed to activities in the Area) in advance, in order to protect the areas *before* the activities pose threats (with the exception of the London Convention, see section II.F.4 above).

115. Under the regional seas agreements that provide for establishing marine protected areas beyond national jurisdiction, several activities may be subject to regulation in order to safeguard marine protected area values. This facilitates a more integrated approach to protecting these values and allows for designation of multiple-use marine protected areas that can encompass also emerging activities that may threaten the area in the future. Yet the regional-seas agreements cover only limited areas beyond national jurisdiction.

116. The availability of specialized regimes that allow certain areas to be designated for a higher level of protection is useful if an area is especially threatened by only one activity. The value- added of multiple-use marine protected areas lies in areas threatened, or likely to be threatened, by more than one activity. Moreover, by identifying priority biodiversity areas early on, their ecological and representative values and their contributions to a global network can be ensured even as the intensity and range of human activities beyond national jurisdiction continues to grow. At the same time, coordination among different legal instruments will likely remain necessary, as considered in paragraphs 118-122 below.

117. From the perspective of each type of user (e.g., fishers, ship operators, cable layers), it will likely be preferable to have a unified set of measures and the areas in which they apply, which can be easily and quickly accessed. A single, specialized instrument could draw together relevant measures and areas in a unified code linked to nautical charts. This would include measures affecting that particular use in any multiple-use marine protected areas beyond national jurisdiction.

4. Participation by relevant States and high-seas freedoms: coordination between relevant international institutions

118. Most States are parties to the global instruments governing shipping (IMO) and activities in the Area (UNCLOS and the 1994 Part XI Agreement). Participation in the United Nations Fish Stocks Agreement and FAO Compliance Agreement is more limited (see annex I below). In the case of regional instruments regulating fishing activities and regional fisheries management organizations, some States have not adhered to the relevant instruments in areas where they are fishing and do not conduct their

103/ T. Scovazzi, note 1 at 10.

fishing operations in a manner that is consistent with the measures adopted by the regional fisheries management organization, as required by the United Nations Fish Stocks Agreement. This is "unregulated" fishing as defined in the FAO International Plan of Action to prevent, deter and eliminate illegal, unreported and unregulated fishing (see annex II below). (For non-compliance with applicable rules ("illegal" activities), see paragraphs 119-121 below.) When some of the States fishing a particular stock do not observe these measures, they undermine their effectiveness.

119. With the Regional Seas agreements, most coastal States adhere to the relevant agreement (below). At the same time, any marine protected area regulations agreed among the Parties of a regional agreement do not bind non-Parties. Thus, impacts on marine biodiversity caused by non-Parties, such as overfishing, entanglement in fishing nets, or ships' discharges, are not subject to regulations established under the Regional Seas agreements. (They may be subject to regulations established by regional fisheries management organizations or IMO instruments.) To address this problem, the regional-seas agreements may invite participation by non-Parties, as in the case of the Mediterranean noted above, but they cannot command it. Similarly, where another international agreement governs a particular high-seas activity in the region, the regional-seas body can seek to coordinate with the relevant institution (e.g, regional fisheries management organization or the IMO); it can encourage these bodies to incorporate protections for a designated area into their own measures on fishing or shipping. 104/ If many of the same States are parties to both agreements, they can prepare coordinated proposals for complementary protective measures in the different bodies. This mode of proceeding is currently engaged in the North-East Atlantic, where the Parties to OSPAR are seeking to work with the NEAFC in identifying and protecting cold-water corals; further coordination may be required within the European Commission. A recent report on the impact of fisheries on the marine environment indicates that the system of coordination in the North-East Atlantic may be flawed, as the fisheries bodies lack a mandate for biodiversity conservation and protection and have been slow to implement the ecosystem approach. 105/

120. Under the Convention on Migratory Species and its Agreements, conservation is also undermined if all the range States do not join the Agreement (annex III). This Convention and its Agreements also seek coordination with other bodies to address impacts by non-Parties and governed by other international agreements; for example, to reduce bycatch through the competent fisheries bodies, or marine pollution within the framework of other appropriate legal instruments (e.g., IMO instruments vis-à-vis shipping).

121. Such coordination can also work in reverse. CMS/ACAP Parties must adopt, in relation to fishing activities within the area of regional fisheries management organizations, measures at least as stringent as those agreed by the relevant regional fisheries management organization for reducing the incidental taking of albatrosses and petrels. 106/ In the Antarctic, as noted above, marine protected area provisions under annex V of the Protocol require prior approval by the CCAMLR Commission, which effectively gives the Commission a decisive role in establishing marine protected areas in the region.

122. In all cases, however, this type of coordination can extend the threshold level of protection adopted under one agreement to other States not party to that agreement.

5. The adequacy of high-seas enforcement

123. A further problem is failure to comply with applicable rules. The problem of "flag of convenience" vessels is briefly noted above (section II.A.1). Other vessels are rendered "stateless" by illegally flying flags for which they have not registered. All of these are "free riders" that often avoid the

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104/ In this regard, United Nations General Assembly resolution 59/25 (para. 56), adopted 17 November 2004, encourages improved cooperation between regional fisheries management organizations and other regional entities, such as the UNEP regional seas programmes and conventions. Similar encouragement is reflected in numerous other international documents.

105/ *Turning the Tide – Addressing the Impact of Fisheries on the Marine Environment*, Royal Commission on Environmental Pollution, 25th Report, December 2004 at 253, available at www.rcep.org/uk/fishreport.htm.

106/ Article XIII.2.

burdens of IMO regulations or fish in a manner inconsistent with the measures adopted by a regional fisheries management organization. The inadequacies of high-seas enforcement are manifest in a wide range of illegal activities at sea (e.g., pollution discharges, dumping, fishing, trafficking in drugs or migrants). Solutions to this larger problem will need to be dealt with as a whole and are beyond the scope of this paper. They include strengthening both flag and port State enforcement, further development of regional enforcement arrangements, further use of agreed at-sea boarding and inspection schemes as set out in the United Nations Fish Stocks Agreement, and systematic use of modern information and communications technologies to identify and track illegal activities (see sections II.A.1 and II.C above).

124. A further problem is that noted in point 4 above; that unless States participate in the legal arrangements establishing high-seas marine protected areas, they are not bound by them. While the mechanisms suggested above to broaden participation may be employed, they do not guarantee that all States whose activities may impact the designated area will join in observing protective measures.

125. The deficiencies and difficulties of high seas enforcement are likely to have already had adverse effects on high seas areas designated for protection under one or another existing international instrument, although no systematic study of this problem has been undertaken. High-seas sites designated for protection in the future would be subject to similar concerns. At the same time, certain existing and emerging tools available for high seas enforcement offer opportunities to improve compliance with any marine protected area designations beyond national jurisdiction (see section VI.8above).

6. The gaps

126. **High-seas fisheries.** The most striking inadequacy in the existing legal framework for establishing marine protected areas beyond national jurisdiction vis-à-vis existing threats to priority biodiversity areas is in relation to impacts from certain types of high-seas fisheries. Much of the oceans (Pacific and Indian oceans and parts of the south Atlantic) are not covered by regional fisheries management organizations with the legal competence to regulate high seas bottom fisheries or the impacts of bottom trawling. Most existing regional fisheries management organizations have not adopted measures giving effect to an ecosystem approach for conserving non-target species and habitat. Inadequate compliance and enforcement undermines current fisheries conservation and management measures. While a number of measures are available to establish area protections from fisheries impacts (see section III.B above), few have been widely employed, and effective global oversight of high-seas fisheries conservation and management is lacking.

127. **Emerging and intensifying high seas activities.** The extent and magnitude of threats from marine debris, dumping (whether illegal or historic dumping that preceded entry into force of the London Convention), noise pollution, and bioprospecting are only beginning to emerge, and little is known about threats from the laying of undersea cables. This makes it difficult to judge the adequacy of the existing legal framework.

128. **An integrated marine protected area approach.** The second major gap has to do with achieving an integrated approach to protecting priority biodiversity areas in marine protected areas beyond national jurisdiction from different threats governed by more than one specialized management regime, and in order to encompass also emerging threats for which no specialized regime yet exists. This gap requires enhanced coordination among specialized regimes. In cases where priority biodiversity areas are not under a clear and present threat, they may benefit from proactive recognition that lays the groundwork for management planning. The means to promote and facilitate such coordination and planning seem lacking at both regional and global levels.

129. **A biogeographic framework.** A third gap is a means to coordinate individual marine protected area designations beyond national jurisdiction within a larger ecosystem and biogeographic framework. The lack of such a framework will hinder the development of a more comprehensive approach to integrated ocean management that ensures the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction.

V. COVERAGE OF EXISTING LEGAL INSTRUMENTS IN RELATION TO IDENTIFIED PRIORITY BIODIVERSITY AREAS

130. The scientific research paper on patterns of species richness in the high seas (available on the Secretariat's website) and the related scientific study on biodiversity in marine areas beyond the limits of national jurisdiction (UNEP/CBD/WG-PA/1/INF/1) identifies species richness in different areas of the high seas. Species were grouped into marine invertebrates (e.g, crustaceans, mollusks), fish, reptiles (e.g., sea turtles), seabirds, and marine mammals.

131. The analysis shows that areas of highest species richness and thus priority for conservation of marine biodiversity are located in the tropical Indo-Pacific (Indian Ocean, Tasman Sea, and Western Pacific). Even when non-fish vertebrate species alone are considered (i.e., reptiles, seabirds, and mammals), the Indo-Pacific remains the priority. Additional "hotspots" for non-fish vertebrates are found around seamount areas in the North-West and North-East Atlantic, which overlap with important fishing grounds. Further seamount "hotspots" for all species studied are found in the South Atlantic, within the Southern Ocean convergence zone, and in the Eastern Pacific. High seas areas of the South-West Pacific are another priority area, notably in relation to seabirds. High seas areas of the South-East Pacific outside the Southern Ocean convergence zone are a priority for marine mammal conservation. High seas areas over extended continental shelves are a priority in the North-East Atlantic (invertebrates, fish, marine mammals) and in the North-West Atlantic (invertebrates, fish, seabirds, marine mammals). There follows a brief, preliminary analysis of the coverage of existing legal instruments in relation to the areas identified above.

A. Global instruments

132. It is obvious that all of the global instruments considered in this study apply to all of these areas. In most cases, however, they contain only general obligations. More specific global measures applicable to States parties have only been developed under the IMO instruments, the International Whaling Convention, and with respect to prospecting and exploration for certain types of mineral resources of the Area. It is beyond the scope of this study to evaluate whether the measures developed under the IMO instruments (e.g., to control marine debris, oil discharges) are sufficient to reduce impacts to biodiversity from shipping activities in the identified areas. With respect to whaling, the general moratorium on whaling applies throughout the world's oceans to the direct threat of hunting. Regarding prospecting and exploration of minerals associated with seamounts, the rules and regulations are still under development.

133. With respect to the identified area priorities, "special protection" status under existing global instruments is limited to the following:

(a) The whaling sanctuary in the Indian Ocean would appear to be relevant to biodiversity protection in parts of the Indo-Pacific. The whaling sanctuary in the Southern Ocean appears to cover areas of the South-East Pacific outside the Southern Ocean convergence zone, but this would have to be verified through map overlays;

(b) MARPOL 73/78 Special Area status in the Southern Ocean (to reduce pollution from oil, noxious liquid and garbage (debris)) would appear to reduce these types of pollution as a source of impact on seamount biodiversity "hotspots" in the South Atlantic. This is reinforced through annex IV to the Antarctic Treaty Protocol.

B. Regional instruments

134. For the *North-West Atlantic*, the only applicable regional instrument is the North-West Atlantic Fisheries Convention, with respect to impacts from fishing. An analysis of the adequacy of the conservation measures adopted pursuant to this convention for biodiversity conservation (specifically, for seamounts and high seas areas over extended continental shelves), including the utilization of closed areas

and seasonal closures, is beyond the scope of this study. Nevertheless, recent reports indicate that they are not adequate. 107/

135. In the *North-East Atlantic*, the applicable regional instruments are the North-East Atlantic Fisheries Convention, the regional seas agreement for the North-East Atlantic, and the CMS Agreement on small cetaceans of the Baltic and North Seas (ASCOBANS). As in the North-West Atlantic, the identified priority areas are seamounts and high seas areas over extended continental shelves. To date, as noted above, no special area protections have been adopted by the OSPAR Commission for high-seas areas, although there has been some consideration of the need for such measures. Further analysis would be needed to determine what special protections governments have adopted pursuant to ASCOBANS that apply to high seas areas. The North-East Atlantic Fisheries Commission (NEAFC) agreed in November 2004 to close five seamounts and part of the Reykjanes ridge on the high seas to fishing for three years to protect vulnerable deepsea habitats. Further analysis of area-based conservation measures adopted by NEAFC has not been undertaken for this study.

136. In the *South-West Pacific*, measures applicable to seabird protection in areas beyond national jurisdiction would be those adopted by the two regional fisheries management organizations in the region regarding seabird bycatch and pursuant to the CMS Agreement on albatrosses and petrels (CMS/ACAP). As noted in section IV.B.4 above, Parties to CMS/ACAP must adopt, in relation to their activities within the area of regional fisheries management organizations, measures that are at least as stringent as those agreed by the regional fisheries management organization for reducing the incidental take of albatrosses and petrels. (There are currently six States Parties to CMS/ACAP. 108/) The two regional fisheries management organizations in the region function under the conventions on Western and Central Pacific highly migratory species (WCPFC) and southern bluefin tuna (CCSBT). Whether existing measures are adequate would require further analysis. The Western and Central Pacific convention only entered into force in 2004 and the Commission has just begun to function.

137. For seamounts in the *South Atlantic within the Southern Ocean convergence zone*, protective measures vis-à-vis fishing impacts (including by-catch) would be available under CCAMLR. If the seamounts in questions also lie within the Antarctic Treaty area, protections might be established under both instruments. Whether CCAMLR measures are adequate would require further analysis. Further measures for seabird protection could be adopted pursuant to CMS/ACAP.

138. For seamount "hotspots" in the *Eastern Pacific*, some of these may fall within the area of the Inter-American Tropical Tuna Commission (IATTC), but some appear to lie outside the area of any regional fisheries management organization. Whether IATTC measures are adequate would require further analysis. For seabird protection, further measures could be adopted pursuant to CMS/ACAP.

139. For the *Western Pacific*, the South Pacific regional-seas convention applies to high-seas areas surrounded by the Parties' EEZs, which appear to be those identified as priority areas. The WCPFC functions in relation to the conservation and management of highly migratory species, including with respect to bycatch in fisheries (seabirds, sea turtles, marine mammals). Further measures for seabird protection could be adopted pursuant to CMS/ACAP.

140. For the *Indian Ocean*, regional fisheries management organizations function under the Agreement for the Establishment of the Indian Ocean Tuna Commission (IOTC) and CCSBT. Whether IOTC (and CCSBT) measures are adequate would require further analysis. Further measures for seabird protection could be adopted pursuant to CMS/ACAP.

141. In the high seas areas of the *Tasman Sea*, WCPFC and CCSBT function, as well as CMS/ACAP. Further analysis would be required to determine whether measures taken are adequate. In late 2004, New Zealand and Australia announced plans to cooperate in managing adverse impacts caused by deepsea

107/ See M. Gianni, note 88.

108/ Australia, New Zealand, Ecuador, Spain, South Africa, United Kingdom.

bottom trawling on vulnerable marine ecosystems and biodiversity in the Tasman Sea, including in high seas areas. Further discussions will be held in 2005 on a regional management framework for areas beyond national jurisdiction, which might result in a non-binding or a binding agreement. The possibility of interim measures to control bottom trawling is under discussion, including with third countries.

C. The gaps

142. The scientific research paper on patterns of species richness in the high seas identifies fishing as the major existing threat to biodiversity in the areas identified. Potential threats include the development of minerals associated with seamounts. It is beyond the scope of this study to review others' analyses of the location and magnitude of existing threats in the identified areas, notably from fishing and shipping. Further analysis is also needed of specific conservation and management measures adopted by the regional fisheries management organizations identified above and pursuant to CMS/ACAP that apply in the identified priority areas. Nevertheless, it is known that certain fisheries, such as bottom trawl fisheries, are currently unregulated or inadequately regulated in the Indo-Pacific region and South Atlantic. Their regulation in the North Atlantic to date has been inadequate to protect biodiversity. 109/ A recent analysis evaluating the effectiveness of seabird by-catch measures taken by regional fisheries management organizations suggests that further work is warranted in most regions. 110/ Thus, it is clear there are significant gaps in the adequacy of measures to conserve and use sustainably marine biodiversity in the identified areas, even if a definitive evaluation in relation to existing threats would take further study.

VI. OPTIONS FOR COOPERATION FOR THE ESTABLISHMENT OF MARINE PROTECTED AREAS IN MARINE AREAS BEYOND THE LIMITS OF NATIONAL JURISDICTION

143. In order to realize the goals of decision VII/5 for effectively managed and ecologically based marine protected areas that contribute to a global network, building on national and regional systems, careful analysis will be needed to:

(a) Identify areas that need protection, and the goals and framework for site selection;

(b) Identify existing threats to each area, the relative importance of each threat, and the adequacy of existing specialized instruments in addressing these threats, whether through generalized measures or designated special area protections;

(c) Identify emerging threats and their time frame, and the availability of adequate area protection measures through existing specialized regimes;

(d) Identify where coordination among specialized instruments and/or any applicable Regional Seas agreement could address existing and emerging threats; and

(e) Identify where further measures and/or new instruments are needed;

(f) Identify necessary institutional arrangements.

A related consideration is whether water-column protections need to be supplemented with seabed protections, or vice-versa.

144. In identifying areas that need protection, the full range of goals considered in section IV.A above should be considered, in part to ensure that more than just "current use" values are taken into account. As for current threats, some may argue that marine protected area designations need not be established unless and until threats exist that are likely to impair the values of the area and so that appropriate protective

109/ See M. Gianni, note 88.

110/ C.J. Small, *RFMOs: Their duties and performance in reducing bycatch of albatrosses and other species* (Birdlife International, Cambridge, UK 2005).

measures can be determined. Others may argue that a precautionary approach requires that priority biodiversity areas and representative types of ecosystems be identified and protected in advance to avoid certain types of threats and preserve their values.

145. The options for cooperation for the establishment of marine protected areas in marine areas beyond the limits of national jurisdiction identified below are grouped into three categories: (i) further use and improvement of existing instruments, (ii) integration and coordination among existing instruments, and (iii) the development of new mechanisms and instruments. It will be important to consider which actions may be most effective in realizing the goals of decision VII/5 in the short, medium, and long term.

A. Options for cooperation under existing instruments: further use and improvement

1. International shipping

146. PSSA designations may cover areas beyond national jurisdiction. There are few, if any, restrictions on the types of protective measures available under different IMO instruments that may be associated with these designations. Among the binding measures available are discharge restrictions, ships' routeing measures, and mandatory reporting. Others could also be considered, such as stricter measures on ballast water exchange. States proposing PSSAs for IMO approval can tailor proposals to protect particular priority biodiversity areas and the threats posed by shipping activities, both in areas beyond national jurisdiction and/or at the intersection of national areas and areas beyond national jurisdiction. Where discharges from ships are a major problem, additional or more stringent restrictions might be agreed under MARPOL 73/78 as available for Special Areas (and thus applicable also in PSSAs).

2. Fisheries conservation and management

147. The scope of the United Nations Fish Stocks Agreement should be expanded to include all high seas fish stocks. This would require that precautionary and ecosystem approaches are applied in conservation and management measures for discrete stocks like those associated with seamounts, including measures to protect biodiversity in the marine environment.

148. Under the regional fisheries management organizations there is substantial scope for further application of geographically-based protective measures of the type noted in section III.B above, including closed areas, interim prohibitions on destructive fishing practices like bottom trawling that adversely impact vulnerable marine ecosystems, as urged by the United Nations General Assembly in paragraph 6b of its resolution 59/25, or other measures to eliminate destructive fishing practices affecting priority biodiversity areas. In addition, the mandates of some regional fisheries management organizations may need to be amended or renegotiated to update them, so that they fully incorporate the ecosystem and precautionary approaches called for in the United Nations Fish Stocks Agreement, including concern for the effects of fishing on non-target species and habitat.

149. To address problems of unregulated bottom fisheries and their impacts on vulnerable marine ecosystems, the United Nations General Assembly, in paragraph 67 of its resolution 59/25, has called upon regional fisheries management organizations or arrangements with competence to regulate bottom fisheries to urgently adopt, in their regulatory areas, appropriate conservation and management measures, in accordance with international law, to address the impact of destructive fishing practices, including bottom trawling that has adverse impacts on vulnerable marine ecosystems, and to ensure compliance with such measures. In paragraph 68 of the same resolution, the General Assembly called upon members of regional fisheries management organizations or arrangements without the competence to regulate bottom fisheries and the impacts of fishing on vulnerable marine ecosystems to expand the competence, where appropriate, of their organizations or arrangements in this regard. This may, however, take some time to accomplish.

150. Specifically in relation to the priority biodiversity areas identified in the scientific research paper on patterns of species richness in the high seas, available on the website of the Convention on Biological Diversity and the scientific study on biodiversity in marine areas beyond the limits of national jurisdiction (UNEP/CBD/WG-PA/1/INF/1), further study is needed of the adequacy of the conservation and management measures adopted by the IOTC, CCSBT, IATTC, and WCPFC to address the impacts of fishing and whether these bodies might expand their competence as suggested or whether new arrangements would be preferable.

151. The tools available to regional fisheries management organizations to protect priority biodiversity areas could be further elaborated through the FAO guidelines on the ecosystem approach to fisheries management. In addition, an assessment and compilation of the measures available for area-based restrictions and lessons learned (toolbox) would be valuable. Innovative approaches could also be incorporated as annexes of the United Nations Fish Stocks Agreement (e.g., further elaboration article 6.6. of the United Nations Fish Stocks Agreement, on new or exploratory fisheries). A further option could be improved reporting of fisheries bycatch disposed of at sea, in order to better document the location of vulnerable deep-sea species and habitat (e.g., coral) as well as rare/endemic species whose distribution and status remain unknown, such as seamount species.

152. In considering the relationship between CITES and regional fisheries management organizations, the extent to which the measures adopted by a regional fisheries management organization give full effect to an ecosystem approach to fisheries management could be taken into account in determinations as to whether an introduction from the sea will be detrimental to the survival of the species concerned.

153. In some circumstances, the area of application of a particular regional fisheries management organization may need to be extended, or interregional fisheries management organization cooperative initiatives developed, in order to cover the full migratory range of target species as well as associated and dependent species and habitat and thus ensure implementation of an ecosystem approach (e.g., CCAMLR, in order to fully cover stocks of Patagonian toothfish).

154. At the global level, more effective oversight of high-seas fisheries conservation and management is needed to ensure the conservation and sustainable use of shared marine biodiversity. FAO already plays a role in bringing together secretariat representatives of regional fishery bodies at biennial meetings. Many believe, however, that further efforts are needed to encourage States Members of regional fisheries management organizations to improve the effectiveness of their agreements. For example, the members of the Ministerial High Seas Task Force on Illegal, Unreported and Unregulated (IUU) Fishing recently agreed that they will support the idea of a mechanism for global oversight of regional fisheries management organizations to promote a more systematic approach to the implementation of the United Nations Fish Stocks Agreement, including through giving a greater role to the annual meeting of States parties to the Agreement. 111/ Other options include the United Nations General Assembly and the United Nations Informal Consultative Process on Oceans and the Law of the Sea.

3. Regional seas agreements

155. It may be appropriate to expand the geographic scope of some regional-seas agreements to cover adjacent high seas areas, subject, of course, to the constraint that these agreements do not govern non-Parties and that measures adopted pursuant to them must be consistent with UNCLOS and its provisions on high-seas freedoms. Coordination with other relevant agreements could also be pursued.

111/ First Meeting of the High Seas Task Force: Summary of Outcomes, Document HSTF/10, 14 March 2004 at 4. The members of the Task Force are Ministers from Australia, Canada, Chile, Namibia, New Zealand, and the United Kingdom and the Directors-General of IUCN-The World Conservation Union, WWF International and Earth Institute. (www.high-seas.org)

4. Area activities and scientific research

156. Especially in the context of hydrothermal-vent sites, scientists have noted the value of establishing a global network of sites for integrated study and long-term scientific observation, and in order to avoid conflicts among research projects. 112/ Moreover, if the "preservation reference zones" contemplated in the rules and regulations of the International Seabed Authority are to be effective, they must be protected not only from mining but also from other activities. In addition, the International Seabed Authority is restricted to setting vulnerable areas off limits at the exploitation stage rather than early on in prospecting and exploration stages. Noting that the management or protection of all the world's hydrothermal vent and seep sites is an unrealistic goal, the Authority's Secretary-General has suggested the possibility of developing internationally agreed criteria for the identification of sites of critical importance and sensitivity in the seabed beyond national jurisdiction -- due to their scientific or educational value or their significance for species survival. He further notes that the Authority would benefit from close collaboration with those already conducting research on hydrothermal vents. 113/

157. First, it would be useful if the Authority was authorized to take a more proactive approach to setting aside preservation reference zones at an early stage. Second, it would be useful to develop agreed criteria for a network of Area sites for integrated study and long-term scientific observation. This might be undertaken through a coordinated approach among major scientific research institutions and relevant organizations like the International Seabed Authority, the Convention on Biological Diversity, and possibly others.

5. Environmental impact assessment

158. Certain international instruments, considered above, already require environmental assessment before a particular activity may proceed in areas beyond national jurisdiction (e.g., UNCLOS, rules and regulations of the International Seabed Authority, London Convention (dumping), annex I to the Antarctic Protocol). The Convention on Biological Diversity also provides for each Party to assess the environmental impacts of proposed projects under its jurisdiction or control likely to have significant adverse effects on biodiversity, and for appropriate notification and consultation regarding activities likely to have significant adverse effects on biodiversity in areas beyond national jurisdiction. These procedures in principle allow determinations about particular sites where activities may be prohibited or restricted to avoid adverse impacts. Under the United Nations Fish Stocks Agreement, implementation of the precautionary approach requires that States assess the impact of fishing on non-target and associated or dependent species and their environment.

159. A more uniform approach could be developed among relevant bodies for advanced environmental assessment of activities beyond national jurisdiction; for example, in the Area, in particular regions, or in relation to particular activities wherever they occur (e.g., bioprospecting). This would provide the basis for identifying particular sites warranting a higher level of protection.

6. Collaborative initiatives among like-minded States

160. Also based on the existing legal framework, in conformity with UNCLOS, there are already examples of protective arrangements agreed among concerned States for designated areas, both binding and non-binding. These may be short-term or long-term. While they have no binding effect on non-

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112/ Document ISBA/8/A/5, 7 June 2002 at para. 53, available at www.isa.org. See also L. Mullineaux, S.K. Juniper, D. Desbruyeres, *Deep-Sea Sanctuaries at Hydrothermal Vents: A Position Paper,* InterRidge News (http://interridge.org), vol. 7(1), 1998 at 15-16, cited in H. Korn, S. Friedrich, U. Feit, *Deep Sea Genetic Resources in the Context of the CBD and the UNCLOS* (BfN 2003). See also H. Thiel, "Unique Science and Reference Areas on the High Sea", in Thiel & Koslow, eds. (BfN 2001), note 1 at 98-101.

113/ Documents ISBA/8/A/5, note 119 at paras. 53-54, with reference to ISBA/8/A/1, 9 May 2002 at para. 20, available at www.isa.org.

participating States, they may gain wider recognition and effect through broader international agreements. For example:

(a) The Pelagos Sanctuary for marine mammals in the Mediterranean (see section III.A.2 above) was initially established by a tripartite agreement among France, Italy and Monaco in 1999 and later accepted as a SPAMI under the Mediterranean Convention's protocol in 2001.

(b) Pursuant to the 1986 Titanic Maritime Memorial Act, the United States restricted those subject to United States jurisdiction and control from causing disturbance to the wreck and called on United States officials to pursue international agreement to reinforce these protections. Negotiations begun in 1997 led to an agreement with the United Kingdom, France, and Canada to recognize the wreck as an international maritime memorial and underwater historical wreck of exceptional international importance. The agreement is open for signature by all States. It will enter into force once two States have ratified it. It respects high seas freedoms and avoids any assertion of jurisdiction over the wreck. The Parties agree to regulate activities such as research and salvage that may disturb or harm the wreck site. According to a United States of America official, the agreement may be a very good model for international cooperation regarding activities directed at natural features, such as deep-sea vents located in international waters. 114/ In a similar vein, a United States law to protect any United Staites sunken military craft from removal, disturbance, or injury unless authorized for archaeological, historical, or educational purposes was signed into law in October 2004. This, too, encourages the negotiation and conclusion of international agreements to protect these craft as maritime heritage. 115/

(c) Memoranda of understanding among range States to conserve sea turtles and their habitat pursuant to the Convention on Migratory Species are non-binding agreements but gain wider recognition through the binding Convention;

(d) In late 2004, New Zealand and Australia announced plans to cooperate in managing adverse impacts caused by deep-sea bottom trawling on vulnerable marine ecosystems and biodiversity in the Tasman Sea, including in high-seas areas. Further discussions will be held in 2005 on a regional management framework for areas beyond national jurisdiction, which might result in a non-binding or a binding agreement. The possibility of interim measures to control bottom trawling is under discussion, including with third countries.

7. Voluntary arrangements among private actors

161. Certain professional or industry associations may agree to help identify and protect priority biodiversity areas beyond national jurisdiction, such as groups of scientists, 116/ marine archaeologists, or commercial entities engaged in bioprospecting, laying submarine cables, tourism or, in the future, use of areas beyond national jurisdiction for mariculture or the generation of renewable energy.

8. Emerging compliance and enforcement tools

162. While not a major topic for this study, emerging technical capabilities can improve compliance and enforcement regarding special area protections. These include vessel monitoring systems (VMS) which allow vessel location information and, in some cases, fish catch data, to be transmitted

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114/ The International Agreement Concerning the Shipwrecked Vessel RMS Titanic has been signed by the United Kingdom and the United States, and the UK has ratified it. See "Agreement to Protect *Titanic* Provides Model for High-Seas MPAs, *MPA News,* vol. 6, no. 4, September 2004 at 4; and U.S. Ocean Action Plan, http://ocean.ceq.gov at 24.

115/ Ronald W. Reagan National Defense Authorization Act for FY 2005, referenced in U.S. Ocean Action Plan, http://ocean.ceq.gov at 25.

116/ For example, the InterRidege Biology Working group is developing a code of conduct for the sustainable use of hydrothermal vent sites by researchers and seabed tourism operators in order to reduce threats to these deep seabed ecosystems. Operating guidelines are also contemplated, which may provide principles for conservation measures such as MPAs. UN Doc. A/59/62 ("Oceans and the Law of the Sea"), 4 March 2004 at para. 249, with further reference to http://134.102.240.35/public_html/wg-bio.htm.

automatically via satellite to management and enforcement authorities, 117/ electronic chartingto facilitate identification of sites and associated protective measures; satellite navigation systems and transmittersso that vessel operators can quickly determine their location and any restrictions that apply, 118/ and IMO requirements for automatic identification systems for ships (transponders on board), effective 31 December 2004to assist in vessel tracking and compliance. 119/ On the high seas, States apply these measures to their own flag ships; otherwise, they must either be bound by convention to operate such systems in designated areas (e.g., regional fisheries conventions) or subjected to them through port entry requirements.

163. The site-specific nature of marine protected areas offers some advantages in terms of enforceability. Where traditional high-seas enforcement is hampered by the difficulty of monitoring vessel activities over vast areas, monitoring specific locations simplifies the task. In addition, States most directly interested in a particular site could develop a surveillance and enforcement system, consistent with high-seas freedoms. For example, analogous to the provisions of some regional fisheries management organizations, when protective measures are adopted pursuant to one or another convention, States parties to that convention could be granted a right to board and inspect, as appropriate, to ensure compliance with agreed international measures. Another possibility to encourage compliance by fishers would be for a regional fisheries management organization to grant an exclusive fishing option to one entity (through the responsible State) to fish a particular seamount community, placing the burden of proof on that entity to maintain the ecological integrity of the site, subject to defined penalties for failure to do so.

B. Integration and coordination among existing instruments

1. Between international instruments and bodies

164. Existing international instruments contain a number of provisions for coordination and integration of special area protections among the relevant instruments and bodies, both at global and regional levels. Several of these are noted in sections II, III, and IV. At the global level, they include specific provisions for consultation and cooperation between the International Seabed Authority and UNESCO with respect to arrangements for protecting underwater cultural heritage, or more general suggestions that PSSAs might be listed on the World Heritage List, declared a Biosphere Reserve, or included on another list of areas of international or regional importance. Regional agreements on protected areas for the North-East Atlantic and Antarctic provide explicitly for coordination with the relevant fishing and/or shipping instruments. ACCOBAMS provides for coordination with the Mediterranean Regional Seas instruments in habitat protection for cetaceans, while ASCOBANS specifies that conservation, research, and management measures be applied in conjunction with other competent bodies.

165. In a further development, it is possible for Parties to one agreement to actually incorporate measures provided for under another. For example, annex IV of the 1991 Antarctic Protocol incorporates the stricter requirements of Special Area designation under MARPOL 73/78 with respect to pollution from oil, noxious liquid substances, and plastics and garbage; in addition, it provides for ongoing consistency with MARPOL 73/78 as the latter is amended or new regulations are adopted. In another

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117/ See, for example, E.J. Molenaar, "Satellite-Based VMS for Fisheries Management: International Legal Aspects", 15 *International Journal of Marine and Coastal Law* 65 (2000).

118/ For example, requirements that all boats be equipped with satellite navigation systems and transmitters on Australia's Great Barrier Reef. This allows those responsible for navigating the ships to quickly determine which of several zones they are sailing through and thus which activities are permitted (e.g., fishing, pollution discharge). "Sink or Swim", 432 *Nature* at 14, 4 Nov. 2004. www.nature.com/nature.

119/ Amendments to the International Convention for the Safety of Life at Sea (SOLAS), which entered into force on 1 July 2002, require ships to carry automatic identification systems (AISs) capable of providing information about the ship to other ships and to coastal authorities automatically. All ships of 300 gross tons and upwards, as well as all passenger ships and tankers regardless of size, should have transponders on board by 31 December 2004 at the latest.

example, CMS/ACAP Parties must adopt in relation to fishing activities within the area of a regional fisheries management organization measures at least as stringent as those agreed by the regional fisheries management organization for reducing the incidental take of albatrosses and petrels.

166. Additional developments might contemplate:

(a) Members of regional fisheries management organizations incorporating into their conservation and management measures appropriate restrictions on fishing activities in areas identified as essential habitat under the CMS Agreements;

(b) Specific provision, as in the Antarctic, for a means to ensure coordination at the regional level between marine protected area arrangements for areas beyond national jurisdiction and any relevant regional fisheries management organization; this would include further cooperation and coordination between regional fisheries management organizations and other regional entities such as the UNEP Regional Seas conventions, as called for in paragraph 56 of General Assembly resolution 59/25;

167. Specifically in relation to the priority biodiversity areas identified in scientific research paper on patterns of species richness in the high seas (available on the Secretariat's website), further cooperation and coordination could be developed:

(a) In the North-East Atlantic between OSPAR, NEAFC, ASCOBANS and the European Union;

(b) In the South Pacific, regarding the high seas areas to which the South Pacific Regional seas convention applies, between the body established by that Convention, the WCPFC, and CMS/ACAP Parties;

(c) Means like charting and mapping that draw attention to special area protections established, for example, under a regional seas agreement, so that operators in a specialized field exercising high-seas freedoms like shipping, fishing, or laying undersea cables are made aware of these designations; and

(d) That organizations such as the International Seabed Authority or a competent regional fisheries management organization adopt measures to complement the protective measures associated with a PSSA designation covering areas beyond national jurisdiction, or vice-versa; this would help integrate water column and seafloor protections.

2. At the interface between national and international areas

168. As protected area networks continue to evolve under the regional-seas agreements, and as priority biodiversity areas beyond national jurisdiction are identified adjacent to areas within national jurisdiction (in effect "straddling" national and international zones), cooperation and coordination will be needed to ensure:

(a) That coastal State measures for activities within national jurisdiction and on the continental shelf beyond 200 nautical miles (e.g., oil and gas development) reinforce protections adopted through international bodies for the adjacent high-seas water column or Area;

(b) That as adjacent high-seas priority biodiversity areas are determined to be important for ecosystem and habitat conservation within national jurisdiction, coastal States, either directly or through regional-seas arrangements, can effectively pursue coordinated protections through specialized international regimes for shipping, fishing, etc; and

(c) That high-seas bottom fishing activities do not adversely impact priority biodiversity areas comprising sedentary species beyond 200 nautical miles subject to coastal State sovereign rights,

through arrangements between the coastal State and any regional fisheries management organization governing these fisheries and/or directly with the fishing States concerned.

169. Specifically in relation to the priority biodiversity areas identified in the scientific paper, further cooperation and coordination could be developed between coastal States and relevant bodies to address fishing impacts on sedentary species of extended continental shelves:

(a) In the North-East Atlantic between relevant coastal States, the European Union, and NEAFC;

(b) In the North-West Atlantic between relevant coastal States and NAFO.

C. New mechanisms and instruments

170. As considered in section IV.C above, the major gaps or inadequacies in the existing international legal framework regarding cooperation for establishment of marine protected areas in marine areas beyond national jurisdiction lie in high seas fisheries and the possibility of an integrated approach to marine protected areas and networks within a biogeographic framework.

1. High Seas fisheries

171. There are clear gaps in the ability to protect priority biodiversity areas through proper regulation of fishing activities, not only in the failure of existing regional fisheries management organization mandates and measures to fully reflect the ecosystem and precautionary approaches to fisheries management of the United Nations Fish Stocks Agreement and other international instruments, but also in the geographic coverage by regional fisheries management organizations of certain types of fisheries. To address these gaps, the United Nations General Assembly in paragraph 69 of its resolution 59/25 called upon States to urgently cooperate in establishing new regional fisheries management organizations or arrangements, where necessary and appropriate, with the competence to regulate bottom fisheries and the impacts of fishing on vulnerable marine ecosystems in areas where no such relevant organization or arrangement exists. This will take some time.

172. Specifically in relation to the areas identified in Patterns of species richness in the high seas, new regional fisheries management organizations and arrangements are needed for bottom fisheries, including around seamounts, in the Indian Ocean, Tasman Sea, and, possibly, the eastern Pacific.

173. New mechanisms at the global level for promoting the rapid upgrade of regional fisheries management organization conservation mandates might also be contemplated. Members of the Ministerial High Seas Task Force on IUU, noted above, agreed in March 2005 that its secretariat should conduct a performance assessment of high seas regional fisheries management organizations against objective criteria based on the standards established by relevant international agreements. Further discussion of a possible regional fisheries management organization performance review has taken place in the FAO Committee on Fisheries in March 2005 and is likely in the context of preparations for a review of the United Nations Fish Stocks Agreement in early 2006.

2. Integrated Approaches to marine protected areas and networks and a biogeographic approach

174. There are clearly numerous opportunities for greater cooperation and coordination among competent global and regional bodies, both to identify marine areas requiring protection and to identify activities and processes that adversely impact the biodiversity of these areas. The roles of the Covention on Biological Diversity, the International Seabed Authority, the International Whaling Commission, FAO, IMO, regional fisheries management organizations, regional-seas bodies, and CMS/Agreements have been considered in this study, as well as some specific avenues for further cooperation. The annual discussions in the United Nations General Assembly, United Nations Informal Consultative Process on Oceans and the Law of the Sea, and informal consultations among States parties to the United Nations Fish Stocks Agreement are key forums to promote more coordinated and integrated approaches.

175. At the same time, beyond the general mandate of UNCLOS (articles 192 and 194.5), there is no global agreement encompassing the concept of protecting priority biodiversity areas *per se* in order to achieve the goal of conserving the biological diversity and productivity of the oceans beyond national jurisdiction, including ecological life support systems. There are only limited means to identify and protect these areas from high seas activities *before* the activities pose threats; and coordinated approaches through different legal instruments is the only way to take an integrated approach to different threats to these areas. Network design is in its infancy.

176. This study has suggested that marine protected areas beyond national jurisdiction could serve as a coordinating framework for existing specialized regimes, drawing on the model of how PSSAs provide a framework for the application of associated protective measures available under different IMO instruments. Some argue that marine protected areas could ultimately provide the basis for a comprehensive, integrated approach to managing different threats, including from emerging uses. marine protected areas offer an opportunity to practice integrated management at a smaller scale, through voluntary arrangements and coordination among different specialized regimes, while the possibility of larger scale reforms, including new instruments within the framework of UNCLOS, is considered.

177. In order to make progress toward marine protected area networks beyond national jurisdiction, one option would be to consider a staged approach of identifying and protecting these areas that makes use of non-binding and, possibly, binding instruments.

178. To identify agreed priority biodiversity areas, a global framework is necessary based on agreed goals and criteria for selecting sites and establishing priorities on a scientific basis, as is currently done under some regional-seas agreements. This framework would likely also have to reflect biogeographic areas and give some indication of concepts of scale. In the first instance, this framework could be developed as a non-binding instrument, perhaps under the Convention on Biological Diversity, and sites selected and recognized. This would be similar to the way that the Biosphere Reserves are recognized through the non-binding Man and the Biosphere Programme. The Convention on Biological Diversity might also be a logical mechanism for coordinating the identification of priority sites.

179. Certain principles might also be agreed for application in selected priority biodiversity areas, including a precautionary approach to activities in the area and prior environmental impact assessment; again, initially, as a non-binding instrument.

180. These priority biodiversity areas would operate in the same way that PSSAs operate, with no separate legal status but as an internationally recognized geographic anchor for binding associated protective measures available under specialized international instruments governing different activities. Where there is no relevant instrument to guard against a particular threat, collaborative voluntary arrangements might be contemplated.

181. As experience is gained with these arrangements, further legal developments could be considered.

182. Another option is to proceed directly to consideration of a binding legal agreement that provides for identification and establishment of marine protected areas beyond national jurisdiction, most likely pursuant to an existing convention. This could take the form of:

(a) An implementing agreement to UNCLOS, adopted in a manner similar to either the United Nations Fish Stocks Agreement or the 1994 Part XI Agreement;

(b) An implementing agreement to the Convention on Biological Diversity, which would require amendment of the Convention; 120/

(c) A new mechanism under the Convention concerning the Protection of the World Cultural and Natural Heritage (1972), to enable the recognition and protection of sites of outstanding universal value in marine areas beyond national jurisdiction, which would require amendment of the Convention; 121/ or

(d) A global agreement that provides for a network of subsidiary agreements in which groupings of States working within regional organizations are appointed to manage particular areas beyond national jurisdiction, subject to oversight by an international management body.

183. Any new agreement on establishing marine protected areas beyond national jurisdiction would encounter difficulties regarding adherence by States and decision-making. First, without widespread adherence to the agreement, marine protected area protective measures might be undermined by non-Parties. Second, the procedures for approving new marine protected area designations would have to balance the Parties' interests in protecting particular areas with concerns regarding high seas freedoms. This will make it difficult to agree on decision-making procedures for approval, with some States urging consensus, others a majority vote, and others a procedure that allows a State that 'objects' to the decision within a given time period not to be bound by it ("opt out"). Coordination with existing instruments would also be necessary.

184. Some have suggested that the Parties to a new agreement would serve as trustees of the common interest in the conservation and sustainable use of biodiversity in areas beyond national jurisdiction. Such a concept is embodied in the Underwater Cultural Heritage Convention, with the designation of a coordinating State charged with acting for the benefit of humanity as a whole. In a similar fashion, under a new agreement, a sub-group of particularly interested States could pursue extended recognition and support for an area beyond national jurisdiction, perhaps building upon initial steps they have taken to protect that site.

120/ The provisions of Articles 4 and 5 of the Convention, with respect to areas beyond national jurisdiction, govern only activities and processes carried out under the jurisdiction or control of each Party, and their effects. In order to address these activities and their effects beyond national jurisdiction on the conservation and sustainable use of biodiversity, the Parties are to cooperate either directly or through competent international organizations. Some argue that direct cooperation might entail the development of an implementing agreement pursuant to the Convention, which would have to be adopted and enter into force as an amendment to the Convention. Any such agreement would have to respect the competencies of existing international bodies.

121/ IUCN World Conservation Congress Recommendation 17, adopted November 2004. The Convention calls for each State Party to identify and delineate properties *within* its territory (emphasis added).

Table – Human activities and the major conventions governing them in areas beyond national jurisdiction 122/

THREATS/ACTIVITIES	MAJOR LEGAL INSTRUMENTS
Fishing Overharvesting Bycatch Destructive fishing practices Marine debris	UNCLOS International Whaling Convention UN Fish Stocks Agreement FAO Compliance Agreement CMS CITES Regional fisheries management conventions
Minerals Development Physical destruction Pollution Sediment plumes & turbidity Noise	UNCLOS and 1994 Part XI Agreement International Seabed Authority rules and Regulations
Shipping Pollution Alien species Noise Physical impacts (whales) Marine debris	UNCLOS Numerous IMO conventions, including: MARPOL 73/78 SOLAS Ballast Water & Sediments IMO measures: PSSAs & Compulsory Pilotage
Bioprospecting Physical destruction Potential large-scale harvesting	UNCLOS
Marine Scientific Research/Hydrography Physical destruction	UNCLOS Antarctic Treaty
Submarine Cables Physical destruction	UNCLOS
Dumping Pollution Physical (smothering)	UNCLOS London Convention and 1996 Protocol Regional Seas Conventions/protocols/annexes
Renewable Energy (e.g., OTEC, currents, wind turbines)	UNCLOS IMO Conventions (e.g., MARPOL 73/78)
Open Ocean Aquaculture Pollution Disease Escape of alien or genetically- modified species	UNCLOS IMO Conventions (e.g., MARPOL 73/78, vis-à-vis fixed or floating platforms at sea)
Large-Scale Ocean Modification (e.g., ocean fertilization/CO^2 sequestration)	UNCLOS
Marine Archaeology Physical destruction Physical (smothering)	UNCLOS UNESCO Underwater Cultural Heritage
Tourism Physical destruction Light pollution Noise	UNCLOS
Land-Based Activities (e.g., Mediterranean high seas; effects of POPs)	UNCLOS Regional seas conventions/protocols/annexes

122/ In areas beyond national jurisdiction, the Convention on Biological Diversity creates general obligations for States Parties to individually apply relevant Convention provisions to activities and processes under their jurisdiction or control and to cooperate with other States in the conservation and sustainable use of biodiversity. It does not regulate these activities *per se* beyond national jurisdiction.

Annex I

MAJOR GLOBAL CONVENTIONS AND STATE PARTICIPATION

Convention/Agreement	Year	States Parties
United Nations Convention on the Law of the Sea (UNCLOS) www.un.org/depts/los	1982	148
Agreement relating to Implementation of Part XI of the Convention on the Law of the Sea	1994	121
Convention on Biological Diversity (CBD) www.biodiv.org	1992	188
Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA) www.un.org/depts/los	1995	52
Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (FAO Compliance Agreement) www.fao.org	1993	29
International Convention for the Regulation of Whaling (IWC) www.iwcoffice.org	1946	60
Convention on the Conservation of Migratory Species of Wild Animals (CMS) www.cms.int	1979	89
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) www.cites.org	1973	167
UNESCO Convention on the Protection of the Underwater Cultural Heritage www.unesco.org/culture/laws/underwater	2001	Not in force

Convention/Agreement	Year	States Parties
International Maritime Organization (IMO) Conventions		
International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78): (Annex I/II)	1973/78	132
Convention on Safety of Life at Sea (SOLAS)	1974	158
International Convention for the Control and Management of Ships' Ballast Water and Sediments	2004	Not in force
Convention for the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention – 1972)	1972	85
Protocol of 1996 of the London Convention of 1972	*1996*	Not in force

Annex II

MAJOR NON-BINDING GLOBAL LEGAL INSTRUMENTS THAT REINFORCE OR SUPPLEMENT THE BINDING INTERNATIONAL LEGAL REGIME FOR MARINE AREAS BEYOND THE LIMITS OF NATIONAL JURISDICTION

FAO Code of Conduct for Responsible Fisheries, 1995

FAO International Plans of Action:

- to reduce the incidental catch of seabirds in long-line fisheries (1999);
- for the conservation and management of sharks (1999);
- for the management of fishing capacity (1999);
- to prevent, deter and eliminate illegal, unreported and unregulated fishing (2001).

UN General Assembly Resolution on Large-Scale Pelagic Driftnet Fishing and its Impacts on the Living Marine Resources of the World's Oceans and Seas, 1991 (A/RES/46/215, 1991).

UNEP Global Programme of Action on Protection of the Marine Environment from Land-Based Activities (1995), *with respect to areas like the Mediterranean Sea where national jurisdiction over the water column for the most part does not extend beyond the 12-nautical-mile territorial sea.*

UNEP Global Plan of Action for the Conservation, Management and Utilization of Marine Mammals (1984, rev. 1997).

UNESCO Action Plan for Biosphere Reserves (1984) and the Seville Strategy and Statutory Framework for the World Network of Biosphere Reserves (1995).

Agenda 21: Action Programme of the United Nations Conference on Environment and Development (1992), paras. 17.46 (e) and (f), 17.86.

Plan of Implementation of the World Summit on Sustainable Development (2002), para. 32 (a) and (c).

Annex III

REGIONAL LEGAL AGREEMENTS APPLICABLE TO MARINE AREAS BEYOND NATIONAL JURISDICTION

A. Regional Seas Agreements

These agreements do not affect the rights of non-Party States that may be active in the region (e.g., shipping, fishing).

Convention on the Protection of the Marine Environment of the North East Atlantic, 1992 (replaces 1972 Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft and the 1974 Convention for the Prevention of Marine Pollution from Land-Based Sources) – www.ospar.org

- Annex I – Prevention and Elimination of Pollution from Land-Based Sources (1992);
- Annex II – Prevention and Elimination of Pollution by Dumping or Incineration (1992);
- Annex III – Prevention and Elimination of Pollution from Offshore Sources (1992);
- Annex IV – Assessment of the Quality of the Marine Environment (1992);
- Annex V – Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area (1998).

Regional States Parties to the Convention: 16

Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean or Barcelona Convention (1976, amended in 1995) – www.unepmap.org

- Protocol for the Prevention and Elimination of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft or Incineration at Sea (1976, amended in 1995);
- Protocol Concerning Cooperation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea (2002, replacing the 1976 Protocol);
- Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities (1980, amended in 1996);
- Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (1995, replacing a previous 1982 Protocol);
- Protocol Concerning Pollution Resulting from Exploration and Exploitation of the Continental Shelf, the Seabed and its Subsoil (1994);
- Protocol on the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal (1996).

Regional States Parties to the Convention: 22

Convention for the Protection of Natural Resources and Environment of the South Pacific Region (1986) – www.sprep.org.ws

- Protocol for the Prevention of Pollution of the South Pacific Region by Dumping (1986);
- Protocol Concerning Cooperation in Combating Pollution Emergencies in the South Pacific Region (1986).

Regional States Parties to the Convention:

Antarctic Treaty (1959)
Protocol on Environmental Protection (1991)

- Annex I – Environmental Impact Assessment (1991);
- Annex II – Conservation of Antarctic Fauna and Flora (1991);
- Annex III – Waste Disposal and Waste Management (1991);

- Annex IV – Prevention of Marine Pollution (1991);
- Annex V – Area Protection and Management (1992).

States Parties to the Convention: 43

B. Regional fisheries management organizations (RFMOs) and the conventions establishing them

No study has been undertaken to determine whether every State fishing in the area of application of each of the conventions below has become a party to the convention.

Competence over all living marine resources, except as noted:
CCAMLR - Commission under the Convention on the Conservation of Antarctic Marine Living Resources (1980) – www.ccamlr.org;
GFCM – Commission under the Agreement for the Establishment of the General Fishery Commission for the Mediterranean (1949, rev. 1997) – www.fao.org/fi;
NAFO – Organization under the Convention on Future Multilateral Cooperation in the North-West Atlantic Fisheries (except sedentary species) (1978) – www.nafo.ca;
NEAFC – Commission under the Convention on Future Multilateral Cooperation in North-East Atlantic Fisheries (except sedentary species and highly migratory species) (1980) – www.neafc.org;
SEAFO – Organization under the Convention on the Conservation and Management of Fishery Resources in the South-East Atlantic Ocean (2001) – www.mfmr.gov.na/seafo/seafo.htm;

Competence over specific species:
CCSBT - Commission under the Convention for the Conservation of Southern Bluefin Tuna (1993) – www.ccsbt.org;
IATTC - Commission under the Convention for the Establishment of an Inter-American Tropical Tuna Commission (1949, rev. 2003) – www.iattc.org;
- Agreement for the International Dolphin Conservation Programme (IDCP, 1998)

ICCAT - Commission under the International Convention for the Conservation of Atlantic Tunas (1996 and 1984 and 1992 protocols) – www.iccat.es;
IOTC – Commission under the Agreement for the Establishment of the Indian Ocean Tuna Commission (1993) – www.iotc.org;
WCPFC - Commission under the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (2000) – www.ocean-affairs.com;
NASCO – Organization under the Convention for the Conservation of Salmon in the North Atlantic Ocean (1982) – www.nasco.int;
NPAFC – North Pacific Anadromous Fish Commission under the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean (1992) – www.npafc.org.

Competence over areas within national jurisdiction:
IBSFC – Commission under the Convention on Fishing and Conservation of the Living Resources in the Baltic Sea and Belts (1973);
IPHC – Commission under the Convention Between the United States and Canada for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea (1953 and 1979 Protocol);
PSC – Pacific Salmon Commission under the Treaty between the Government of the United States of America and the Government of Canada Concerning Pacific Salmon (1985 and 1999 Amendments) – www.psc.org.

C. Convention on Migratory Species – Agreements - www.cms.int

Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS, 1992) – www.ascobans.org

8 of 15 Range States are Parties.

Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA, 1995) - www.cms.int/species/aewa

49 of 117 Range States of the Atlantic and Indian Oceans are Parties.

Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS, 1996) – www.cms.int/species/accobams

17 of 28 Range States are Parties.

Agreement on the Conservation of Albatrosses and Petrels (ACAP, 2001) – 25 Range States of the Pacific and Southern Oceans - www.cms.int/species/acap, www.acap.aq.

6 of 25 Range States are Parties.

Competence over areas within national jurisdiction:

Agreement on the Conservation of Seals in the Wadden Sea (1990) – www.cms.int/species/wadden_seals

3 of 3 Range States are Parties.

Non-binding memoranda of understanding (MOUs) and competence over areas within national jurisdiction:

MOU concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa (1999) – www.cms.int/species/africa_turtle

19 of 26 Range States have signed.

MOU on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (2001) – www.cms.int/species/iosea.

20 of 41 Range States have signed.

D. Other relevant regional agreements

Convention for the Conservation of Antarctic Seals (1972).

Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific (1989, 1990 protocols).

Convention on Conservation and Management of Pollock Resources in the Central Bering Sea ("Donut Hole" Agreement, 1995).

Agreement to end unregulated fisheries of regulated stocks in the high seas area of the Barents Sea ("Loophole" Agreement, 1999).

Competence over areas within national jurisdiction:

Inter-American Convention for the Protection and Conservation of Sea Turtles (1996) – www.seaturtle.org (9 of 12 signatory States are Parties).

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Oceans and the law of the sea

Report of the Secretary-General

Addendum

Summary

The present report has been prepared in response to a request by the General Assembly, in paragraphs 73 and 74 of its resolution 59/24 of 17 November 2004, for the Secretary-General to report to the Assembly at its sixtieth session on issues relating to the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction. As provided in that resolution, the report should assist the Ad Hoc Open-ended Informal Working Group established by the General Assembly in preparing its agenda. The Working Group will be convened by the Secretary-General in New York not later than six months after the release of the present report and will study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction.

In accordance with Assembly resolution 59/24, the report presents information on the scientific, technical, economic, legal, environmental, socio-economic and other aspects of the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction, including key issues and questions where more detailed background studies would facilitate consideration by States of these issues and, where appropriate, possible options and approaches to promote international cooperation and coordination in this area. It also presents information on past and present activities of the United Nations and other relevant international organizations with regard to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction.

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Contents

		Paragraphs	*Page*
I.	Introduction	1–11	3
II.	Scientific, technical, economic, environmental, socio-economic and legal issues	12–225	5
	A. Scientific issues	13–57	5
	B. Technological issues	58–97	15
	C. Economic issues	98–118	25
	D. Socio-economic issues	119–127	31
	E. Environmental issues	128–175	33
	F. Legal issues	176–225	44
III.	Past and present activities of the United Nations and other relevant international organizations	226–304	56
	A. United Nations	227–240	56
	B. United Nations programmes and institutions	241–247	59
	C. United Nations specialized agencies	248–262	61
	D. Other international organizations	263–297	65
	E. Other international entities	298–300	72
	F. Organizations working on intellectual property rights	301–304	73
IV.	Conclusions	305–317	74

I. Introduction

1. Oceans support an abundant and diverse web of life, which constitutes an integral part of the biological diversity of our planet and makes an extremely valuable contribution to its health, including for human life. For example, marine biodiversity produces a third of the oxygen that we breathe, moderates global climate conditions and provides a valuable source of protein for human consumption and other products. At the same time, available evidence indicates that biodiversity, including marine biodiversity, is under growing pressure from different types of human activity. The primary causes of loss of biodiversity include pollution, climate change and increasing demands for biological resources as a result of the growth in the human population and world production, consumption and trade. As a result of these unprecedented pressures, we are witnessing the degradation of habitats and the over-exploitation of biological resources.

2. Conservation and sustainable use of biodiversity, including marine biodiversity, must therefore become an integral part of social and economic development in order to ensure that the variety of services it provides will be available to support human needs in the long term.

3. It is important to clarify what is understood by the term biodiversity and biological resources in the context of the present report. The terms are not used in the United Nations Convention on the Law of the Sea[1] and are commonly used with different connotations. The Convention on Biological Diversity[2] uses and defines these terms. The present report follows the definitions contained in the latter Convention, taking into account that recent developments may have shed new light on their meaning.

4. Biological diversity is defined in article 2 of the Convention on Biological Diversity 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". Biodiversity is therefore an attribute of life, and refers to the variability of life in all forms, levels and combinations. It includes ecosystem diversity, species diversity and genetic diversity.

5. On the other hand, "biological resources" are the tangible biotic components of ecosystems and species. As defined in article 2 of the Convention on Biological Diversity, biological resources include "genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity". Genetic resources, in particular, are defined as "genetic material of actual or potential value", and genetic material is defined as "any material of plant, animal, microbial or other origin containing functional units of heredity".

6. In the light of recent developments in the field of genetics, it is now known that every cell of every living organism contains "functional units of heredity". It could therefore be concluded that genetic resources can include plant seeds, animal gametes, cuttings or individual organisms, as well as DNA extracted from a plant, animal or microbe, such as a chromosome or a gene, with actual or potential value for humans in light of their genetic characteristics.

7. The value of the diversity of genes, species or ecosystems per se should not be confused with the value of a particular component of that diversity for human needs. Species diversity, for example, is valuable because the presence of a variety of species helps to increase the capability of an ecosystem to be resilient in the face of a changing environment. At the same time, an individual component of that diversity, such as a particular species of fish, may be valuable as a biological resource for human consumption or use.

8. Biodiversity can be diminished either if the diversity itself is reduced, such as through the extinction of a species, or if the potential of the components of diversity to provide a particular service is diminished, such as through unsustainable harvesting. Both a change in the diversity itself per se and a change in specific components of biodiversity deserve attention from decision makers and each often requires its own management goals and policies.[3]

9. The issue of conservation and sustainable use of biodiversity, including marine biodiversity, has been attracting increasing attention recently as part of the growing concern about the future of our planet. This resulted in a series of decisions adopted in recent years by the General Assembly, under its agenda item on oceans and the law of the sea. The most recent action taken by the General Assembly was to adopt resolution 59/24 of 17 November 2004, in paragraph 73 of which the Assembly decided to establish an 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: (a) To survey the past and present activities of the United Nations and other relevant international organizations with regard to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction; (b) To examine the scientific, technical, economic, legal, environmental, socio-economic and other aspects of these issues; (c) To identify key issues and questions where more detailed background studies would facilitate consideration by States of these issues; and (d) To indicate, where appropriate, possible options and approaches to promote international cooperation and coordination for the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction. In paragraph 74 of the same resolution, the Secretary-General was requested to report on these issues to the Assembly at its sixtieth session, in order to assist the Working Group in preparing its agenda, in consultation with all relevant international bodies, and to convene the meeting of the Working Group in New York not later than six months after the release of the present report.

10. The present report is presented in response to the request of the General Assembly. It is based on publicly available information, as well as information received from relevant organizations and experts cooperating with the Division for Ocean Affairs and the Law of the Sea of the Office of Legal Affairs of the Secretariat. The Secretariat is grateful to those who have contributed to the preparation of this report.[4]

11. The information is organized around the issues to be studied by the Working Group. An addendum to the previous report of the Secretary-General on oceans and the law of the sea (59/62/Add.1) presented information on vulnerable marine ecosystems and biodiversity in areas beyond national jurisdiction, and reports of the Secretary-General relating to fisheries, in particular his report contained in document A/59/298 complement the information provided in the present report.

II. Scientific, technical, economic, environmental, socio-economic and legal issues

12. The present chapter of the report responds to subparagraphs 73 (b) to (d) of General Assembly resolution 59/24. It examines scientific, technical, economic, socio-economic, environmental and legal issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction. It also identifies, under each of these themes, key issues and questions where more detailed background studies would facilitate consideration by States of these issues, as also requested by the Assembly. Similarly, the report indicates, where appropriate, possible options and approaches to promote international cooperation and coordination for the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction. Possible options for cooperation are also presented in the conclusions to the present report.

A. Scientific issues

13. The oceans are characterized by an exceptional range of ecosystems with complex structures and functions. These can be broadly divided into the pelagic (water column) and the benthic (seabed) ecosystems. The pelagic and benthic environments are high in biodiversity,[5] suggesting a greater number of species exist in the sea than on land. Analyses of selected deep sea floor systems have led some scientists to predict that the whole deep sea floor beyond areas of national jurisdiction could perhaps harbour several million species (see also A/59/62/Add.1, paras. 167-199).

14. Research in areas beyond national jurisdiction is carried out in complex and little known environments. With the development of new technologies and techniques, scientists have had to adjust their thinking about the processes and functions of ecosystems found in oceans. At the same time, knowledge about the biological diversity of the deep ocean is so limited that it is not possible to estimate the number of species in any region or to predict the geographic range they occupy. Efforts need to be made to understand these ecosystems in order to be able to promote their conservation and sustainable use.

1. Ocean ecosystems

(a) Pelagic ecosystems

15. The pelagic environment can be divided vertically into three zones, the epipelagic or “light” zone, extending from the surface to approximately 150 to 200 metres below sea level, the mesopelagic or “twilight” zone, extending from approximately 200 metres to 1,000 metres below sea level and the bathypelagic zone, which is dark and cold and extends from 1,000 metres downwards.[6] The boundaries of each zone vary in depth depending on local or regional conditions and each is characterized by a distinct community of plankton, micronekton and fish. A distinctive fauna has been identified close to the seabed known as the hyper-benthic or benthopelagic fauna. The species diversity of pelagic ecosystems is low compared to benthic ecosystems. Species diversity generally increases to the

transition between the mesopelagic and bathypelagic zones and then decreases with increasing depth.

Epipelagic zone

16. The epipelagic zone generally goes down to 150 to 200 metres, where there is sufficient light for photosynthesis. Broadly, species diversity is highest in the subtropics followed by the equatorial belt and then drops markedly after the transitional zone, with polar seas having diversities of less than 50 per cent of the tropics and subtropics. This pattern, however, is not even across all groups of animals.[7] Recently, a new framework has been established for a global regional ecology of the pelagic environment based on a suite of physical processes and patterns of phytoplankton productivity. This scheme takes into account features of oceanography that do not necessarily reflect latitude, such as major upwellings on the western boundaries of continents.[8]

17. Recent studies on zooplankton have indicated that knowledge concerning the diversity of the epipelagic communities is still inadequate. Even in well-studied groups such as copepods, new species are being regularly described and, more significantly, widely distributed "old" species are being recognized as complexes of several morphologically very similar species. This means that the collation of old records of species occurrence may be highly inaccurate.[9] The use of DNA sequencing has shown that these problems are not restricted to small animals.[10] In addition, it is difficult to acquire knowledge about gelatinous and meso- and bathypelagic soft tissue animals, which do not preserve well using conventional methods of fixation,[7] leading to the general conclusion that knowledge of the zooplankton also decreases with increasing depth.

Mesopelagic zone

18. The mesopelagic zone contains communities of animals that undergo daily migrations (which are visible with sonar as dense reflective layers) towards the surface at dusk to feed, returning to deeper waters at daybreak to avoid predators. These migrators make a significant contribution to the rapid transport of carbon from the surface layers to depth, but this is secondary to sinking of surface production.[11] The daily migrating plankton and micronekton layers are also critical in trophic focusing in areas of elevated topography (see Seamounts). As with the epipelagic zone, many mesopelagic species are thought to have wide geographic distribution. However, confidence in putative distributions has been undermined by recent discoveries triggered by the use of new technology, such as DNA or genetic investigation.[12]

Bathypelagic zone

19. In the bathypelagic zone, diversity of pelagic species appears to peak at around 1,000 metres partially because the mesopelagic and bathypelagic faunas mix at these depths. Such transition zones are known as ecotones. Below this depth, the biomass of pelagic organisms decreases exponentially and species diversity also apparently decreases steadily. This zone is probably the least studied and least understood part of the pelagic realm. The animals are different from those in the mesopelagic zone as there is no light. The rain of food from the epipelagic zone decreases from the surface of the oceans to the seabed and life at these depths is sluggish. Topographic

barriers, such as the mid-ocean ridges, tend to separate areas of the ocean at these depths and bathypelagic species have a stronger tendency towards regional distribution rather than the (putative) cosmopolitanism typical of the shallower pelagic realms. However, below 3,000 metres, sometimes termed the abysso-pelagic zone, cosmopolitanism increases (see also A/59/62/Add.1).

20. The understanding of how pelagic biodiversity varies with oceanic, regional and mesoscale oceanographic features is limited. This situation becomes worse with increasing depth and is a major technological and financial challenge to investigate.

(b) Benthic ecosystems

21. The geological morphology of some of the oceanic basins can be important in determining the ecological characteristics of the oceans by modifying the hydrography.[13] Central ridges that cross some of the major ocean basins, dispersed and aggregated seamounts and other topographic features of the sea floor define the type of sea floor biological assemblage encountered. Trenches affect the sedimentation rates of nearby abyssal habitats by trapping sediment that would otherwise be transported to the abyssal plain where it could create perturbations, eradicating benthic assemblages on occasion, generating mosaics of isolated habitats within which speciation of taxa with limited dispersive ability occur, thus contributing to high regional diversity.[14] The knowledge of how these events take place is poorly documented.

Continental slopes and abyssal plains

22. The largest seabed habitats are the continental slopes and abyssal plains, with an area equivalent to 90 per cent of the total global ocean. Work based on deep-sea samples indicates that the diversity of animals living in or on deep-sea sediments is high.[15] At the same time, evidence shows that despite the large number of rare animals, a few species make up most of the individuals in a set of deep-sea samples. The most diverse species were small animals up to about 1 millimetre in size, termed the macrofauna. While it is clear that some species of animals can have a very wide distribution in the deep sea, this is likely to be strongly influenced by life-history characteristics or size. The high numbers of rare species in deep-sea samples sustain viable populations by way of the so-called “source-sink dynamics”, whereby reproductive populations living in optimal conditions (source populations) produce large numbers of offspring which are broadcast into the water lying over the seabed and many of which end up settling in areas where they can survive but are unlikely to reproduce and contribute to the next generation (sink populations). Given the vast size of the abyssal plains and continental slopes, the potential for larvae and juveniles and even adults, in the case of the smallest organisms, to drift over large distances is significant. Therefore the pool of species contributing to any single local area of the deep sea is very great.

23. In this hypothesis, the bathyal zone is thought to act as the “source” population for the abyssal plains that are therefore viewed as a giant “sink” for propagules of bathyal origin.[16] The source-sink hypothesis has important implications in terms of conservation and development of deep-sea resources. It may be argued that exploitation of resources on the abyssal plains will not result in species extinctions because source populations of affected species would still exist on the continental margins. However, to assess the potential for extinction resulting from such

activities requires information on the geographic range and distribution of individual abyssal species, which is very limited.

Seamounts

24. Seamounts are undersea mountains of tectonic and/or volcanic origin. Estimates from the digital global elevation map based on the 2-Minute Gridded Global Relief Data (ETOPO2) dataset distributed by the United States National Oceanic and Atmospheric Administration give numbers of between 14,000 and 30,000 seamounts with an elevation of 1,000 metres or higher,[17] although the number of seamounts in the world's oceans remains uncertain. A more accurate prediction of the location of seamounts is also not possible without making available higher resolution data that is currently classified and out of the reach of scientists, although it appears that seamounts are found across all oceans.

25. A recent analysis of the SeamountsOnline database (http://www.seamounts.sdsc.edu) reveals 1,971 species recorded from 171 seamounts, mostly in the Pacific Ocean, with several in the Atlantic Ocean and only a few in the Indian Ocean. This analysis confirms the previous view that seamount communities are distinct from the surrounding deep-sea fauna and therefore are highly endemic. It is increasingly recognized that seamounts may also act as biological hot spots in the oceans and often attract a high abundance and diversity of large predators, such as sharks, tuna, billfish, turtles, seabirds and marine mammals. Crustaceans and corals are the next most commonly sampled animals, followed by molluscs, sea urchins, brittlestars, starfish, segmented worms and sponges. Almost every seamount that has been sampled has revealed markedly high levels of new species. Any estimates are likely to be conservative in terms of the number of species because of limited numbers of samples and limitations of sampling gear. The lack of affinity between seamount communities across only 1,000 kilometres of ocean is remarkable and indicates that seamount species may be restricted in distribution to single clusters or chains of seamounts or even to single seamounts. This means that human impacts on seamounts resulting from fishing or mining may result in species extinction and a global reduction in the diversity of the global seamount fauna. There is therefore an urgent requirement to assess the distribution of biogenic structures and associated communities on seamounts to identify which areas harbour significant species diversity.

Cold-water coral reefs

26. Cold-water corals are formed by a few species of stony corals, including *Lophelia pertusa, Madrepora oculata, Solenosmilia variabilis, Goniocorella dumosa, Oculina varicosa, Enallopsammia profunda* and *Enallopsammia rostrata*. Discoveries of new cold-water coral reefs have continued over the past few years. These discoveries have included the largest *Lophelia* reef found to date, the Røst Reef off the Lofoten Islands, which lies at a depth of 300 to 400 metres and covers an area 40 kilometres long by 2 to 3 kilometres wide. Sightings on the western side of the Atlantic Ocean are sparse, but indicate that a similar belt stretches from off the coast of Canada to Brazil.[18] Genetic analysis of *Lophelia pertusa* from off the Brazilian coast indicates a large genetic distance from European populations, which may suggest that the south-west Atlantic populations may not be co-specific to north-east Atlantic animals.[19]

27. In the southern hemisphere, cold-water coral ecosystems have been found associated with seamounts south of Tasmania and around New Zealand. These coral ecosystems, as with *Lophelia pertusa* reefs, are associated with highly diverse and endemic communities of animals. The fracture zone in the South Pacific area has not been explored to confirm the existence of cold-water coral reef ecosystems and the area off the coast of Chile also remains uninvestigated with regard to the presence of cold-water coral ecosystems.

28. Other types of coral can form distinct habitats with associated communities of animals. In particular, large colonies of octocorals or gorgonians can form dense forests or gardens, as found in the North Pacific, along the Aleutian Island chain, in the Bering Sea and in the Gulf of Alaska. These habitats are rich in rockfish (*Sebastes* spp), shrimp and other crustaceans. They also host other suspension-feeding attached animals, such as crinoids, basket stars and sponges. Gorgonians and other corals form dense populations in areas such as canyons and may have a highly diverse associated fauna. The New England seamounts have recently been investigated primarily with regard to octocorals and fish, but results have not yet been reported.[20]

29. There is an urgent need to identify areas hosting cold-water coral or other biogenic reef communities. Deep-sea corals grow slowly and reefs take thousands of years to develop. These structures can be imaged from ships using acoustic methods, but since vast areas of the seabed are potential habitats for reef-forming organisms, seabed assessment using autonomous underwater vehicles may be useful. The diversity and levels of endemism of species associated with such biogenic reefs are poorly understood and require urgent investigation. There is also little information on the reproduction, recruitment and ability to recover from human impacts for many reef-forming deep-sea corals, gorgonians and sponges and most information is on *Lophelia pertusa*. In situ observations and experimentation are required to address these issues. Although scientists generally agree that it is difficult at the present time to predict the impact of human activities on deep-sea species, there is some evidence of the impact of trawling on cold-water corals.[21]

Trenches

30. There are 37 trenches, mostly distributed around the periphery of the world's oceans.[22] The supply of organic material to trenches can be high and abundances of animals living on the seabed can be higher than in the surrounding deep sea.[23] About 700 deep-sea species have been recorded inhabiting trenches below 6,000 metres in depth. This fauna is highly endemic, with 56 per cent being found only in trenches and 95 per cent occurring only in a single trench.[24] Species diversity declines with depth, especially below 8,500 metres. Endemism is mainly at the species level and it is clear that many trench species are derived from close relatives in the adjacent oceans. These habitats remain poorly explored.

Canyons

31. The continental margins are dissected in many places by submarine canyons. These areas are often a focus for biological activity and are characterized by dynamic currents driven by internal waves and upwelling and high rates of accumulation of organic matter from the shelf. Communities may be quite different from the surrounding continental slope. Canyons can be rich in species but are

extremely variable in physical form and biology. They may also support considerable populations of fish, including commercial species. An abundance of large predators such as cetaceans are also attracted to these localities, which may be regarded as pelagic and benthic hot spots. As a result, they have also become a focus of conservation efforts.[25]

Reducing habitats

32. Reducing habitats occur in regions of the oceans where oxygen concentrations are low. Such areas are often associated with high concentrations of methane or hydrogen sulphide and include dysaerobic ocean basins, hydrothermal vents, cold seeps and the remains of large dead animals, such as whales, described below.

33. Dysaerobic basins or extreme oxygen minimum zones (EOMZs) occur where intense upwelling leads to high surface productivity. This productivity sinks and decomposes at mid-ocean depths, consuming dissolved oxygen and, when combined with sluggish water circulation, leads to the development of massive areas of mid-water oxygen minima. The eastern Pacific Ocean, the south-east Atlantic, the area off west Africa, and the northern Indian Ocean are by far the largest reducing habitats in the oceans.[26] The boundaries of the EOMZs may fluctuate (for example in the eastern Pacific during the El Niño phenomenon) causing marked economic impacts by influencing the catches of fish and shellfish, often abundant around these areas because of high surface productivity. These areas may also be important as global sinks for the deposition of carbon.[6]

34. The organic-rich sediments of EOMZs can support dense mats of sulphide oxidizing bacteria that thrive in waters rich in the nitrate used for sulphide oxidation to produce energy.[27] Overall, the diversity of EOMZ communities is depressed compared to normal deep-sea habitats and many of the residents of these zones are specially adapted for life in low oxygen conditions. Adaptations include small body size, special respiratory structures, blood pigments such as haemoglobin, the formation of biogenic structures such as tubes or “nests” to survive in very soupy sediment, the occurrence of sulphide oxidizing symbionts (as in vent and seep organisms) and other biochemical adaptations. Sometimes, dense aggregations of macrofauna and megafauna can occur at the base of EOMZs where organic material is plentiful and oxygen levels are sufficiently elevated for more animals to survive. In general, the species diversity of EOMZs is not well studied.[26]

35. Subsurface reducing habitats occur when, within the ocean bottom sediment, anoxia is created by the microbial degradation of organic matter. These areas are populated by communities of anaerobic bacteria, which can extend hundreds of metres into the sediments, representing a vast reservoir of microbial diversity. Even on crustal rocks, deep subsurface microbial communities exist, deriving energy from oxidation of hydrogen generated by the chemical interactions of seawater percolating up from beneath the seabed. These organisms are extremely difficult to access but have been sampled from venting fluids, especially following sea-floor eruptions. These hyperthermophilic organisms may influence the chemistry of venting fluids, but little is known about the diversity or function of these communities.

Hydrothermal vents

36. Hydrothermal vents are ecosystems that occur at divergent plate boundaries (mid-ocean ridges) and convergent plates where back-arc spreading centres occur. At mid-ocean ridges, interaction among the liquid magma from the earth's mantel, gases and water at extreme pressures create high-temperature deep-sea vents rich in chemicals that feed bacteria at the base of unique food chains.[28] A recent investigation of the biogeographic value of chemosynthetic systems has revealed that vents are like oases in the deep, supporting life and spreading species richness. The biological processes occurring at hydrothermal vents are powered by chemical energy rather than sunlight.[29] Because of the peculiar circumstances in which life develops in these ecosystems, hydrothermal vent organisms are a subject of interest from both a scientific and a commercial point of view.

37. The main characteristic of hydrothermal species is their tolerance to extreme conditions and their very peculiar physiology. Organisms mostly belong to the domain archaea, an evolutionary branch that is separate from those of bacteria and eukarya. The biomass at these habitats is typically high and dominated by tubeworms (*Riftia pachyptila*), clams (*Calyptogena magnifica*), mussels (*Bathymodiolous thermophilus*) and a variety of gastropods, polychaete worms and shrimps.

38. The diversity of species around hydrothermal vents is low, with about 500 described species, but levels of endemism in these habitats are high (more than 90 per cent). Although different vents have similar taxa at higher taxonomic levels (the genus and family), at the species level there are significant differences between vents. This led to the establishment of biogeographic provinces including the East Pacific, comprising the Galapagos Rift, the east Pacific Rise and the Guaymas Basin; the north-east Pacific; the western Pacific, where hydrothermal vents have been found in a variety of back-arc basins, including the Lau Basin, the Manus Basin, the Marianas Trough and the Fiji Basin (1987) and the Okinawa Trough (1988); and the mid-Atlantic, where a number of vents have been discovered.[30] The species also vary between Atlantic and Pacific vents. The first plume signals south of the equatorial fracture zone have recently been reported but have not yet been located. The most recent discoveries have been in the Indian Ocean.[31]

Cold seeps

39. Cold seeps are areas where cold, oxygen-depleted fluids, which may be rich in hydrogen sulphide or methane, flow upwards through cracks in the ocean floor. Cold seeps are associated with active and passive continental margins from 400 to 6,000 metres deep. New discoveries of seep sites are continuing.[32] In general, the diversity of seep communities is thought to reflect the age of a seep site, with ages up to 200,000 years being reported for some areas, such as the Gulf of Mexico. Many species appear to be restricted in distribution to one or two seep sites. Very few species are shared with other reducing habitats, such as vents, although there are similarities at higher taxonomic levels that indicate a common origin for elements of the faunas of these habitats. The biological diversity of seeps is less understood than that of deep-sea hydrothermal vents. Despite the fact that these habitats are probably more diverse than hydrothermal vents, only 200 to 300 species of seep-endemic animals have been identified. A high proportion remains undescribed, in particular those animals that do not contain symbiotic bacteria.

Carcasses

40. There are thousands of whale carcasses on the bottom of the oceans. These massive but highly localized influxes of organic matter represent a source of food for a specialized but poorly studied fauna. The animals inhabiting whale carcasses can occur in huge densities. Over 400 species have been documented. Macrofaunal diversity appears to rival many other hard substrate habitats in the deep sea.[33] At least 19 species are shared with other reducing habitats, including hydrothermal vents and cold seeps, and they may have represented important geographic stepping stones during the evolution and radiation of organisms reliant on these habitats.

(c) Micro-organisms

41. In the last 15 years, there has been a revolution in the understanding of the contribution of microbial organisms to production, biochemical cycling and diversity in the oceans. Despite these advances, the available knowledge is still in its infancy, but the continued application of genomic technologies will bring further revelations on biological processes driving the marine biosphere at the global scale.[6]

42. Micro-organisms include both heterotrophic (consumers), autotrophic (primary producers or photosynthetically active organisms) and mixotrophic (mixed nutritional strategy) prokaryotes (bacteria) and microbial eukaryotes. Particular interest is generated by micro-organisms in the deep ocean, below the sea floor and deeper into the subsurface. Buried deep within ocean sediments, in hot-ocean crust crevices, they have adapted to extreme environmental conditions (extremophiles) that include high pressure, high and low temperatures, unusual or toxic chemicals and minerals, or low availability of essential nutrients. In addition to those in vents and seeps, organisms found in brine pools (features similar to lakes at the bottom of the ocean, which result from the higher salinity of water bodies above certain areas of the ocean floor where significant amounts of salt deposits are buried) are of potential interest to marine scientists as a result of their unique physiological characteristics.[34]

Hot spots

43. Hot spots are microscopic rich areas of organic matter, typically related to living and dead microbial cells, floating in an otherwise nutrient-poor ocean environment.[35] Hot spots of diversity and biological activity in the ocean or pelagic zone occur in areas associated with coral reefs, oceanic islands, seamounts and other topographic and hydrographic areas such as canyons and fronts. In the food-limited environment of the open oceans, these areas are of major importance for the survival of large predators and support extensive populations of fish and other pelagic organisms.

44. Major hot spots are located in the tropical Indo-Pacific area, in particular on the seamounts in the Pacific, Indian and Atlantic Oceans. Although hot spots in species diversity are located mainly in the subtropics, hot spots of productivity with a high importance to pelagic predators have also been located in temperate and polar zones.[36] Hot spots should form natural focuses for conservation measures to protect both pelagic and benthic habitats, especially in the subtropics where the biodiversity across many trophic levels and groups of organisms is very high.[37]

2. Research activities

(a) Ongoing research

45. In present times, a host of research activities are carried out to study the ecology, biology and physiology of deep seabed ecosystems and species. The majority of activities are on a small scale, spread among independent research activities and programmes that are ongoing in many universities and research institutions in the world.[38] Most of these activities are of an exploratory nature. Some are a joint effort between the scientific communities of two or more States, such as the Arctic Mid-Ocean Ridge Expedition in 2001, conducted by scientists from the United States and Germany.[34]

46. More ambitious programmes involve a strong element of international scientific cooperation as well as joint ventures between public and private institutions. The New Challenger Global Ocean Expedition, organized by Deep Ocean Expeditions, the P. P. Shirshov Institute of Oceanology, the Russian Academy of Sciences, and Diversa Corporation, is an example of a joint venture. Census of Marine Life and the InterRidge organization are examples of international research programmes. Census of Marine Life is a global network of researchers engaged in an initiative to explain the diversity, distribution and abundance of marine life in the oceans, with a strong focus on deep-sea species. It has seven field projects, including the Census of Diversity of Abyssal Marine Life, the Biogeography of Deep-Water Chemosynthetic Ecosystems and the Mid-Atlantic Ridge Ecosystem Project.[39] InterRidge is an international organization comprising 2,700 researchers from 27 countries whose objective is to develop oceanic ridge research in a cost-effective and cooperative manner.[40]

47. The Integrated Ocean Drilling Program is an international marine research programme that investigates sub-sea-floor environments by studying the deep biosphere, environmental changes, processes and effects, and solid earth cycles and geodynamics. The Program has four international partners: two lead agencies: the National Science Foundation of the United States and the Ministry of Education, Culture, Sports, Science and Technology of Japan; a contributing member: the European Consortium for Ocean Research Drilling Managing Agency; and an associate member: the Ministry of Science and Technology of China. The Program also works in collaboration with other research programmes, such as the Global Ocean Observing System of the Intergovernmental Oceanographic Commission and International Geosphere-Biosphere Programme.[41]

48. A number of national institutions, some of which are mentioned below, are at the forefront of research on the deep oceans.

49. The French Research Institute for Exploitation of the Sea[42] carries out research projects on the exploration, knowledge and exploitation of the deep-ocean and its biodiversity with a focus on developing deep-ocean-related technology and ocean-floor observatories.

50. The National Oceanic and Atmospheric Administration of the United States, in particular its vent programme, studies the impacts and consequences of submarine volcanoes and hydrothermal venting on the global ocean.[43] This is an integrated research programme, focusing on the distribution and evolution of hydrothermal plumes and their geological, physical, chemical and geophysical characteristics.[34]

51. The Japan Agency for Marine-Earth Science and Technology, with its research centre known as the Extremobiosphere Research Center, conducts research on organisms thriving in the deep sea and in the deep subsurface, concentrating on extremophiles in terms of (a) what kinds of organisms live in such extreme environments; (b) what are their distinctive features; and (c) what is their potential usefulness in human life and/or in industrial applications.

Marine genomics

52. Researchers are using innovations in genomics research[44] to develop an accurate portrayal of the mechanisms employed by deep-sea life forms to survive in the harsh conditions of the marine abyss.[45] The findings might assist research efforts relating to the application of characteristics of deep-sea bacterial genes for improving human nutrition and degrading pollutants. In February 2005, the J. Craig Venter Institute, a non-profit research organization based in the United States, announced the launch of its marine microbe genome project, which aims to sequence the genome of more than 100 of the key marine microbes stored in culture collections around the world and provide a baseline against which to interpret the structure and functions of marine microbial genes. All the results of this project will be made public through the National Center for Biotechnology Information of the United States. Although the Institute's activities have focused on water column species, some of the techniques used may be relevant to future studies on deep seabed genetic resources.[34]

53. The Ocean Genome Legacy is a non-profit, private research foundation whose mission includes promoting the conservation of marine genomic diversity through the creation and maintenance of a publicly accessible, permanent archival collection of genomic DNAs, DNA libraries, voucher specimens and voucher strains and development of improved methods for genome resource banking, including genome amplification and cell and tissue cultivation and preservation. The mission of the Marine Genome Resource Bank is not only to preserve a portion of the disappearing diversity of marine environments, but also to provide access to a wide representation of marine genomes in the hope of augmenting the emergent science of environmental, functional and evolutionary genomics.[46]

54. While genome resource conservation is not a substitute for species and ecosystem conservation, it can provide many important tools for preservation and management of endangered species. The archived genomic DNAs and DNA libraries contain the raw genetic materials that can be isolated, sequenced, expressed and manipulated, so that genetic processes, products and regulation can be examined and explored. Thus, public genome resource collections can provide the physical materials and source information that add value to the sequence data currently being made available through the electronic media. Public genome conservation archives can serve to democratize genomic research, placing publicly funded resources within the reach of a greater number of researchers and fostering cooperation among smaller groups to utilize products created by centralized research facilities. The website of the Japan Agency for Marine-Earth Science and Technology also hosts a metadatabase of the genomes of several deep-sea micro-organisms that have been sequenced by the Agency and other scientific institutions in the world.[47]

(b) Research activities that need to be undertaken

55. To understand fully the ocean ecosystems so as to ensure their sustainable use and conservation, there are areas where more research needs to be carried out, some of which are identified below.[48] The geographic variation in diversity of the pelagic realm is complex and poorly understood. Species diversity and the presence or absence of individual species or communities have a large influence on processes related to the major biogeochemical cycles in the oceans. A major international research effort is required to address the lack of data on the diversity and species distribution of deep-sea animals, the benthic fauna, from the shallow bathyal to the abyssal zones of the central ocean basins and along isobaths on the continental slope.[49] Special efforts should be made to explore unsampled regions of the oceans.

56. Many questions regarding diversity and distribution will require simultaneous studies in conventional and molecular taxonomy.[50] Old records of species, including distribution information, are probably highly inaccurate.[9] Revising classification of species will require a large amount of human effort, as sorting benthic macrofaunal and meiofaunal samples is a lengthy procedure and requires skilled parataxonomists. A lack of trained taxonomists is currently a major barrier to overcoming the lack of understanding of the biology of the high seas.[6]

57. Major challenges relate to the remoteness of the study areas and the difficulty and expense of conducting continuous sampling from research vessels. In addition, high costs are involved in building infrastructure for the systematic recording of findings and analysis of the varied environments and biodiversity of the deep ocean. In many areas of the world, the resources and efforts required exceed the existing oceanographic capabilities and institutional framework, including human resources.[13] To address these challenges, international research projects offer a significant opportunity to train a new generation of marine scientists from around the world, thus spreading expertise and knowledge to the parts of the globe with the richest marine biodiversity, including developing countries in need of capacity-building. The Census of Marine Life programme provides an effective model on which to base such an effort.[6]

B. Technological issues

58. While the oceans cover two thirds of the planet,[51] it is estimated that the vast majority — 90 per cent — are unexplored. Access to the deep sea is dependent on technological progress relating to vessels, equipment, techniques for sampling and analysis, appropriate infrastructure, highly trained personnel and adequate financial resources. Although marine technology has advanced immeasurably in recent years, it still has limitations in collecting samples and in documenting observations in both the water column and on the seabed. In addition, the cost and infrastructure required by institutions and Governments to obtain systematic recordings of the biodiversity and to characterize the high seas and seabed exceeds, in most cases, the existing oceanographic capabilities and institutional infrastructure, as well as available human resources.

59. The section below describes selected examples of technology and tools that scientists use (in situ or ex situ) in their exploration of the deep ocean, its biodiversity and ecosystems. Technologies used for marine science include survey vessels with surface or deep tows, to take images of the seabed for bathymetric

charts; several types of submersibles lowered and operated from mother ships; equipment for geological, geochemical and biological sampling; techniques for preservation of biological samples; and analytical techniques to classify the organisms. There are also emerging molecular, chemical, optical and acoustical technologies, which will help to improve the understanding of biological diversity in the pelagic and benthic environments.

1. Research and supporting vessels

60. Research vessels used in areas beyond national jurisdiction are large ships capable of oceanic research cruises lasting several months at sea, serving as mobile platforms for marine research with a wide variety of sampling and surveying equipment. Such equipment includes traditional gear, such as box corers, multicorers, dredges, trawls and water samplers,[52] very sophisticated and expensive unmanned platforms, such as remotely operated and autonomous underwater vehicles, hybrid remotely operated vehicles, deep-towed vehicles and a range of manned submersibles launched and retrieved by vessels. Remotely operated vehicles are becoming the primary tool for studying the biodiversity of the deepest oceanic ecosystems and are a key technology in the international Census of Marine Life programme which has utilized, for example, the French remotely operated vehicle "Victor". These vehicles are manoeuvrable and can be easily controlled from the surface. Because it is exponentially more expensive to build all of these vehicles as the attainable depth increases, owing to the increased pressure they must endure, they are built in various classes suited for specific ranges of water depth.[53]

Survey ships (surface or towed arrays)

61. The first stage of the exploration of seabeds is the creation of bathymetric charts. The use by ships of acoustic systems, including sonar imaging presenting local reflectivity of the bottom and thus its nature, make it possible to obtain in a precise and fast way topographic images of the relief of the seabed (bathymetry). Vessels conducting physical oceanography and marine biology surveys of the deep are often equipped with autonomous laboratories and instruments for storing and analysing collected data.

62. Manned submersible vehicles are defined as any undersea vehicle that has a one atmosphere cabin for human occupancy and is dependent on a surface support vessel. The primary advantage of the manned submersible is that it permits the researcher, in particular, to work in situ at great depths in the sea. The United States deep-diving submersible "Alvin", operated by the Woods Hole Oceanographic Institution, and the French submersible "Nautile" have been diving on the Mid-Atlantic Ridge in a historic example of international cooperation and exploration of the planet Earth. The Japan Agency for Marine-Earth Science and Technology has also developed the "Shinkai 6500", which is capable of carrying out surveys and observations at a maximum depth of 6,500 metres and navigating along the bottom, holding its position at a constant depth to conduct visual observation and capture videotape and still photographs. The "Mir I" and "Mir II" are three-person submersibles of the Russian Federation with a maximum operating depth of 6,000 metres. The Mir vessels allow scientists to observe the deep sea through multiple viewing ports, video records, instrument placement, sample collecting and environmental monitoring. The submersibles are launched and recovered with a specialized crane from the starboard side of their primary support vessel.

63. Unmanned platforms or remotely operated vehicles are attached to the mother ship by a control/retrieval cable, which supplies power to the unit, allows for real-time transfer of data, including pictures and video, to shipboard monitors where pilots and scientists can safely follow its progress and direct its movements. Remotely operated vehicles can be fitted with multifunction manipulators for complex tasks. The "Victor 6000" of the French Research Institute for Exploitation of the Sea is one of the leading remotely operated vehicles equipped to provide high resolution maps of the deep. The Japan Agency for Marine-Earth Science and Technology also operates the "Hyper Dolphin", which incorporates various state-of-the-art features such as a unique super-high-definition camera to display images of the high quality necessary to observe the sea floor closely. Such high resolution is also essential when observing living organisms. Another example is the Canadian "ROPOS" (Remotely Operated Platform for Ocean Science), which is launched into deep water in a cage to a maximum depth of 5,000 metres, to about 40 metres above the sea floor. Attached to ROPOS are two video cameras, two robotic arms for taking samples of rocks or organisms, bottles for collecting water samples, a box for collecting biological samples and preserving them at in situ pressure and temperature, a suction sampler that can vacuum up sediments and organisms and a specialized water sampler for hydrothermal fluids.

64. Autonomous underwater vehicles are economically more viable than remotely operated vehicles and can function without tethers, cables or remote control. They have a multitude of applications in oceanography, environmental monitoring and underwater resource studies.

65. The Japan Agency for Marine-Earth Science and Technology, for example, developed the "Urashima", which is fitted with a closed-cycle type fuel cell and a highly sophisticated navigation system, which has allowed the Urashima to establish a world record for continuous underwater operation. It automatically collects various ocean data, such as salinity and temperature. The Urashima can conduct expeditions in such areas as submarine volcanic zones. It is equipped with side-scan sonar and a digital camera to obtain topographical data on the deep sea floor. Another autonomous underwater vehicle frequently used in deep sea explorations is the Woods Hole Oceanographic Institution vehicle ABE (Autonomous Benthic Explorer), which is intended for long-duration deployment of up to one year.[54] It runs on batteries and, at present, can survey the sea floor at depths up to 5,000 metres on dives lasting more than a day. The United States also operates a new vehicle designed for science missions at abyssal depth, the "Odyssey II", intended for survey operations.

66. The hybrid remotely operated vehicle, a new type of vehicle developed by the Deep Submergence Laboratory at the Woods Hole Oceanographic Institution and Johns Hopkins University, is capable of reaching a depth of 11,000 metres to perform a variety of tasks, such as photography, biological sampling and topographical mapping. The hybrid operates in two modes: as a remotely operated vehicle utilizing up to 20 kilometres of armoured, lightweight microcable, which allows scientists to receive data and communicate with the craft in real time; or as an autonomous underwater vehicle pre-programmed to collect data in wide-area surveys for later analysis.

67. Deep towed vehicles are less complex than remotely operated and autonomous underwater vehicles, but are useful as platforms for a variety of different

oceanographic instruments that measure biological, chemical and physical aspects of the ocean. The deep towed vehicle is different from a remotely operated vehicle in that it has no propelling device. It was originally developed for mapping the sea floor. Deep towed vehicles can be equipped for studies on archibenthic organisms, preliminary surveys for deep-sea exploration by manned and unmanned submersibles and underwater installation of observation instruments. The main purpose of this type of vehicle is to conduct wide-area deep-sea surveys and towing is best suited for this purpose. This system permits simpler design and has much lower operating costs. The Japan Agency for Marine-Earth Science and Technology has two deep towed vehicle systems. The camera system consists of two types: the 4,000 metre class and the 6,000 metre class. The sonar system is the 4,000 metre class. There are many different types of towed vehicles such as the Canadian Moving Vessel Profiler, which can house a video plankton counter or similar device while simultaneously utilizing several external sensors that record various physical qualities such as conductivity (salinity), temperature and current speed.[55] Another example is the deep towed vehicle "Bridget" of the British National Oceanography Centre in Southampton, which moves up and down near the ocean floor to study water plumes associated with hydrothermal vents. In the 6,000 metre class, other examples of deep towed vehicles are the "Deep Tow 6000" of the Scripps Institution of Oceanography; Scampi and SAR (Système Acoustique Remorqué) of the French Research Institute for Exploitation of the Sea; Argo II of the Woods Hole Oceanographic Institution and the Towed Ocean Bottom Instrument system of the National Oceanography Centre, whose main sensor is a sidescan sonar, which sends a sound pulse whose echoes are used to produce an acoustic image of the sea floor.[56]

2. Sampling techniques

68. Detection and identification techniques, both morphological and molecular, have relied on collecting samples from remote sites and analysing them in laboratories. In order to advance the understanding of pelagic biodiversity and its role in the oceans, there is a need to develop methods for surveying large volumes of water, preferably at timescales appropriate to variations in physical parametres that can be measured using oceanographic instrumentation. Once samples are collected and concentrated, automated systems must accommodate the analysis method. Identifying the diversity of organisms from marine samples is a particular problem, especially because many are not amenable to culture, although recent developments in culture technology have increased the range of species that can be grown in artificial conditions.

69. Deep-sea drilling remains the best way to sample the subsurface, but it is costly and there is a risk of contamination of the results from retrieved samples.[57] However, the Japan Agency for Marine-Earth Science and Technology's vessel "Chikyu", with its blowout prevention system similar to those used on high-pressure oil wells, will maintain environmental safety against oil or gas spills while recovering sediment and rock cores.[58] The Chikyu will be a state-of-the-art scientific drilling vessel equipped with 10,000 metres of drill string to allow the vessel to drill more than 7,000 metres beneath the sea floor, at a depth of 2,500 metres.[59] A riser drilling system will make it possible to drill through formations that have been difficult to drill using current conventional scientific drilling methods. The system will recover and collect core samples (columns of sediments

and rocks) for analysis and study aimed at measuring the formation properties by logging instruments and performing long-term monitoring in the deep.

70. Scientists have developed new instrument packages that plug into sealed drilled holes in the sea floor. These probes, or circulation obviation retrofit kits, offer potential windows into the interacting chemical, hydrological, geological and biological processes that occur beneath the sea floor.[57]

71. The main technologies that have advanced the understanding of seabed organisms are high performance liquid chromatography, used for detailed analysis of photosynthetic pigments; flow cytometry, used in the enumeration of size-fractionated particles and the discrimination of specific groups of organisms by cell scatter and characteristics of fluorescence; the use of DNA clone libraries for identification of groups of organisms by nucleotide sequence similarity; and the use of oligonucleotide probes, which have allowed identification of specific groups of organisms and enumeration or relative quantification by epifluorescence microscopy, or dot-blot hybridization (arrays). Other examples include (a) the Environmental Sample Processor, developed at the Monterey Bay Aquarium Research Institute, which extracts nucleic acids from protists in the water and detects specific organisms by their DNA; (b) the Submersible Incubation Device of the Woods Hole Oceanographic Institution, which determines levels of photosynthesis in the water around it; and (c) the submersible flow cytometer, which analyses microbial cells in the water continuously for up to two months. Because it samples continuously, scientists can see changes in plankton populations over time that cannot be detected by traditional sampling.[60]

72. Underwater video profilers, optical plankton recorders and shadowed image particle profiling and evaluation recorder systems have already been successfully used to quantify particulate matter and zooplankton in the water column. Such equipment has generally been deployed from surface vessels and towed through vertical profiles in the water column. Approximately 100 optical plankton recorders are in use throughout the world, although the resolution of these machines is limited. The development of these technologies in a small size, with high resolution and to the point where they could be mounted on autonomous underwater vehicles, deployed on fixed moorings at dynamic locations (that is, ocean fronts) or drifting-arrays equipment, would greatly increase their utility.

73. Autonomous underwater vehicles already carry a range of equipment for gathering oceanographic measurements including fluorimetres, transmissometres, temperature and salinity probes and acoustic devices. Increasing the speed and range of these platforms will greatly enhance the ability to study pelagic ecosystems not only in the epipelagic and mesopelagic zones but to full ocean depth. Miniaturizing a range of equipment used to characterize small organisms will greatly enhance our understanding of how the diversity of these organisms is influenced by the physical environment and, in turn, how these organisms influence biogeochemical cycling and the formation of biological hot spots. Further miniaturization of such equipment would reduce it to a size where it could be deployed on deep-ocean observatories or even on autonomous underwater vehicles.

3. Preservation of samples and data analysis

74. For marine biological research in deep-sea environments, deep-sea samples need to be collected and kept under the same environmental conditions as those in

the deep sea where the organisms grow naturally. For such purposes, the Japan Agency for Marine-Earth Science and Technology has developed the deep-sea baro/thermophiles collecting and cultivating system (DEEP-BATH), which samples mud containing deep-sea micro-organisms under deep-sea environments and then isolates and cultivates the bacteria without subjecting them to above-ground conditions. This system also allows micro-organisms to grow at different temperatures and pressure conditions for observation. To date, the Agency has been able to isolate 180 microbial species from the Mariana Trench. The Agency has also developed a pressurized aquarium tank (DEEP AQUARIUM), which maintains deep sea organisms in conditions similar to their original environment.[59]

75. The traditional procedure for identifying organisms involves comparing the physical characteristics of a collected specimen with the characteristics for a known species. Today, deep-sea investigations can complicate this process because two identical specimens can be named differently since there is no comparison to another type of sample. DNA-based methods are objective and avoid such problems, allowing classification and distribution of organisms across the world's oceans. A recent advance in the field of molecular techniques is the development of DNA bar coding. This approach uses a small segment of an organism's DNA to identify its species name. This technology affords scientists an advantage when trying to identify large numbers of collected organisms. This process is being used by the Census of Marine Life.[6]

4. Databases

76. Databases are information tools that are researchable and allow for wide and quick sharing and access. There are a number of databases containing information on deep-seabed resources and expeditions. The InterRidge website, for example, hosts several relevant databases, including the hydrothermal vent database, the Mid-Ocean Ridge back-arc basin MOR and BAB cruise database, and the hydrothermal vent faunal database. The latter, which contains almost 500 species, is currently being merged with the ChEss (Biogeography of Chemosynthetic Ecosystems) database, which is a project of the Census of Marine Life. This database includes ascertained and suspected hydrothermal vent sites and contributes also to the International Seabed Authority central data repository, which was developed to collect and centralize all public and private data and information on marine mineral resources.[34] The Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO) has developed a dataset on a register for marine organisms, which is being maintained at the National Museum of Natural History, in Leiden, the Netherlands. The register contains a list of species names as well as additional information, such as author names, vernacular names and information on geographical and bathymetrical distribution. Synonyms are also added, but only if they are still in use or have been used recently. The Ocean Biogeographic Information System is the information component of the Census of Marine Life and is a web-based provider of global geo-referenced information on marine species and strives to assess and integrate biological, physical and chemical oceanographic data from multiple sources.[61]

5. Biotechnology

77. The biotechnology sector is one of the most dynamic research areas with increasing prospects for growth and profitability.[62] The marine environment covers a

wide thermal range whose variability has facilitated extensive speciation at all phylogenetic levels, from micro-organisms to mammals, and includes plenty of metabolites and other resources in living or dead form. Developments in molecular technology and bioinformatics will allow more information to be gathered on the diversity of existing bacteria and their potential. The next generation of technology for monitoring biological processes, remediation of pollutants and conversion of wastes will all be linked to these new biological technologies.

78. Marine biotechnology is the science in which marine organisms are used in full or partially to make or modify products, to improve plants or animals or to develop micro-organisms for specific uses. Advances in biotechnology with the ability to transfer genetic material from one organism to another, have opened up the exciting possibility of transferring segments of DNA that are responsible for the biosynthesis of secondary metabolites from unculturable bacteria. Synthetic methods are constantly improving so that complex molecules can be synthesized on industrially useful scales. Ongoing exploration will provide subsurface organisms and genes for by-product screening.

79. Deep sea organisms, in particular, are interesting because of their ability to adapt to extreme environments. Knowledge of their adaptation process provokes questions as to the mechanisms they use and possible commercial applications. Many have been sampled with an eye to their biotechnology potential. The marine biotechnology industry is based on the realization that many micro-organisms found in various marine environments can, through biotechnology, provide new products and processes for use in many sectors. The biomass of bacteria constitutes promising deposits of molecules that can be used in the areas of health, pharmacology, cosmetology, the environment and chemistry. The number of related patents is rising (see also paras. 215 and 216, below).

80. Most inventions concern the genomic features of deep seabed species, the isolation of active compounds and sequencing methods. Others relate to the isolation of proteins that present enzymatic activity with potential for industrial applications. Several inventions concern the cell components and biological compounds themselves, which offer interesting properties for use in biomedical applications. While studies that extend biological technologies to the marine environment are few, they hold great promise.[63]

81. Modern technologies such as molecular techniques have opened up vast areas of research for the extraction of biomedical compounds, including from the oceans and seas. The search for new metabolites from marine organisms has led to the isolation of around 10,000 metabolites many of which are endowed, in particular, with pharmacodynamic properties. In recent years, many bioactive compounds have been extracted from various marine animals, such as sponges, soft corals and sea slugs, and are being sold commercially by this developing industry.[62]

82. From discovery and recovery of an organism from its original habitat to practical application of the organism, several steps take place. To obtain a molecule of biotechnological interest, the succession of phases includes fermentation, extraction, purification, identification and validation of biological activities. Once validated, there may be an attempt to synthesize the molecule, totally or partially. Natural molecules may then become models that can be copied or modified to increase their effectiveness and/or to reduce their level of toxicity.

Biotechnology research

83. Biotechnology research includes applied programmes that promote the systematic collection, culture of and research on deep-sea organisms. This type of activity entails describing the genetic and physiological features of deep-sea organisms and assessing their potential for biomedical, industrial, environmental and other types of application.

84. Research in the area of biotechnology is being carried out in a number of universities and institutes all over the world, including the Extremobiosphere Research Center of the Japan Agency for Marine-Earth Science and Technology. In addition to its main mission, marine biological research, the Research Center aims at realizing practical industrial applications, including the production of useful substances by taking advantage of organisms' functions. In its Cooperative Research Project for Extremophiles, the Research Center seeks out contacts with corporations through the Deep-Sea Bioforum to provide proposals for experimental and joint research based on corporate needs and to accept researchers from the private sector for research projects. In addition, depending on corporate needs, it is also prepared to provide research facilities alone. The Research Center supports private sector research and development through this initiative by providing the results of its research as well as organism resources, genomes and other organism data. In order to support the needs of the private sector, in particular, the Research Center strives to realize ongoing development including the establishment of a genome bank of useful enzymes of new micro-organisms as well as deep-sea micro-organisms and the utilization of genome data analysis software.[59]

85. The Marine Bioproducts Engineering Center is a research centre of the National Science Foundation in the United States working in partnership between the University of Hawaii at Manoa and the University of California at Berkeley. The Center's activities span from discovery and screening of new organisms (including extremophiles) to the design of cultivation and purification systems, aimed at the production of marine bioproducts such as polyunsaturated fatty acids, antibiotics, antivirals and enzymes. The Center is structured in such a way as to bridge research activities with development of products and processes.[34] Undersea technology issues such as biotechnology and pharmaceuticals, sea-floor observing and sensing and vehicle development are also addressed by the National Oceanic and Atmospheric Administration of the United States in its Undersea Research Program. The Program is a unique national service that provides scientists with the tools and expertise they need to work in the undersea environment. Six regional research centres provide the scientific community with access to a wide array of underwater technologies, including submersibles, remotely operated and autonomous underwater vehicles, underwater laboratories and sea-floor observatories.[64]

86. The French Research Institute for Exploitation of the Sea also implements a programme on biotechnological transfer from deep water species for oncological, cardiovascular and tissue regeneration applications and for new anti-tumour strategies. This programme is conducted in cooperation with the University of Western Brittany, the Regional University Hospital Center in Brest, France, the French National Institute of Health and Medical Research, the French National Centre for Scientific Research and the Faculty of Odontology at the University of Paris V.[34]

87. The activities of the Australian Institute of Marine Science in the field of marine biotechnology are oriented towards the development of pharmaceutical and health-care products, agri-chemicals for crop protection and novel bioremediation agents for environmental protection. The Institute possesses one of the world's largest publicly owned collections of biotic extracts for bioactive chemical discovery, including material from around 20,000 marine macroscopic and microscopic organisms from around Australia. Since only an estimated 1 per cent of microbial diversity can be cultured using standard techniques, a large proportion of the microbiology effort at the Institute is spent on the development of novel culture and fermentation procedures.[34]

Biotechnology and its applications

88. Potential applications from marine-sourced material include pharmaceuticals, fine chemicals, enzymes, agri-chemicals, cryoprotectants, bioremediators, cosmaceuticals and nutraceuticals. A study of small-molecule new chemicals introduced globally as drugs between 1981 and 2002 showed that 61 per cent can be traced to, or were inspired by, natural products.[65] This figure rose to 80 per cent in 2002-2003. Compounds from natural products are considered to be more agreeable to consumers and two thirds of the anti-cancer drugs, for example, are derived from both terrestrial and marine natural products. Marine plants, animals and micro-organisms produce many unique biochemicals with great potential in treating diseases such as cancer and inflammatory disorders and may prove effective against HIV/AIDS. Marine-sourced material (for example, from sea water/sediment) has a higher chance of being successful commercially because of its mega-diversity.[65]

89. Although natural molecules are used by a variety of industries, they are mostly known for their application in the health sector. Biotechnology could lead to more preventive medicine based, inter alia, on genetics and targeted diagnostics. There are also a considerable number of new drugs that are the result of biotechnology, including anti-cancerous and anti-inflammatory agents. In addition, biotechnology may bring solutions to illnesses such as obesity, diabetes or neurological ailments. The role of biotechnology in the health-care industry is increasing and more and more partnerships are being created between biotechnology and pharmaceutical companies. From 22 in 1993, companies using biotechnology for the health sector now number 190, of which 13 have over $1 billion in sales each per year. In the United States, the approval of new drugs increased by 25 per cent in 2003, with some 300 biotechnology products based on natural compounds (see also para. 125, below).[34]

90. The area of cosmetology is also a growing economic sector. The most researched and in-demand products are in relation to anti-ageing and wellness agents. Biotechnology is also applied for the preservation of the environment and to dispose of non-biodegradable products and their toxic components. Micro-organisms (bacteria and micro-algae) and algae, can be used to fight pollution through bio-absorption or degradation of the pollutant agents. According to the mechanisms used, these processes are called, for example, bio-detoxification, bio-purification or bio-fixation. With regard to the environment, an important area of application relates to antifouling systems. There is a need for new non-toxic agents to protect equipment such as ships' hulls that do not have an adverse impact on marine flora or fauna. The possibility of cloning genes of biosynthesis enzymes is promising for genetically modified plants. In the area of agriculture and the food

industry, the possibility to exploit marine molecules as additives or texturizing agents has been recognized.[66]

Bioinformatics

91. Bioinformatics play a key role in the identification of candidate compounds for pharmaceutical and many other purposes in that it allows the rapid screening and selection of potential compounds for further testing. Since the technology and software associated with bioinformatics is increasingly being made available, including through open source software, bioinformatics is likely to change the way biotechnology research is conducted in the future. Trends suggest that there is a decreasing dependence on physical transfers of biological material in favour of electronic transfers. Bioinformatics is also likely to reduce research and development costs. It should be noted that the development of genomics has been favoured by the advent of biological informatics (bioinformatics), which can be loosely defined as the application of information technologies to biodiversity studies and their applications.[66]

Biotechnology and partnerships

92. Biotechnology is also emerging as a sector that increases cooperation between pharmaceutical companies and other biotechnology companies, academic researchers, non-profit institutions, medical centres and foundations. For example, Targeted Genetics, a company based in the United States, has entered into a collaboration with the International AIDS Vaccine Initiative, which aims at producing an affordable vaccine at an accessible cost for developing countries and that can also be commercialized in developed countries. The Millennium Ecosystem Assessment found that bioprospecting partnerships are most effective when supported by a range of international and national laws, as well as self-regulation measures such as codes of ethics.[66]

93. The nature of partnerships between biotechnology and pharmaceutical companies is also changing: instead of simply licensing out their products, biotechnology companies increasingly demand a partner role in most phases of the commercialization phase, including the sharing of royalties. For example, the Industry Sponsor Program of the Marine Bioproducts Engineering Center was set up to interact with industrial sponsors, with the aim of building a group of industry participants in the Centre's activities.[66]

6. Need for further technology development

94. As technology develops and becomes more widely available, scientific research in the extreme environments of the deep ocean is likely to increase. The best technology that could be developed for the study of biological diversity in environments beyond areas of national jurisdiction will vary from one ecosystem to the other and from mission to mission.[13] It should also take into account the need for characterizing biological diversity. Not only will this allow an expansion of knowledge on extreme ocean ecosystems in order to improve their conservation and sustainable use, but it will also provide opportunities to discover valuable resources and compounds of potential application to the food, industrial and pharmaceutical sectors.

95. Understanding the emerging areas of chemical signalling and signal transduction are important to enhance knowledge of bioluminescence, biofouling, biocorrosion, biofilm function and symbiosis. The results of such research can be used to develop anti-fouling and anti-corrosion materials as well as create an understanding of how microbes colonize surfaces.

96. Sensitive and accurate means of predicting the impacts of stressors on marine organisms are needed to strengthen indices of ecosystem health. This can be achieved through genome-enabled technologies and their application to real-time monitoring technologies to complement engineering and remote sensing initiatives. An ultimate goal would be to design, programme and build a system to carry out multiple tasks remotely.

97. A limited number of institutions worldwide own or operate vehicles that are able to reach areas deeper than 1,000 metres below the oceans' surface and can therefore be actively involved in deep seabed research. A larger number of institutions operate vehicles that are capable of reaching shallower depths. In either case, developing or operating deep-sea technology is a highly consuming exercise, financially as well as in terms of time.[34] It is estimated that the operation of a research vessel with its equipment may cost around $30,000 per day.[67] Scientific programmes on vent communities have been carried out by States that have access to the latest technologies for vent exploration and sampling. Such programmes could involve some of the ocean rim countries. These efforts, in accordance with the United Nations Millennium Declaration (General Assembly resolution 55/2), which prescribes that benefits from the use of new technology should be available to all, would promote more international cooperation in sharing of logistics in scientific exploration. Some of the programmes in waters beyond national jurisdiction could be linked to national programmes of countries for both work sharing and economic reasons. It is noted that, similarly, strong attempts are currently being made for sharing of technical and scientific know-how for better returns from different research programmes. The Census of Marine Life is one such example where ocean rim countries are encouraged to come together to understand biodiversity in the past, present and future timescales.

C. Economic issues

1. Tragedy of the commons and the free-rider problem

98. Many of the benefits derived from biodiversity and ecosystem services are characterized by economists as public goods, which means that rivalry among users and exclusivity of uses are low. For example, the services of oceans in regulating global climate are purely public goods, since one person's consumption does not interfere with another's. The conservation and sustainable use of public goods are problematic because there are no incentives to ensure their continued supply, since markets do not place a monetary value on their conservation and use, that is, they are non-market goods.[68]

99. Biological resources beyond national jurisdiction are resources shared by all States, also referred to in economic terms as "global commons". Markets treat shared resources as "free resources" available through an open access regime. Economic theory and evidence demonstrates that open access to such resources leads to inefficient exploitation to the point that no further surplus value can be

derived from these resources.[68] In fact, as the primary objective of market participants is maximization of individual wealth, the market's failure to place limits on the use of these resources will invariably result in their degradation.[69] Fishers who refrain from harvesting in order to promote conservation of a stock have no assurance that other fishers will not deplete the same stock.[68] From an economic point of view, it appears that the tools to deal with this problem include the assignment of property rights and the adoption of management rules to regulate access to the resources.[70]

2. Economic valuation of ecosystem services and biological resources

100. Two aspects of the valuation of ecosystem services and biological resources are often mentioned in literature. First, usually only market values are taken into account in decision-making regarding the use of marine biological diversity. Second is the issue of discounting. This procedure allows the conversion in mathematic terms of costs and benefits of a thing or activity at different points in time in the future to comparable costs and benefits at another point in time, such as in the present.[71] For example, while the cost of refraining from fishing in the present may appear great as compared to the benefit of harvesting in the future, the benefit of abundance of fish will be greater than it may appear now. The future benefit only looks small due to discounting, because it is so far away. Discounting is important for environmental policymakers as it could be used to reduce the urge to focus on the current or short-term cost of conservation and to avoid disregarding future and long-term benefits of maintaining biological resources. There is no agreement by economists on the discounting method to be used.

101. Lack of conservation measures for biological resources and ecosystems in general is also a result of gross undervaluation of biodiversity, especially of ecosystem services. There are many different values of biodiversity, some of which are not taken into account as modern economies focus on market transactions. As a result, goods and services that do not enter the marketplace and remain outside the traditional economic accounting system are largely overlooked.[71] Therefore, non-marketed ecosystem goods and services are not treated as a form of capital subject to depletion and depreciation. Countries depleting their natural resources can appear to be experiencing economic growth, but in reality the erosion of their natural wealth is not shown on their balance sheets.[71] Furthermore, as ecosystem goods and services are not traded in formal markets, they do not send price signals that warn of changes in their supply or condition, nor are people conscious of the role ecosystem services play in generating those ecosystem goods that are traded in the marketplace.[72] Thus, even if biodiversity is of great importance to society, its importance is not reflected in the marketplace and it appears that there is a lack of will to allocate adequate funding for its conservation. The lack of consideration for the effects of economic development on habitats and ecosystem services may create costs over the long term that may greatly exceed the short-term economic benefits of development. Hence, there is a need for policies that achieve a balance between sustaining ecosystem services while pursuing economic development.[72]

102. One way of achieving this balance is by placing a value on all the uses provided by ecological goods and services to enable policymakers to decide whether the resource is worth preserving, given the cost of its conservation. Calculating the total economic value of ecological goods and services is a difficult task. Economic values include direct use value, indirect use value, option value, bequest value and

other non-use value of ecosystem goods and services. Direct use values are those generated by ecosystem goods and services used directly by human beings. They include the value of consumptive uses, such as harvesting of food products and medicinal products, and the value of non-consumptive uses, such as the enjoyment of recreational activities that do not require harvesting of products. Indirect use values are those generated by ecosystem services that maintain the health of the ecosystem itself and provide outside benefits.[73] For example, marine ecosystems provide natural goods and services such as carbon storage, atmospheric gas regulation, nutrient cycling and waste treatment. Often the values of ecosystem services are not considered in commercial market analyses, despite their critical importance to human survival.[74] Option values are derived from preserving the option to use, in the future, ecosystem goods and services that may not be used at present. Many components of biodiversity that we do not use, or are unaware of at present, may in the future be used to meet human needs. For example, advances in molecular biology are leading to an acceleration in the use of genetic materials. The underlying genetic diversity of marine organisms therefore has tremendous potential economic importance that would not be realized by the loss of marine biodiversity. Bequest value is the value that captures the willingness to pay to preserve a resource for the benefit of future generations. Non-use values are values given to the enjoyment people may experience simply by knowing that a resource exists even if they never expect to use that resource directly themselves (existence value).[73]

103. The calculation of the total economic value offers a way to compare the diverse benefits and costs associated with ecosystems, by attempting to measure them and express them in a common denominator, typically a monetary unit.[73] It can also assist in determining whether the benefits justify the costs involved in the implementation of conservation measures. It should be borne in mind that the costs for conservation measures should include both the direct costs of implementing conservation measures and the opportunity costs of foregone uses. Furthermore, conservation measures may not conserve biodiversity in its entirety, depending on the measure adopted, and this must be taken into consideration when calculating the benefits. This cost-benefit analysis will allow for the identification and estimation of the impact that conservation measures will have.[73]

3. Economic value of biodiversity in areas beyond national jurisdiction

104. The economic value of biodiversity in areas beyond national jurisdiction is especially difficult to ascertain. One exercise found that marine systems contributed to around two thirds of the total value of global ecological services. It also showed that the areas beyond national jurisdiction had a very significant role to play. Although the exercise was theoretical and criticized by some scholars, it nevertheless provided an idea of the relative importance of the components of the biosphere.[75]

105. The commercial value or direct use value of ecosystem goods and services can be calculated to a certain extent by looking at the main commercial activities relating to biological resources currently being carried out in areas beyond national jurisdiction. For example, the commercial value of fisheries and bioprospecting can provide an idea of the direct use value of biodiversity, although the extent of bioprospecting activities currently being undertaken is unclear.

Fishing

106. In its publication *The State of World Fisheries and Aquaculture 2004*,[76] the Food and Agriculture Organization of the United Nations (FAO) reported that catches of oceanic species occurring principally in the high seas continued to increase. The share of oceanic catches in global marine catches reached 11 per cent in 2002.[76] In the same year, there was an increase in trade of oceanic species amounting to $5.9 billion. This state of affairs also causes increased pressures on fish stocks in areas beyond national jurisdiction. The actual value may be more than FAO estimates, as many catches are the result of illegal, unreported and unregulated fishing.

Bioprospecting

107. In order to provide an idea of the commercial value of bioprospecting beyond national jurisdiction, the broader context of the biotechnology sector needs to be considered[34] (see also paras. 77 to 93, above). As reported by the United Nations University (UNU) Institute of Advanced Studies,[34] according to the Ernst & Young global biotechnology market overview in 2004, the global biotechnology industry (not limited to marine biotechnology) supported almost 200,000 employees worldwide and generated revenues of up to $46.6 billion in 2003.[77] In connection with marine biotechnology, a 1996 study estimated that the worldwide sales of products related to marine biotechnology were expected to reach $100 billion by the year 2000.[78] Profits from a compound derived from a sea sponge to treat herpes were estimated to be worth $50 million to $100 million annually and estimates of the value of anti-cancer agents from marine organisms are up to $1 billion a year. However, it is not clear how many, if any, of these products use biological resources from areas beyond national jurisdiction. The UNU study demonstrates that, on the basis of an analysis of patent databases, bioprospecting for deep seabed genetic resources is taking place and related commercial applications are being marketed.[34] Furthermore, there are some patents involving genetic resources from the deep seabed where it is unclear whether practical applications for their use have been developed or not.[34] Bioprospecting activities may therefore create a market for genetic resources.

108. Bioprospecting, including the development and commercialization of products derived from genetic resources in areas beyond national jurisdiction involves very high costs (see paras. 83 to 90, above) and it is estimated that it may take approximately 15 years to produce results.[34] Furthermore, only 1 to 2 per cent of preclinical candidates actually become clinically produced.[34] Estimates for the costs of research and development to develop a new drug (not necessarily one related to marine biotechnology) presently range between $231 and $500 million to $800 million and $1.7 billion.[79] Due to the high costs involved, patenting is presently the main avenue for securing economic benefit as a return for investment.[80] The protection of inventions is granted for a limited period, generally 20 years.[81]

109. In the case of land-based bioprospecting, pharmaceutical companies have been willing to pay substantial sums for access to the regions where there is extensive inter-species competition and have made deals with host countries that involve giving them a royalty on the products that might eventually be based on this prospecting. In some cases, the terms of agreement for bioprospecting includes the

allocation of a fixed sum of money, to be used for conservation measures, in exchange for the right to receive samples from bioprospecting.[82] The UNU study highlights, however, that it appears that the extension of patentability of biological and genetic material has not been based on sufficient economic analysis and that the positive benefits expected from patent protection with regard to trade, foreign direct investment and technology transfer have not been evidenced.[34]

4. Possible economic tools for the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction

Environmental externalities

110. In the absence of suitable regulatory and enforcement mechanisms, people and companies can shift a part of the costs of their economic activities onto others.[68] For example, the environmental impacts resulting from their activities are often paid for by everyone affected, as there is often no liability as the damages may not be attributable solely to one person or company. As these costs are external to the costs people and companies pay to operate, they are in economic terms known as "externalities". It is important that those who exploit shared biological resources pay for the full cost of their acts, including any damage. Failure to do so will lead to overuse of the resources. The process for making economic actors recognize and assume responsibility for environmental and social costs is known as "internalizing externalities". This process should ensure that shared resources do not become over-exploited.

111. Some of the options for internalizing externalities are based on market approaches for the conservation of biodiversity. These approaches seek to change the users' behaviour through incentives, thus encouraging them to adopt more environmentally benign uses and discouraging them from engaging in harmful uses.[73] However, as the Millennium Ecosystem Assessment reported, there remain many challenges in implementing market-orientated approaches. These include the difficulties in obtaining the information needed to ensure that the buyers are indeed obtaining the services that they are paying for; the need to establish underlying institutional frameworks required for markets to work; and the need to ensure that benefits are distributed in an equitable manner.[3] Technical literature suggests several options for internalizing environmental externalities, some of which are outlined in the paragraphs below.

Elimination of perverse incentives

112. Perverse incentives such as subsidies to promote economic growth may discourage conservation. For example, perverse subsidies in fishing industries are incentives for fishers to overfish.[68] According to the Millennium Ecosystem Assessment report, fishery subsidies amounted to approximately $6.2 million in Organization for Economic Cooperation and Development (OECD) countries in 2002, or about 20 per cent of the gross value of production. The report added that many countries outside the OECD area also have inappropriate input and production subsidies.[3] Estimates of global industrial fisheries subsidies vary between $15 to $30 billion each year.[83] The Millennium Ecosystem Assessment highlighted the need to eliminate subsidies that promote excessive use of ecosystem services and, where possible, to transfer those subsidies to payments for non-marketed ecosystem services.[3] The issue of subsidies that lead to illegal, unreported and unregulated

fishing and fishing overcapacity was addressed by the General Assembly in its resolution 59/25 of 17 November 2004 and, more recently, at the sixth meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (see A/60/99).

Reforming tax systems

113. Certain types of tax can be adopted to correct market failures. In particular, placing taxes on polluting materials, wastes, emissions and other activities and products, could internalize externalities. It has been suggested that such taxes could raise revenues while also raising economic efficiency.[68] Furthermore, Governments could impose mitigation and restoration requirements on both public and private projects to facilitate the restoration of ecosystem services that a project might affect.[68] Taxes could also be placed directly on resources, as a form of rent on resource extraction. The failure to collect resource rents from exploitation of common resources has generated excessive profit-seeking behaviour without proper consideration for the environment. Revenues from these charges would raise additional funds that could be used for conservation projects, while discouraging environmentally damaging activities.

Payment for environmental services

114. Payments for environmental services are based on the idea that those who provide environmental services should be compensated for doing so and that those who receive the services should pay for their provision.[84] Examples include pollution charges (paying those who minimize pollution) and eco-labelling and certification schemes for environmentally friendly goods in order to allow consumer preferences to be expressed through markets (for example, dolphin friendly tuna).[3]

Property rights over the "commons"

115. Some experts believe that replacing open access with some form of property rights could stimulate economic measures for protection of ecosystems.[68] This enables the creation of markets, based on the premise that holders of these rights will maximize the value of their resources over time, thereby optimizing biodiversity use, conservation and restoration.[85] In the case of resources beyond national jurisdiction, these property rights would have to be in conformity with the existing legal framework.

116. Licences that establish a form of property rights and encourage sustainable use, rather than serving only to collect revenue, act as incentive mechanisms. The longer the term of the licence, the more likely the user will have a long-term interest in the area and therefore an incentive to use the resources sustainably, that is, self-regulation. Instruments that promote self-regulation may be useful, especially in areas beyond national jurisdiction where it is more difficult to enforce protection measures.[86]

117. By assigning property rights within the existing and future management regimes established by the Regional Fisheries Management Organizations, systems such as individual transferable quotas and cap-and-trade systems could be set up to promote the conservation and sustainable use of the resources in question by promoting a sense of ownership by all stakeholders. Shares and quotas can be transferred, divided and bought or sold. They can also be leased or mortgaged, like

other types of property rights.[87] Limits can be placed on their transferability to ensure equity, if necessary. In the example of fisheries, management regimes for commercial fisheries can be shifted from effort control to transferable harvest quotas, defined as shares in the total allowable catch. By securing harvest shares in the total allowable catch, fishers are provided with an economic incentive to build or rebuild stocks to optimum levels since they are assured a fair share in the derived benefits.[68]

118. The establishment of appropriate forms of property rights, in conformity with the international legal regime, could also constitute a basis for the development of exchange markets. Exchange markets have been established for environmental commodities, such as credits for sulfur dioxide, the gas largely responsible for acid rain. Other examples include markets for nitrogen oxide, wetland mitigation credits, particulate matter and volatile organic compounds. The biggest emissions market, however, for carbon dioxide, the gas believed to be most responsible for global climate change, is still in its earliest phases. The carbon market, which follows the emissions trading approach of the United Nations Framework Convention on Climate Change[88] and its Kyoto Protocol,[89] is rapidly becoming a global market. Similar types of markets could be envisaged to stimulate biodiversity conservation.

D. Socio-economic issues

119. Knowledge about the socio-economic importance of marine biological diversity beyond national jurisdiction is necessary in order to formulate policies dealing with the conservation and sustainable use of those resources. However, preliminary research indicates a lack of relevant in-depth studies. This dearth of information can be explained by various reasons, including the fact that interest in marine biodiversity, and specifically marine biodiversity in areas beyond national jurisdiction, is relatively new.

120. In addition, difficulties arise when trying to assess the socio-economic benefits of marine biodiversity, since a comprehensive evaluation of marine biodiversity is, for the moment, impossible owing to a lack of basic knowledge. It is difficult to relate the provision of goods and services to biodiversity, as the link between biodiversity and ecosystem functioning is not clearly understood.[90]

121. Despite these difficulties, it is generally understood that ecosystems, including marine ecosystems in areas beyond national jurisdiction, play a key socio-economic role. Socio-economic goods and services provided by living marine environments include employment, food, raw materials, leisure and recreation, cultural services, information services (genetic and medicinal resources), education, research, aesthetic, inspiration and other non-use values and option-use values. Thus, marine ecosystems not only provide us with an array of goods and services that are essential to a healthy environment, but they also contribute significantly to food security and global employment.[91] As a consequence, their degradation often causes significant harm to human well-being, including livelihoods and health.[91] Two examples from marine ecosystems clearly illustrate the above. The first example is the collapse in the early 1990s of the Newfoundland cod fishery because of overfishing, which resulted in the loss of tens of thousands of jobs and cost at least $2 billion in income support and retraining. In the second example, the total damages for the Indian

Ocean region over 20 years resulting from the long-term impacts of massive coral bleaching in 1998 are estimated to be between $608 million and $8 billion.[91]

122. Socio-economic goods and services are easily identifiable in the cases of fisheries and marine genetic resources. Fisheries represent an important source of employment and income. FAO has estimated the number of individuals earning an income from primary sector employment in fisheries and aquaculture at around 38 million in 2002.[76] Fish also represents a valuable source of micronutrients, minerals, essential fatty acids and protein in the diet of people in many countries. Overall, fish provides more than 2.6 billion people with at least 20 per cent of their average per capita intake of animal protein.[76] The declining state of capture fisheries threatens to reduce a cheap source of protein in developing countries[91] and also has major implications for artisanal fishers and the poor.[3] The conservation of fishery biodiversity is the sine qua non condition for the existence of fisheries as an economic activity and for the livelihoods of many fishing communities. Nonetheless, there are few socio-economic studies available and these aspects tend to be underrated or neglected in the debates regarding management of high-seas fisheries.[92]

123. The analysis of future population growth trends indicates a need for the adoption of conservation measures that will take into account the socio-economic impact of marine biological diversity beyond areas under national jurisdiction. According to United Nations estimates, by 2050 the world population is projected to reach 9.1 billion persons, 2.6 billion more than in 2005. Most of this growth will be in developing countries.[93] Lastly, projections show that most of the population growth will be coastal,[94] thus putting additional pressure on marine ecosystems.

124. In consequence, world total demand for fish and fishery products is projected to expand by almost 50 million tons to 183 million tons in 2015.[94] On the other hand, world capture production is projected to stagnate,[94] and demand would tend to exceed potential supply.[94] According to the latest projections of FAO,[76] there would be a global shortage in the supply of fish in the future, the overall effects of which would be a rise in the price of fish.[95] Reduction in fish supply would also have negative effects on food security and livelihoods among other things.

125. As regards genetic resources found in marine areas beyond national jurisdiction, they are expected to become an important socio-economic issue because of the social gains that would result from the numerous products derived from them (see also paras. 88 to 90, above). The pace of discovery of new species, as well as of products that are potentially useful to pharmacology, is higher for marine and microbial life than for terrestrial organisms.[34] The pharmaceutical industry has identified a number of uses for these new species and products. Marine drugs obtained from these and other organisms could be used as antioxidants, antifungals and antibiotics and to fight diseases such as HIV/AIDS, cancer, tuberculosis, malaria, osteoporosis, Alzheimer's and cystic fibrosis. Some of these drugs are at the preclinical development phase.[34] Much hope is placed in drugs based on marine organisms in light of the shortcomings of current drugs.

126. Other industries could also benefit from discoveries made in marine environments beyond national jurisdiction. Among the many examples of commercially useful compounds that have been discovered is a glycoprotein which functions as the "anti-freeze" that circulates in some Antarctic fish, preventing them from freezing in their sub-zero environment. The application of this glycoprotein in

a range of processes is being considered, including to increase the freeze tolerance of commercial plants; to improve farm-fish production in cold climates; to extend the shelf-life of frozen food; to improve surgery involving the freezing of tissues; and to enhance the preservation of tissues to be transplanted.[34]

127. In sum, potential uses of marine organisms are numerous. The possibility that certain types of bacteria could be useful in dealing with marine pollution, especially oil spills, is currently being investigated. Furthermore, oceans have been characterized as an infinite reservoir of high-quality food, anti-biofouling and anti-corrosion substances, biosensors, biocatalysts, biopolymers and other industrially important compounds.[78]

E. Environmental issues

128. The high seas and the ocean floor beyond national jurisdiction are the least explored areas on the planet. They are believed to contain vast energy and mineral resources and to shelter major biological resources. Furthermore, the oceans in general, including areas beyond national jurisdiction, play a key role in the biogeochemical cycles that regulate oxygen and carbon dioxide in our atmosphere and hence global climate and the very continuation of life on Earth. However, marine biodiversity and ecosystems in these areas are increasingly affected by a wide array of anthropogenic stresses.

129. As pointed out in the preceding sections of the present report, the conservation of marine biological resources and their sustainable use are closely interrelated. Therefore, potential adverse impacts caused by various ocean uses on marine biodiversity need to be identified and managed.

130. The present section will outline the main current and foreseeable impacts on marine biodiversity in areas beyond national jurisdiction. Human activities already affecting marine biodiversity must be properly managed in accordance with existing legal regimes in order to minimize their impact and to ensure sustainable use of marine biodiversity. Furthermore, emerging activities should be assessed for possible impacts, in order to enable the development of an appropriate regime to ensure that biological resources are not destroyed and that any development is sustainable. Activities and phenomena that could have an impact on marine biodiversity include fishing, climate change, pollution, the introduction of alien species, waste disposal, mineral exploitation, anthropogenic underwater noise, marine debris, scientific research, carbon sequestration, tourism and pipelines and cables.[96]

131. To meet these environmental challenges, more research is needed to assess the biogeography of the deep sea floor biota and the distribution of key habitats as well as the impacts of anthropogenic stresses on deep-sea biota. The few well-established studies on the deep-sea and open-ocean ecosystems should be continued.

1. Impacts of fishing

132. By and large, the dominant human-caused direct effect on fisheries ecosystems is fishing itself,[97] thus making the global impact of fishing activities on marine ecosystems a major concern for the international community. As an anthropogenic activity in the marine environment, fishing affects marine habitats worldwide and

has the potential to alter the functioning and state of marine ecosystems, in particular vulnerable ecosystems as well as the biodiversity associated with them. Compounding the effects of fishing activities on the marine environment, unsustainable fishing practices, such as over-exploitation of fishery resources, illegal, unreported and unregulated fishing, the use of non-selective fishing gear, as well as destructive fishing practices and techniques in fishing operations, have aggravated the ecosystem effects of fishing activities and made such fishing practices the single greatest risk to vulnerable marine ecosystems and associated biodiversity.

133. According to the most recent information from FAO, reported landings of fish have continued to grow, albeit at a lower rate than in preceding decades. They are now oscillating around 80 million tons. If China, a large producer, is excluded, the production of the rest of the world decreased by about 10 per cent since the mid-1980s.[76] Reported landings of distant-water fishing have also been decreasing since the mid-1980s, after a plateau of 20 years at 7 million tons. As a percentage of total world landings, they have been sharply declining since 1970 with the extension of exclusive economic zones.

134. Fishing pressure on stocks is generally high. While close to 25 per cent of stocks are moderately or under-exploited, 52 per cent of the stocks are fully exploited and 25 per cent of them are over-exploited, depleted or recovering. Considering stocks for which information is available, overfishing appears widespread and the majority of stocks are fully exploited. The percentage of stocks exploited at or beyond their maximum sustainable levels varies greatly by area. Assessments regularly conducted on the 17 major tuna stocks indicate that close to 60 per cent requires stock rebuilding and/or reduction of fishing pressure. Analysis of FAO statistics indicate that overfishing has increased from 1950 to 1990 and has been stable since 1990 at about 25 per cent. A small proportion of stocks appear to be recovering. Top predators, medium-level predators, as well as sub-surface pelagic and deep-sea resources, show similar trends. In addition, overfishing tends to lead to decline in these large predatory fish so that the relative numbers of low trophic-level small fish and invertebrates increases. This also leads to a phenomenon known as “fishing down marine food webs”, whereby second-level marine life preyed upon by the fish at the top of the trophic levels are increasingly used for human consumption, thus causing further disruptive effects on the whole food chain.

135. The World Summit on Sustainable Development called for recovery of overfished stocks by 2015. Considering the stagnation observed, a very serious change is required if the goal is to be reached.[98] As to the impact of fishing on dependent and associated species, what is required is the implementation of existing measures, both legally binding and recommendatory, which mandate States to eliminate unsustainable fishing practices and develop selective, environmentally friendly and cost-effective fishing gear and techniques, as well as the application of the ecosystem approach to fisheries management.

Pelagic fisheries

136. In high-seas pelagic fisheries, catches of tuna and tuna-like species have been increasing throughout the years. The rate of increase has been much higher in comparison to other epipelagic species and tuna catches are still growing at a rapid pace, while those of other species have decreased in recent years.[99] Trends in catch

per unit effort over nine oceanic areas indicate that tuna and billfish biomass has declined by approximately 90 per cent, with a shift towards dominance by smaller pelagic species.[100] Reduction of fish stocks below 30 per cent of their unfished biomass is generally not considered sustainable.

By-catch

137. Pelagic open-ocean fisheries seriously affect several groups of species, such as whales, sharks, seabirds, dolphins and turtles, whose biological characteristics render them vulnerable to depletion or even extinction. Oceanic sharks, primarily blue (*Prionace glauca*), oceanic whitetip (*Carcharhinus longimanus*), and silky shark (*Carcharhinus falciformis*), are taken in large numbers as by-catch of longline fisheries and their highly prized fins are removed. This catch is largely unreported and unregulated.[101]

138. Seabirds are taken as incidental by-catch by pelagic longliners, most notably those targeting tuna and toothfish in the Southern Ocean.[102] Albatrosses are particularly vulnerable, as they are long-lived and slow-breeding. Modifications to longline equipment and deployment techniques as well as other mitigation measures are being implemented to reduce seabird by-catch. FAO has adopted international plans of action for both seabirds and sharks that should assist in reducing the incidental catch of these two species in longline fisheries.

139. All seven species of sea turtle are endangered and some are on the verge of extinction. Among the major threats to sea turtles are incidental capture and drowning during commercial fishing with gill nets, shrimp nets, trawls, set nets, traps and longline equipment. Modifications to fishing equipment, such as the use of circle hooks and whole-fish bait, could substantially reduce sea turtle mortality.[103]

140. The death of large numbers of dolphins caught as by-catch by purse-seiners targeting tuna in the late 1960s alarmed the public and led to government action to modify net design and fishing practices, which have reduced dolphin by-catch to a level of mortality considered to be sustainable. However, by-catch problems remain for juvenile tuna, endangered turtles and other non-target species attracted to logs and other floating objects associated with some tuna schools.

Drift nets

141. Drift gill nets up to 60 kilometres in length were used to fish for dispersed species of salmon, squid, tuna and billfish on the high seas until General Assembly, in its resolution 46/215 of 20 December 1991, called on the international community to ensure that a global moratorium on the use of large-scale pelagic drift-net fishing on the high seas was implemented. An estimated 40 per cent of the catch by this type of equipment was unwanted catch, including sea turtles, seabirds and marine mammals.[104] Although the moratorium has been widely observed, recent reports indicate that some drift-net fishing may still occur, particularly in the Mediterranean Sea.[105]

Deep sea fisheries

142. Until 1975, catches of deep-water species were relatively small, ranging between 2 and 10 per cent of the total oceanic catches. Since the late 1970s, however, their contribution has consistently been greater than 20 per cent, reaching

30 per cent of the total oceanic catches in recent years. The life history attributes of deep-sea fish species (long lifespan, high age at maturity, low natural mortality, low fecundity, low levels of recruitment, high inter-annual variation in recruitment and aggregation over small areas) make them highly vulnerable to depletion by fishing. A reduction of adult biomass by fishing may have a stronger negative effect on deep-sea fish species than for species living on the shelf.[107] This would mean that exploited populations of deep-sea fish species are likely to reduce quickly and take decades, or longer, to recover. For instance, some species, such as orange roughy, become more vulnerable by aggregating on isolated topographic features, such as seamounts.

143. Deep-trawl fisheries, which target bottom fish species on the high seas, are largely unregulated and unreported fishing activities. Often important biological information relevant to the conservation and management of target species has simply not been collected prior to commencement of the fisheries or following the exploitation of specific deep-sea areas. Deep-water fisheries tend to be more intermittent, less predictable and so less manageable than shallow-water fisheries. They are often characterized as being "serial" or "sequential depletion" fisheries, because fishing vessels find and deplete a stock then move on and repeat the practice.[108] Altogether, it is believed that 62 deep-water species have been fished commercially. Owing to their biological characteristics, most target species are easily over-exploited. Stocks are typically depleted within 5 to 10 years. Some scientists believe that all deep-sea fisheries present in 2003 will be commercially extinct by 2025.[109]

144. In addition, bottom fisheries are known to induce considerable damage to benthic habitats and other underwater features.

145. Deep-water fisheries often target features, such as seamounts and ridges, where food inputs advected by topographically enhanced currents support benthic communities dominated by hard and soft corals, sponges and other suspension feeders. Bottom trawls pick up these benthic communities as by-catch or otherwise reduce them to rubble.[110] Given the slow growth of deep-water corals and uncertain rates of recruitment, the re-establishment of deep-water coral reefs will probably take centuries to millennia. Continued unrestricted fishing could destroy reefs in many areas, leading to extinction for the large proportion of seamount species with highly restricted distribution. Management of bottom trawling has been considered by the General Assembly (see resolution 59/25) and control measures have been taken by some States and regional fisheries management organizations. The issue was also discussed at the sixth meeting of the Informal Consultative Process (see A/60/99).

146. In March 2005, the FAO Committee on Fisheries called on member States conducting deep-sea fisheries on the high seas, individually and in cooperation with others, to address adverse impacts on vulnerable marine ecosystems and to manage sustainably the fishery resources being harvested, including through controls or limitations on new and exploratory fisheries.[111]

2. Whaling and whale falls (sunken whale carcasses)

147. Since the 18th century, whaling has depleted most populations of the larger baleen whale species, eliminating some, such as the North Atlantic grey whale, and driving many others to the verge of extinction. Since the International Whaling

Commission moratorium on commercial whaling, several species now appear to be recovering, although the recovery baseline remains controversial.[112] Current major threats to some populations of whales and other cetaceans are from by-catch, ship strikes, anthropogenic underwater noise, entanglement in fishing equipment and alteration of habitats.

148. The dramatic reductions in populations of great whales could result in species extinctions in seabed ecosystems.[113] Sunken whale carcasses harbour species of invertebrates that must colonize a whale fall to complete their life cycles.[114] Because major habitat loss leads to species extinction, loss of 65 to 90 per cent of whale-fall habitat may well drive 30 to 50 per cent of the whale-fall species extinct.[115]

3. Impacts of climate change

149. Climate change has potentially a great impact on the open-ocean and deep-water environment. The earth has warmed by approximately 0.6° centigrade in the past century and since 1976 the rate of warming has exceeded that at any time during the last 1,000 years.[116] During the past 50 years, a general warming trend has also been documented for large portions of the oceans. One of the consequences of that development for ocean ecosystems could be the partial or complete shutdown of global thermohaline circulation, predicted by several global circulation models.[117] This would alter the currents, oxygenation and temperature of the deep ocean, as well as the productivity of near-surface waters. A recent study predicted that a shutdown of the North Atlantic overturning would cause plankton biomass to decline by more than 50 per cent and global ocean productivity to decline by about 20 per cent.[118] Biogeochemical models generally predict that climate warming will enhance ocean stratification and decrease overturning and hence lead to diminished ocean productivity.[119]

150. The influences of changing climate on regional patterns of circulation, upwelling, production and community structure in the surface ocean are difficult to predict, in part because the ocean-atmosphere system exhibits natural patterns of regional and basin-scale variability over time scales of years to at least several decades.[120] These mini-climate changes induce substantial alterations in the patterns of marine primary production, the structure of phytoplankton, zooplankton, nekton and megabenthic communities, fish recruitment, fisheries yields and the regional abundance and reproductive success of seabirds and marine mammals.[121] While these natural changes obscure the effects of anthropogenic global warming, they clearly demonstrate that ocean ecosystems are highly sensitive to subtle changes in climate and that regional patterns of ecosystem structure, production and biodiversity will be altered substantially as the climate warms.

151. The most dramatically affected marine ecosystems in international waters are likely to be those associated with sea ice. The structure and dynamics of sea-ice communities are linked to seasonal freezing and thawing of seawater and to the steep physical gradients resulting from phase changes and brine formation around sea-ice margins.[122] Sea-ice biota exhibit unique adaptations to their solid/liquid habitat. Sea-ice margins are zones of enhanced productivity and the focuses of population growth, feeding and/or reproduction for a diverse range of organisms, including ice algae, krill, penguins, pinnipeds, cetaceans and polar bears. The size of sea-ice zones and the length of their margins are likely to decrease dramatically

with climate warming, shrinking habitats and threatening the biodiversity of these fragile ecosystems.

152. The fluid nature and great spatial scales of the ice-free upper ocean are likely to allow marine organisms to move to new areas in response to climate changes, with the result that local community structure and function may change; but extinctions of pelagic species may seem unlikely in international waters as the climate warms. The ranges of some species will be compressed and others expanded and some populations will lose essential linkages to particular oceanographic structures, such as fronts and upwelling zones, disrupting life cycles and yielding population, and possibly species, extinctions. This has already happened in the North Sea.[123] Furthermore, continuing fishing pressure on stocks dwindling as a result of climate change, in combination with the synergistic effects of multiple stressors, such as pollutant loading, could very easily drive certain open-ocean species, including non-target species affected by indirect fishing impacts, over the edge to global extinction.[124] This threat is probably greatest for species placed high in marine food webs, whose populations often show pronounced fluctuations in response to natural climate variability. In addition, elevated atmospheric CO_2 concentrations will most probably increase ocean acidity, which may impede calcification processes in a broad range of open-ocean phytoplankton and zooplankton, as well as corals, potentially altering pelagic ecosystem function and biodiversity in the open ocean.[125]

153. Deep sea-floor and mid-water communities will also be affected by climate change. In particular, many deep sea-floor biological processes appear to be linked to the quantity and quality of food material sinking from the euphotic zone, as well as to the variations in sinking flux.[126] Climatic changes resulting in decreased near-surface productivity and deep organic-carbon flux may lead to reductions in benthic standing crops, bioturbation rates and depths and carbon sequestration in deep-sea sediments.[127] However, the resulting changes in ecosystems are very difficult to evaluate until ranges, population structure and rates of gene flow at the deep-sea-floor, both on slopes and in the abyss, are much better known. Healthy ecosystems have a significant capacity both to resist and to recover from periodic disturbances, such as population collapses owing to shifts in currents and changes in sea temperature. Unhealthy ecosystems have a limited capacity to do so. Therefore, the maintenance of ecosystem resilience through the minimization of other major human-induced impacts on marine ecosystems and species would enhance adaptation strategies to climate change.

4. Impacts of non-point source pollution

154. Heavy metals, especially mercury, and halogenated hydrocarbons, such as polychlorinated biphenyls (PCBs), dichlorodiphenyl trichloroethane (DDT) and similar compounds, are semi-volatile and thus are globally distributed via the atmosphere and largely deposited in the oceans. About 80 per cent of PCBs and 98 per cent of DDT and related compounds enter the ocean through the atmosphere.[128] Relatively insoluble in water but lipophilic, they are rapidly taken up by the marine biota, transported to deep water and concentrated in long-lived top predators, where they then become available to humans. A number of highly persistent pollutants appear to be at critical or near-critical levels in deep water organisms, as well as in marine mammals and turtles. These also pose risks to human health. The mercury content of tuna, swordfish, orange roughy and similar

fish now poses a health risk, particularly to women of childbearing age. Environmental concentrations of mercury have tripled in historic times, but production is now being reduced. Use of DDT and PCBs has largely been phased out, but these are highly persistent pollutants.

155. The potential pollutant effects on the behaviour, physiology, genetics and reproduction of open-ocean operations and deep-sea biota remain very poorly known.[129] In addition to metals and chemicals transported from the land to the sea through the atmosphere, diffuse discharges of oils, chemicals, sewage and refuse directly from land-based activities and from ships can have a cumulative impact on the general pollution load of the oceans. However, all of the above effects can be addressed through implementation of the relevant provisions of UNCLOS, proper national management of land-based activities, as recommended in the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, and more effective enforcement of existing shipping regulations.

5. Effects of shipping, including species introduction

156. Ships transport approximately 90 per cent of world trade. Intentional and accidental discharges can have serious effects on biological resources, although this could be avoided by strict enforcement of international regulations adopted by the International Maritime Organization (IMO). Accidental oil spills from tankers can have a catastrophic local impact on marine ecosystems. If large spills occur near oceanographic features where biological activity is concentrated, such as in convergence zones, near sea-ice fronts and in polynyas (areas of open water surrounded by sea ice), they could have substantial negative effects on marine biodiversity. Such effects may be particularly persistent at high latitudes, where low temperatures impede the microbial breakdown of toxic hydrocarbons. Ships may also cause harm to marine organisms and their habitats through physical impact, including ship strikes, in particular with whales, as mentioned in paragraph 147 above.

157. Since 1914, more than 10,000 ships have sunk to the sea floor as a result of warfare and accidents.[130] Although the impact of shipwrecks has not been extensively studied, they may generate reducing habitats[131] and release petroleum hydrocarbons and other pollutants.[132] The scale and duration of such effects merit further study.

158. Ships also affect biodiversity through the release of alien invasive species transported in ballast water and in fouling assemblages on ship bottoms.[133] The threats to biodiversity from invasions of alien species in the high seas are believed to be substantially less than in coastal waters, because natural ocean circulation causes biotic exchanges over vast scales. However, the open ocean contains distinct biogeographic provinces (or biomes), separated by land masses, underwater topography and major circulation features and characterized by distinct production cycles.[134] Consequently, species introduction between ocean basins with similar oceanographic regimes could have adverse effects on biodiversity in the open ocean.[135] This issue is being addressed through the International Convention for the Control and Management of Ships' Ballast Water and Sediments.[136]

6. Anthropogenic underwater noise

159. Noise levels in the ocean are increasing dramatically from human activities such as shipping (propellers, machinery and hydrodynamic flow over the hull of ships); oil and gas exploration (explosives and seismic air guns), scientific research and military operations (sonar). Recent estimates suggest that in some ocean basins such as the North Atlantic, the level of ocean noise is doubling every decade. Research using large-scale underwater listening systems reveals that many large cetaceans (including endangered species of balaenopteridae), under natural conditions, communicate and orient acoustically over scales of thousands of kilometres in the ocean, for example detecting topographic features more than 500 kilometres away. The increasing levels of anthropogenic noise in the oceans constitute smog for acoustically active species, obscuring acoustic signals potentially critical to migration, feeding and reproduction. Other observed effects include stranding and displacement from habitat, tissue damage and mortality (see A/59/62/Add.1, para. 220). Fish are also damaged by noise and this may reduce fish catches. Better assessment of the impacts of underwater noise on acoustically sensitive oceanic species, including both fish and cetaceans, as well as consideration of noise abatement strategies, are needed. In the past two years, concern regarding marine noise has been expressed in meetings of the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas, the International Whaling Commission, the European Parliament, the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area and the World Conservation Union.[137] However, there is no international instrument directly aimed at controlling underwater noise. The sixth meeting of the Informal Consultative Process has proposed that the General Assembly should request further studies and consideration of the effects of ocean noise on marine living resources.

7. Effects of waste disposal

160. The high seas have been a dumping ground for conventional and chemical weapons,[138] low and intermediate-level radioactive waste and other types of hazardous materials. Although dumping of hazardous waste is prohibited under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention) and regional agreements, there have been proposals to dump sewage sludge, dredge spoils and other hazardous wastes in deep ocean trenches. Such disposal could cause future environmental concerns if the London Convention and its 1996 Protocol are not properly implemented and enforced.

8. Carbon sequestration

161. Because of the effects of rising atmospheric CO_2 concentrations,[139] some States are considering the large-scale sequestration of CO_2 in the ocean. Detailed analyses of these sequestration strategies and their impacts on the ecosystem will be available in September 2005 with the release by the Intergovernmental Panel on Climate Change of a special report on carbon dioxide capture and storage and the planned publication in 2006 in the Journal of Geophysical Research of the results from the UNESCO symposium on the ocean in a high CO_2 world.

162. One proposal with potentially far-reaching implications for open ocean ecosystems is to drawdown atmospheric CO_2 by fertilizing large areas of the open

ocean with iron.[140] However, biogeochemical models indicate that iron fertilization, even if carried out on a massive scale, may have only a modest impact on atmospheric CO_2 levels (17 per cent or less) and that the CO_2 would return to the atmosphere within decades.[141] Furthermore, iron-enrichment studies in equatorial and antarctic waters indicate that even short-term iron enhancement can dramatically alter community structure and potentially, carbon export, in iron-limited ecosystems.[142] The efficacy and environmental impacts of such projects should be adequately assessed.

163. Direct injection of CO_2 into the deep ocean is being considered for ocean depths greater than 500 metres, where CO_2 may exist in liquid or solid gas-hydrate form.[143] The principal impact on mesopelagic and benthic ecosystems is likely to be reduced pH values and, for those organisms directly in the path of the CO_2 plume, physiological stress caused by an elevated partial pressure of CO_2. If industrial-scale disposal of CO_2 were to occur in the deep sea, it is clear that few organisms in the direct path of the concentrated plume would survive. Far-field impacts on biodiversity are also expected, with the spatial scale of effects depending on the size of the injection operation and the nature of advection and eddy mixing processes in the injection zone. Because sensitivities to elevated CO_2 concentrations can vary substantially among major mid-water and benthic taxa, community structure and biodiversity levels could change over areas substantially larger than those directly affected by the toxic plume itself. Substantially more research is required to evaluate fully the potential local and regional impacts of CO_2 injection in the deep ocean.[144]

164. Most recently, the Scientific Group of the London Convention has studied proposals for carbon sequestration in geological structures under the ocean floor.[145] While it is intended that the CO_2 would be trapped in these structures, if it escapes, the consequences could be similar to those of deep injection.

9. Energy and mineral exploration and exploitation

165. Exploration and exploitation of the substantial mineral and energy resources on the seabed could potentially have significant effects on high-sea and seabed ecosystems. However, proper regulation and management could prevent or mitigate these effects. Under UNCLOS, the International Seabed Authority has the authority to regulate mineral exploration and exploitation in the International Seabed Area and the protection of the marine environment from harmful effects that may arise from activities in the Area, as defined in the Convention.

Oil and gas exploration and exploitation

166. Large oil reserves have been discovered in water depths exceeding 1,000 metres on several continental margins,[146] generating substantial interest in the expansion of oil and gas production in the International Seabed Area. Environmental effects of oil and gas production are reasonably well-studied at shelf depths and many such effects should be qualitatively similar in the deeper waters. However, the relatively low productivity and slow growth rates of high-seas species and low current velocities in many deep-sea habitats mean they will be more sensitive to disturbance and recover more slowly.[115] Drill cuttings and drilling mud may pose a significant risk to marine life[147] through physical smothering, organic enrichment and chemical contamination by hydrocarbons, heavy metals, special

chemicals and sulphides of the benthos near the cutting source.[147] Experimental studies indicate that drilling muds can inhibit the settlement of marine invertebrate larvae. The environmental impacts of effects drilling should be assessed and ways found to mitigate them.

Methane hydrates

167. Methane hydrates in the deep seabed are likely to be exploited for energy in the future, as they potentially contain twice as much carbon as all other fossil fuels combined.[143] Once exploitation technology for methane hydrates is better established, environmental impact assessments should consider the potential impacts on the novel biota associated with hydrates.

Polymetallic nodule mining

168. Polymetallic nodules, which abound on the abyssal plain in the Area,[148] are a potential source of copper, nickel, manganese and cobalt.[143] The most obvious direct consequence of mining would be the removal of the nodules themselves, which would require millions of years to regrow.[149] Nodule mining would thus essentially permanently remove the only hard substrate present over much of the abyssal sea floor, causing habitat loss and local extinction of the nodule fauna, which differs markedly from the sediment fauna.[150]

169. Because polymetallic nodules are imbedded in sea-floor sediments, nodule mining activities also will inevitably remove much of the top five centimetres of sediment, potentially redistributing this material into the water column.[130,151] Most sediment-dwelling animals in the path of the collector, with the possible exception of nematodes, will be killed immediately and communities in the general mining vicinity will be buried under varying depths of sediment.[130,152] Because abyssal nodule habitats are dominated by very small and/or fragile animals feeding on a thin veneer of organic matter near the sediment-water interface, it has been postulated that the mechanical and burial disturbances resulting from commercial-scale nodule mining will be locally devastating.[153]

170. Nodule mining is also likely to involve discharge of nutrient-rich deep-ocean water, sea-floor sediments and nodule fragments into the surface and/or deep layers of the water column. The location and scale of such discharges will depend on mining technology but they could affect large areas — hundreds to thousands of square kilometres at any given moment. The injection of nutrients, particles and heavy metals from nodule mining into the euphotic zone has the potential to alter dramatically light and productivity regimes, food-web structure, particle export and heavy-metal loading within the zone of influence of the plume. The ecological impacts of nodule discharge on mid-water communities, including those in the oxygen minimum zone, are even more difficult to predict because of extremely limited understanding of the structure and function of these ecosystems. As mining technologies and discharge rates and patterns become better constrained, process studies to address the nutrient and toxicant loading effects of mining discharges will be essential to evaluate threats to biodiversity in the water column. Similar effects from discharges into the water column are likely to occur with mining of polymetallic sulphides and cobalt crusts.

171. To predict and manage commercial mining impacts fully, substantially more information is required concerning (a) species ranges and rates of gene flow for both

the sediment and nodule biota; (b) sensitivity of sea-floor biota to sediment burial; and (c) the spatial-scale dependence of recolonization in abyssal benthic communities. The International Seabed Authority has sponsored a number of scientific studies and workshops on the seabed environment and the potential effects of mining as the basis for regulations that are protective of the environment.

Polymetallic sulfide mining

172. Polymetallic sulphide deposits at hydrothermal vents in the deep sea have recently attracted commercial interest as sources of gold, silver, zinc, lead, copper and cobalt.[143] These deposits are generally associated with mid-ocean ridge or back-arc spreading centres and often occur in the Area. Current commercial interests focus on the massive sulphides around inactive hydrothermal sites at bathyal depths in the territorial waters of New Zealand and Papua New Guinea.[154] Mining of massive sulphides at active vents would undoubtedly be harmful to the local vent communities. However, the impacts of vent mining would differ dramatically from those of nodule mining because new vents would probably form quickly following mining and recolonization of local vent sites, once mining ceased, is expected to proceed rapidly.[155] However, if sulphide mining targeted much larger areas or isolated geologic features with potentially endemic fauna such as calderas on seamounts, there could be a significant risk to biodiversity. Any mining operation for deep-sea massive sulphides should be preceded by a detailed study of the composition and broad-scale distribution of the vent and non-vent biota of the region and at the targeted vent sites.[156]

Cobalt-rich ferro-manganese crusts

173. Cobalt-rich ferro-manganese crusts are found on hard-rock substrates on seamounts, ridges and plateaus. Seamount mining would involve the removal and loss of the biological resources living above, within and alongside the crusts, which can be quite thick. Presumably, mining the crusts and transporting them to the surface would also release sediments and metal species onto adjacent areas of the seamount and into the water column, with a potential impact on the primary production and grazing of fauna in the area, possibly even resulting in extinction. The probable time scale for recovery of the seamount fauna needs to be assessed, on both mined and adjacent areas. While mining of crusts may be far more localized than that of nodules, the distribution of seamount benthic species may also be far more restricted.[115] Management of mining effects must also take account of fishing activities.

10. Marine scientific research

174. Marine scientific research is essential in order to understand marine ecosystems, discover sustainable uses of biological resources and assess the potential effects of other ocean activities. However, if not conducted with due care, scientific research itself could have an adverse impact on marine biodiversity and ecosystems. Research vessels and equipment could cause disturbances in the water column and on the seabed, especially with frequent visits and repeated sampling of the same areas. Research activities on the seabed could alter environmental conditions and cause perturbations harmful to organisms similar to those of seabed mining. Even the introduction of light, noise and heat in areas where these are absent could cause stress to organisms in the area. Smothering, physical disturbance

from sediment removal or spreading, the deposit of debris and chemical or biological contamination also have an impact on biodiversity. Finally, the removal of an entire hydrothermal vent could cause the extinction of associated fauna.

175. The frequency of research expeditions is a cause for concern, especially with plans for systematic observations under various monitoring programmes.[34] Finally, different scientific projects could be incompatible and interfere with each other. To address these concerns, some groups of scientists, such as those at InterRidge, have been working on codes of conduct. However, it has been suggested that international regulatory measures will be needed to ensure that potential effects are assessed in advance and that the resources are used in a sustainable manner.

F. Legal issues

176. The present section is divided into two parts: the first part presents information on the jurisdictional framework and the general principles applicable to the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction and explains the legal framework provided by UNCLOS and other relevant instruments. The second part addresses legal issues relating to genetic resources.

1. Legal framework for the conservation and sustainable use of marine biodiversity beyond national jurisdiction

177. UNCLOS establishes the legal framework for all activities in the oceans. As stated in its preamble, UNCLOS sets out a legal order for the seas and oceans to facilitate international communication and promote peaceful uses of the seas and oceans, equitable and efficient utilization of their resources, conservation of their living resources and study, protection and preservation of the marine environment.

178. UNCLOS does not specifically address issues relating to biodiversity. However, as the Convention applies to all activities in the oceans, its jurisdictional framework and general principles also apply to the conservation and sustainable use of biodiversity, including in areas beyond national jurisdiction.

(a) Jurisdictional framework

179. In setting out a comprehensive set of rules governing ocean activities, UNCLOS divides marine space into a number of zones, divided both horizontally and vertically. Vertically, the sea is divided into the seabed or ocean floor and the superjacent water column. Horizontally, space is measured from baselines extending along the coast, in accordance with articles 5 and 7 of the Convention. In the sea area between the baseline and the coast, called “internal waters”, the coastal State enjoys absolute sovereignty. Extending seawards from the baselines for up to 12 nautical miles is the territorial sea, where the coastal State also enjoys sovereignty, with the exception of a right to innocent passage by foreign ships (article 8). In the exclusive economic zone, which may extend up to 200 miles from the coast, coastal States enjoy sovereign rights over natural resources, both living and non-living, as well as jurisdiction for the construction of artificial islands, the protection of the marine environment and over marine scientific research (article 56). Although in most cases the seabed beyond the territorial sea, termed “the continental shelf”, is subsumed within the regime of the exclusive economic zone, where the physical

shelf extends beyond the 200-mile limit, the sovereign rights of the coastal State over the mineral resources of the shelf and the living "sedentary species" attached to it continue up to the limits set out in article 76 of the Convention.

180. The water column that is not included in the exclusive economic zone, the territorial sea or the internal waters of a State, or in the archipelagic waters of an archipelagic State, constitutes the "high seas" (article 86). Under part VII of the Convention, the high seas are open to all States, under the regime of the freedom of the high seas. The freedom of the high seas includes freedom of navigation; freedom of overflight; freedom to lay submarine cables and pipelines; freedom to construct artificial islands and other installations, subject to part VI; freedom of fishing and freedom of marine scientific research, subject to parts VI and XII. These freedoms must be exercised by all States with due regard for other States' interests in their exercise of high-seas freedoms (article 87). High-seas freedoms must also be exercised under the conditions laid down by UNCLOS, including the provisions on the conservation and management of living resources (part VII, section 2), the general obligations to protect and preserve the marine environment (part XII) and by other rules of international law.

181. Under UNCLOS, the seabed and ocean floor and subsoil thereof beyond the limits of national jurisdiction have been designated as "the Area" (article 1, para. 1 (1)). Part XI of UNCLOS and the 1994 Agreement relating to the Implementation of Part XI of UNCLOS (the Part XI Agreement) specifically define the legal regime for the Area. The Area and its resources are the common heritage of mankind (article 136). Resources are defined in article 133 to mean "all solid, liquid and gaseous mineral resources in situ in the Area at or beneath the seabed, including polymetallic nodules". The International Seabed Authority is the organization through which States organize and control all activities of exploration for and exploitation of the resources of the Area (article 1, para. 1 (3)), particularly with a view to administering mining activities in the Area (article 157). Activities must be carried out for the benefit of mankind as a whole and the Authority must provide for the equitable sharing of financial and other economic benefits derived from activities in the Area (article 140).

182. The continental shelf shall not extend beyond the limits defined in article 76 of UNCLOS and the coastal State is required to delineate the outer limit of its continental shelf in accordance with the provisions of that article.

183. As provided in article 77, coastal States exercise sovereign rights for the purpose of exploring the continental shelf and exploiting its natural resources. The natural resources consist of the mineral and other non-living resources of the seabed and subsoil, together with living organisms belonging to sedentary species, defined as organisms which, at the harvestable stage, are either immobile on or under the seabed or unable to move except in constant physical contact with the seabed or the subsoil. The extent to which the definition of sedentary species under article 77 covers the complex web of life of deep-sea ecosystems may need to be addressed in order to clarify whether such ecosystems and organisms belong to the regime of the continental shelf or of the water column above it. The issue is important since, beyond the 200 nautical mile limit, or within that limit in cases where an exclusive economic zone has not been declared, while the coastal State has sovereign rights over biological resources belonging to sedentary species on the continental shelf, other biological resources are subject to the regime of the high seas. In the context

of conservation and sustainable use, the relationship between high-seas activities, in particular fishing, and a coastal State's sovereign rights over the sedentary species of the continental shelf may therefore need to be clarified.

(b) Instruments relevant to the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction

184. UNCLOS establishes the legal framework for all activities in the oceans and contains the general principles applicable to the conservation and sustainable use of marine biodiversity in areas beyond the limits of national jurisdiction. It is supplemented by a number of specialized instruments, concluded either prior to or after its adoption or which may be concluded in order to implement its general principles. Articles 237 and 311 of UNCLOS define its relationship with these instruments. Below is a brief summary of the relevant instruments that directly or indirectly address issues relevant to the conservation and sustainable use of biodiversity in areas beyond national jurisdiction. Some of the instruments referred to aim at regulating specific activities, such as those discussed in chapter II.E above on environmental issues, others address the conservation and sustainable use of biodiversity itself.[157]

Instruments addressing biodiversity

185. The Convention on Biological Diversity is complementary to UNCLOS in relation to its specific objectives.[158] Pursuant to its article 1, the three objectives of the Convention on Biological Diversity are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources, by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding. While in areas within national jurisdiction the Convention on Biological Diversity applies both to components of biological diversity and to processes and activities carried out under the jurisdiction or control of States, in areas beyond national jurisdiction, that Convention applies only to processes and activities carried out under the authority of States (article 4). This means that the Convention on Biological Diversity does not apply to the components of marine biodiversity beyond national jurisdiction. Nevertheless, in accordance with article 5, States party to that Convention are required to cooperate directly, or through competent international organizations, for the conservation and sustainable use of biodiversity beyond national jurisdiction (see also A/59/62/Add.1, paras. 254-260). In carrying out activities beyond national jurisdiction that have, or are likely to have, a significant adverse impact on the conservation and sustainable use of biodiversity, States parties must take into account the provisions of the Convention (articles 6 to 14) and the policy decisions taken by its Conference of the Parties.

186. Other relevant instruments include the Convention on Migratory Species (including its regional agreements: the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area, the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas and the Agreement on the Conservation of Albatrosses and Petrels, under which parties agree to take, individually or in cooperation, appropriate and necessary steps to conserve migratory species and their habitats; and the Convention on International Trade of Endangered Species, which provides measures to curtail global trade in

threatened and endangered species. Among marine listings established under these instruments are many species of cetaceans, marine turtles and corals (see also A/59/62/Rev.1, paras. 261-264).

Living resources of the high seas

187. The conservation and management of the living resources of the high seas is addressed in articles 116 to 120 of UNCLOS. Fishing on the high seas must be exercised in conformity with the general provisions on conservation and management, as well as with a number of specific global and regional instruments that require high-seas fishing States to cooperate in the establishment of conservation and management measures in the high seas. At the global level, relevant instruments include the United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks and the 1993 FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (see also A/59/62/Add.1, paras. 301-305 and A/59/298, paras. 105-107). At the regional level, the duty of States to cooperate for the conservation and management of marine living resources is implemented through regional fisheries management conventions and arrangements. The regional organizations created under these instruments establish conservation and management measures for specific areas and species in accordance with their mandates. Not all areas beyond national jurisdiction are covered by regional fisheries management organizations and most of these organizations do not manage all fish species (see also A/59/298, paras. 131-149). In addition, the 1946 International Convention for the Regulation of Whaling regulates the conservation and utilization of whale resources.

188. Non-binding instruments relevant in this regard include the FAO Code of Conduct for Responsible Fisheries and four FAO international plans of action. The Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem and the second supplement to the FAO Technical Guidelines for Responsible Fisheries, on the ecosystem approach to fisheries, provide voluntary guidelines on the implementation of the ecosystem approach (see also A/59/298, paras. 110-112).

Navigation

189. Navigation on the high seas is subject to the general provisions under UNCLOS on the prevention, reduction and control of pollution from vessels and the duty of the flag State (articles 194, 211 and 217-220), which are reinforced by a number of specific instruments adopted by IMO, including the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, the International Convention on the Control of Harmful Anti-fouling Systems on Ships and the International Convention for the Control and Management of Ships' Ballast Water and Sediments (see also A/59/62/Add.1, paras. 265-270).

Marine scientific research

190. Marine scientific research must be carried out in conformity with the provisions contained in part XIII of UNCLOS, including the general principles

under article 240. These include the requirement that marine scientific research must be conducted in compliance with all relevant regulations adopted in conformity with UNCLOS, including those for the protection of the marine environment (see also paras. 203 to 205 below).

Cables, pipelines and artificial islands

191. The laying of submarine cables and pipelines is also subject to UNCLOS general provisions on the protection of the marine environment. The same applies to the construction of artificial islands and other installations, which are also regulated by the 1978 Protocol relating to the Convention for the Prevention of Pollution from Ships as regards discharges, while the 1972 London Convention covers their deliberate disposal at sea.

Protection and preservation of the marine environment

192. The protection and preservation of the marine environment is addressed in general by the comprehensive framework set out in part XII of UNCLOS. Article 192 establishes a general obligation for States to protect and preserve the marine environment. States are required to take all measures necessary to prevent, reduce and control pollution of the marine environment from any source, using "the best practicable means at their disposal and in accordance with their capabilities" (article 194, para. 1). In particular, States must "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 194, para. 5). States are also required to avoid the use of technologies, or the intentional or accidental introduction of alien species to a particular part of the environment, which may cause harmful changes thereto (article 196). In addition, States are required to exercise their prescriptive and enforcement jurisdictions to prevent, reduce and control pollution from all sources (articles 194, para. 1, 207, para. 1, 208, para. 1, 209, para. 2, 210, para. 1, 211, paras. 2-4, 212, para. 1 and section 6 of part XII generally on enforcement). They are also to cooperate on a global and, as appropriate, on a regional basis, in the formulation of international rules, standards, recommended practices for the protection and preservation of the marine environment (articles 207, para. 4, 208, para. 5, 209, para. 1, 210, para. 4, 211, para. 1, 212, para. 3). They must monitor the risks or effects of pollution of any activities conducted under their control, as well as assess the potential effects of planned activities on the marine environment (articles 204-206). Moreover, States are required to provide scientific and technical assistance to developing States to enhance their capabilities to protect and preserve the marine environment (articles 202 and 203). Pursuant to article 235, States are responsible for the fulfilment of their international obligations concerning the protection and preservation of the marine environment and they are liable in accordance with international law. They are also responsible and liable for damage caused by pollution of the marine environment arising out of marine scientific research undertaken by them or on their behalf (article 263).

193. The obligations for States to protect and preserve the marine environment are complemented by a number of international instruments, including the IMO instruments mentioned in paragraph 189 above dealing with pollution from vessels, the 1972 London Convention and its 1996 Protocol and the non-binding Global Programme of Action. Other conventions whose implementation would enhance the conservation and sustainable use of biodiversity beyond national jurisdiction, even

though they do not directly address the issue, include the United Nations Framework Convention on Climate Change, the Kyoto Protocol thereto and the Stockholm Convention on Persistent Organic Pollutants (see also A/59/62/Add.1, paras. 271-273 and 275).

194. As envisaged under article 197 of UNCLOS on regional cooperation, a number of regional seas conventions and action plans address the protection of the marine environment, including through measures specifically dealing with marine biodiversity, on a regional basis (see also A/59/62/Add.1, paras. 279-287).[159]

195. The protection of the marine environment from harmful effects that may arise from activities in the Area, is provided for by article 145, under which the International Seabed Authority must adopt measures, including the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment of the Area. The Authority has adopted Regulations on Prospecting and Exploration for Polymetallic Nodules[160] and is currently considering draft regulations for prospecting and exploration of polymetallic sulphide and cobalt-rich crust deposits. These regulations have a strong environmental element aiming, inter alia, at the protection and conservation of the natural resources of the Area and the prevention of damage to marine biodiversity. The Authority also plays an important role in promoting marine scientific research in the Area (article 143; see also paras. 204 and 205 below and A/59/62/Add.1, paras. 252 and 253).

Protection of specific areas and species

196. Some of the legal instruments mentioned above provide for defined geographic areas, including beyond national jurisdiction, to be placed under a higher level of protection than the waters and/or seabed around them (for example, the 1978 Protocol relating to the Convention for the Prevention of Pollution from Ships; the IMO "Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas, which provide for the designation of areas within and beyond the limits of the territorial sea; measures adopted under regional fisheries management conventions and arrangements; the Convention on Migratory Species; and the Regulations on Prospecting and Exploration for Polymetallic Nodules of the International Seabed Authority). At the regional level, some binding legal agreements provide for multiple-use marine protected areas beyond national jurisdiction, while ensuring that the regulation of particular activities is consistent with high-seas freedoms under UNCLOS (for example, the Convention for the Protection of the Marine Environment of the North East Atlantic and the 1995 Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean). High seas sanctuaries, where commercial whaling is prohibited, have been established under the International Convention for the Regulation of Whaling in the Southern Ocean and the Indian Ocean.[161]

2. Genetic resources

197. As described in the introduction to the present report (see, in particular, paras. 5 and 6), the term genetic resources should be read in a broad sense.

Jurisdictional framework

198. Discoveries of highly complex and diverse ecosystems in areas beyond national jurisdiction, coupled with advances in the biotechnology sector, have led to increasing interest and activities in relation to genetic resources beyond national jurisdiction. Such interest has also generated a debate over the legal status of genetic resources.

199. The legal framework established by UNCLOS applies to all activities in the oceans and seas, including those relating to genetic resources, as noted above.

200. As also mentioned above, in the two maritime areas beyond the limits of national jurisdiction, the high seas and the Area, UNCLOS establishes two distinct regimes. Genetic resources in the high seas are subject to the regime of part VII of UNCLOS and other relevant provisions, as described in paragraph 180 above. As regards the Area, the regime set up under part XI and the 1994 Agreement deal specifically with activities relating to mineral resources. Article 145 provides, inter alia, for the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment, from harmful effects which may arise from activities in the Area. In addition, article 143, as well as article 256 and other relevant provisions of part XIII on marine scientific research, could also apply to research relating to biodiversity (see below for further details). Commercial activities relating to genetic resources are not specifically addressed by part XI of UNCLOS.

201. Different views have been expressed on whether, in accordance with UNCLOS, deep seabed genetic resources beyond national jurisdiction fall under the regime for the Area or under the regime for the high seas (see A/59/122). Consequently, the status of these resources should be clarified, in the light of the general principles contained in UNCLOS.

Activities relating to genetic resources

202. It is difficult to differentiate scientific research from commercial activities involving genetic resources, commonly referred to as bioprospecting. In most cases, genetic resources are collected and analysed as part of scientific research projects, in the context of partnerships between scientific institutions and industry. It is only at a later stage that knowledge, information and useful materials extracted from such resources enter a commercial phase. The difference between scientific research and bioprospecting therefore seems to lie in the use of knowledge and results of such activities, rather than in the practical nature of the activities themselves.

203. There is no internationally agreed definition for either marine scientific research or bioprospecting. UNCLOS provides the regime for the conduct of marine scientific research but does not define the term, although it requires States to promote the establishment of general criteria and guidelines to assist States in ascertaining the nature and implications of marine scientific research, through competent international organizations (article 251).[162] At the same time, neither UNCLOS nor the Convention on Biological Diversity use or define the term bioprospecting. The expression is commonly used to cover a broad range of activities, aimed at the exploration of biodiversity for commercially valuable genetic and biochemical resources and further as the process of gathering information from the biosphere on the molecular composition of genetic resources for the

development of new commercial products.[163] The United Nations University, Institute of Advanced Studies, in its report on bioprospecting[34] states that possible elements of a definition of bioprospecting include systematic search, collection, gathering or sampling of genetic resources for purposes of commercial or industrial exploitation; screening, isolation or characterization of commercially useful compounds; testing and trials; and further application and development of the isolated compounds for commercial purposes, including large-scale collection, development of mass culture techniques and conduct of trials for approval for commercial sale. It has also been suggested that the phase of initial research and gathering of information could also be referred to as "biodiscovery", while the term bioprospecting could cover the subsequent phases of collection of the resources for purposes of further investigation and eventual commercial application.[164]

204. As stated above, the conduct of marine scientific research is subject to the general principles under part XIII of UNCLOS. Article 240 establishes that such research shall be conducted exclusively for peaceful purposes; that it shall be conducted with appropriate scientific methods and means; that it shall not unjustifiably interfere with other legitimate uses of the sea and shall be duly respected in the course of such uses; and that it shall be conducted in compliance with all relevant regulations adopted in conformity with UNCLOS, including those for the protection and preservation of the marine environment. Marine scientific research shall not constitute the legal basis for any claim to any part of the marine environment or its resources (article 241). States and competent international organizations shall promote international cooperation in marine scientific research (article 242). States and competent international organizations are further required to make available by publication and dissemination through appropriate channels information on proposed major programmes and their objectives, as well as knowledge resulting from marine scientific research (article 244). For this purpose, States, both individually and in cooperation with other States and with competent international organizations, shall actively promote the flow of scientific data and information and the transfer of knowledge resulting from marine scientific research, especially to developing States, as well as the strengthening of the autonomous marine scientific research capabilities of developing States through, inter alia, programmes to provide adequate education and training of their technical and scientific personnel.

205. As mentioned above, marine scientific research is one of the freedoms of the high seas under articles 87 and 257 of UNCLOS, subject to the general principles of part XII. Under articles 143 and 256, marine scientific research in the Area must be carried out exclusively for peaceful purposes and for the benefit of mankind as a whole, in accordance with part XIII. The International Seabed Authority may carry out marine scientific research concerning the Area and its resources and may enter into contracts for that purpose. The Authority must also promote and encourage the conduct of such research in the Area and shall coordinate and disseminate the results of such research and analysis when available. States parties to UNCLOS may carry out marine scientific research in the Area and shall promote international cooperation in that respect. In particular, they are required to participate in international programmes and encourage cooperation in marine scientific research by personnel of different countries and of the Authority; ensure that programmes are developed through the International Seabed Authority or other international organizations, as appropriate, for the benefit of developing countries and

technologically less developed States with a view to strengthening their research capabilities, training their personnel and the personnel of the Authority in the techniques and applications of research, and fostering the employment of their qualified personnel in research in the Area. States must also disseminate the results of research and analysis, when available, through the International Seabed Authority or other international channels, when appropriate.

206. Although the Convention on Biological Diversity contains provisions regulating access to genetic resources, transfer of technologies, technical and scientific cooperation, funding and handling of biotechnology,[165] in the light of its jurisdictional scope, these provisions regulating access and benefit-sharing are only applicable to marine genetic resources found in areas under national jurisdiction. Access to genetic resources under article 15 is regulated by national Governments on the basis of mutually agreed terms between the country with sovereign rights over the genetic resources and the country using them. Parties are required to undertake scientific research related to resources provided by other parties with the full participation of those parties and take measures to share, in a fair and equitable way, the results of research and benefits arising from commercial and other utilization of genetic resources with parties providing the resources.

207. The Conference of the Parties to the Convention on Biological Diversity has developed the Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits Arising out of their Utilization,[166] which are only applicable to marine genetic resources found in areas under national jurisdiction. The Guidelines, which are voluntary, provide guidance for policymakers and persons using and providing genetic resources. They apply to the genetic resources covered by the Convention on Biological Diversity, as well as to benefits arising from the commercial and other utilization of such resources, with the exception of human genetic resources.

208. The nature of activities relating to genetic resources should be clarified, in light of the general principles contained in UNCLOS.

Technology transfer and intellectual property rights

209. Technology transfer is also particularly important in the context of activities relating to genetic resources beyond national jurisdiction, which require sophisticated and costly equipment and expertise (see paras. 60-97 above).

210. Part XIV of UNCLOS establishes the general principle by which States are required to cooperate, either directly or through competent international organizations, with a view to promoting the development and transfer of marine science and marine technology on fair and reasonable terms and conditions. This should be done particularly for the benefit of developing States, which may need and request technical assistance in this field, with regard to the exploration, exploitation, conservation and management of marine resources, the protection and preservation of the marine environment, marine scientific research and other activities in the marine environment (article 266). States are also required to endeavour to foster favourable economic and legal conditions for the transfer of marine technology for the benefit of all parties concerned on an equitable basis (article 266, para. 3).

211. UNCLOS also encourages States to establish national and regional marine scientific and technological centres, particularly in developing coastal States, and to strengthen existing ones, in order to advance the conduct of marine scientific research in such States and enhance their national capabilities to utilize and preserve their marine resources for their economic benefit (article 275, para. 1). Such regional centres are to provide training and educational programmes on various aspects of marine scientific and technological research, particularly marine biology, including conservation and management of living resources (article 277).

212. Article 267 of UNCLOS recognizes that in promoting the development and transfer of marine technology, due regard must be paid to all legitimate interests including the rights and duties of holders, suppliers and recipients of marine technology.

213. With particular reference to the Area, UNCLOS requires the International Seabed Authority to acquire technology and scientific knowledge relating to activities in the Area and to encourage their transfer to developing States and the Enterprise (articles 144 and 170). Under the Part XI Agreement,[167] seabed mining technology shall be acquired on fair and reasonable commercial terms and conditions on the open market, or through joint-venture arrangements and consistent with the effective protection of intellectual property rights (section 5, para. 1 (a) and (b)). States parties have a duty to promote international technical and scientific cooperation with regard to activities in the Area either between the parties concerned or by developing training, technical assistance and scientific cooperation programmes in marine science and technology and the protection and preservation of the marine environment (section 5, para. 1 (c)).

214. As regards access to and transfer of technology, including biotechnology, States Party to the Convention on Biological Diversity must provide and/or facilitate access to, and transfer of, technologies that are relevant to the conservation and sustainable use of biodiversity or make use of genetic resources (articles 2 and 16, para. 1). Access to and transfer of technologies to developing countries shall be provided under fair and most favourable terms and, in the case of technologies subject to patents and other intellectual property rights, on terms that recognize and are consistent with the adequate and effective protection of those rights (article 16, para. 2). Article 19, which addresses the handling of biotechnology and distribution of its benefits, provides that measures shall be adopted for the effective participation in biotechnology research by countries providing the genetic resources and that they are given priority access, on a fair and equitable basis, to results and benefits arising from biotechnologies based upon such genetic resources (article 19, paras. 1 and 2). The Bonn Guidelines[166] also highlight that the sharing of benefits and transfer of technology and regimes covering intellectual property rights must be mutually supportive.

215. As regards the protection of intellectual property rights, it is believed that the granting of patents is important because it stimulates commercial innovation in the life sciences. A patent is a legal certificate that awards temporary protection over a claimed invention for a period that is generally 20 years. In order for a patent to be awarded, inventions must meet three criteria, they must be (a) new (or novel); (b) involve an inventive step (be non-obvious); and (c) be capable of industrial application (be useful or of utility). A patent awards an exclusive temporary protection to its holder including the right to exclude others from “making, using,

offering for sale or selling" or "importing" the protected invention into a jurisdiction where the patent protection is in force, or to charge others for any uses or purposes involving the protected invention within such jurisdictions, through licensing.[79]

216. At the same time the rise of patent protection in the field of life sciences has raised concerns, such as whether the extension of patent protection to genetic material is justifiable on ethical grounds; whether the "identification, isolation or purification" of genetic material meets the criteria of an inventive step or constitutes mere discovery for the purposes of determining patentability; whether claimed inventions meet the criteria of being capable of industrial application; the impacts of permitting patent claims that are very broad in scope; the economic evidence upon which the extension of patentability to biological and genetic material has been based and implications for competition and innovation; and the implications of multiplying patent protection claims for public health, agriculture, development, scientific research, industry and trade.[79]

217. A number of international instruments on intellectual property are relevant in this context. For activities of relevant international organizations relating to the correlation between the regime for genetic resources under the Convention on Biological Diversity and intellectual property rights regimes see paragraphs 273 and 301 to 304 below.

Conventions and treaties of the World Intellectual Property Organization[168]

218. The World Intellectual Property Organization (WIPO), which has 180 member States, administers 23 international treaties dealing with different aspects of intellectual property protection.

219. The main international instrument in terms of operationalizing international patent protection is the Patent Cooperation Treaty,[169] which makes it possible to seek patent protection for an invention simultaneously in each of a large number of countries by filing an international patent application. Patent filings under the Treaty are an increasing feature of the international intellectual property regime.

220. Another relevant instrument is the Patent Law Treaty,[170] which aims at harmonizing and streamlining formal procedures in respect of national and regional patent applications and patents and thus to make such procedures more user-friendly. Standardization and simplification of the formality requirements reduces risks of formality errors and thus will result in a less frequent loss of rights as well as in cost reductions.

221. Disclosure of the invention is a requirement for the grant of a patent. For disclosure to be adequate, an invention must be described in sufficient detail to permit a person skilled in the art to repeat the effect of the invention. Where an invention involves a micro-organism or the use of a micro-organism, disclosure is not possible in writing but can only be made by the deposit, with a specialized institution, of a sample of the micro-organism. The Budapest Treaty on the International Recognition of the Deposit of Micro-organisms for the Purposes of Patent Procedure provides for the deposit of micro-organisms with an international depositary authority,[171] where a deposit is necessary to satisfy the descriptive requirements of patents legislation for inventions involving a micro-organism or the use of a micro-organism. The deposit assures access to the micro-organism by persons other than the inventor for the purposes of testing or experimenting or for

commercial use when the patent expires. Member States who allow or require the deposit of micro-organisms for the purposes of patent procedure must recognize, for such purposes, the deposit of a micro-organism with any international depositary authority, irrespective of its location. Under the Budapest Treaty, the term "micro-organism" is not explicitly defined so that it may be interpreted in a broad sense. The term has been interpreted to cover genetic material the deposit of which is necessary for the purposes of disclosure, in particular regarding inventions relating to the food and pharmaceutical fields.

Agreement on Trade-Related Aspects of Intellectual Property Rights of the World Trade Organization[172]

222. The Agreement on Trade-Related Aspects of Intellectual Property Rights provides minimum standards of intellectual property protection. It deals with domestic procedures and remedies for the enforcement of intellectual property rights and makes disputes between members of the World Trade Organization (WTO) concerning obligations under the Agreement subject to the WTO dispute-settlement procedures. The Agreement also provides for the applicability of basic General Agreement on Tariffs and Trade (GATT) principles, such as most-favoured-nation status and national treatment.

223. The goals of the Agreement include the reduction of distortions and impediments to international trade; promotion of effective and adequate protection of intellectual property rights; and ensuring that measures and procedures to enforce intellectual property rights do not themselves become barriers to legitimate trade. Article 7 of the Agreement sets out as one of its objectives that the protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations.

224. With respect to patents, article 27, paragraph 1, of the Agreement defines the formal requirements regarding patentable subject matter and provides that patents shall be available for inventions that are new, involve an inventive step and are capable of industrial application. Article 27, paragraph 3 (b), of the Agreement provides that members may exclude from patentability plants and animals other than micro-organisms and essential biological processes for the production of plants or animals other than non-biological and microbiological processes. The Agreement calls for a review of the provisions of article 27, paragraph 3 (b) four years after it has entered into force;[173] that review is ongoing.

225. Under article 28 of the Agreement, a patent confers on its owner the exclusive rights to prevent third parties who do not have the owner's consent from making, using, offering for sale, selling or importing for those purposes the product that is the subject matter of the patent; using the process that is the subject matter of the patent; and using, offering for sale, selling or importing for those purposes the product obtained directly by the process, which is the subject matter of a patent. Patent owners have the right to assign, or transfer by succession, the patent and to conclude licensing contracts. Applicants for a patent have to disclose the invention in a manner sufficiently clear and complete for the invention to be carried out by a person skilled in the art and may be required to indicate the best mode for carrying

out the invention known to the inventor at the filing date or, where priority is claimed, at the priority date of the application (article 29).

III. Past and present activities of the United Nations and other relevant international organizations

226. The present chapter of the report addresses the issues referred to in paragraph 73 (a) of General Assembly resolution 59/24.

A. United Nations

227. UNCLOS, which entered into force on 16 November 1994, provides the legal framework within which all activities in the ocean and seas must be carried out. As a result, the Convention is frequently referred to as a constitution for the oceans. UNCLOS was subsequently supplemented by the two implementing agreements: the 1994 Agreement relating to the Implementation of Part XI of the Convention and the 1995 Agreement for the Implementation of the Provisions of the Convention relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.

228. Oceans and their importance in our life have always occupied a central place at the United Nations. In addition to various instruments adopted under the auspices of the United Nations, including the Convention on Biological Diversity, the General Assembly and other United Nations bodies have adopted over the years numerous decisions on the marine environment and biodiversity. Thus, issues relating to the protection of the marine environment were addressed in a comprehensive way in such documents as the Stockholm Declaration on the Human Environment,[174] and in the World Charter for Nature (see also A/59/62/Add.1, paras. 239 and 240).[175] In 1992, the Rio Declaration on Environment and Development,[176] adopted by the United Nations Conference on Environment and Development, developed the principles that form the basis of sustainable development (see also A/59/62/Add.1, paras. 241 and 242). It stressed in particular the need for inter-State collaboration and developed a number of new and different approaches for the conservation and management of the environment, such as the precautionary approach (principle 15 of the Rio Declaration).

229. The need to improve the conservation of biological diversity and the sustainable use of biological resources is elaborated in chapter 15 of Agenda 21,[177] the programme of action adopted by the United Nations Conference on Environment and Development. Chapter 17 of Agenda 21, dealing with the sustainable development of oceans, coastal areas and seas, promotes an ecosystem approach to ocean management and calls for new approaches to marine and coastal area management and development that are integrated in content and precautionary and anticipatory in ambit. Chapter 17 notes the inadequacy of management measures for high-seas fisheries and calls for an emphasis on multi-species management and other approaches that take into account the relationships among species, especially in addressing depleted species, but also in identifying the potential of underutilized or unutilized populations. It also underlines the need to protect and preserve vulnerable marine ecosystems and, with respect to the high seas, requires States to develop and increase the potential of marine living resources to meet human

nutritional needs, as well as social, economic and development goals, protect and restore endangered marine species, preserve marine habitats and other ecologically sensitive areas and promote scientific research with respect to the living resources.

230. Following the process of the United Nations Conference on Environment and Development, a number of instruments were adopted to implement the commitments agreed upon in Rio de Janeiro, Brazil, in 1992: the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, the 1995 Agreement of Straddling and Highly Migratory Fish Stocks and the Jakarta Mandate on Marine and Coastal Biological Diversity of the Convention on Biological Diversity.

231. The United Nations Millennium Declaration (General Assembly resolution 55/2), and the eight Millennium Development Goals, set the development agenda of the international community for the new century, through an integrated vision aimed at the achievement of peace and decent standards of living for all human beings. The Millennium Declaration emphasizes that respect for nature, and in particular the sustainable management of all living species and natural resources, is the only key to ensure that the "immeasurable riches provided to us by nature" are "preserved and passed on to our descendants". The Declaration underlines that the current unsustainable patterns of production and consumption must be changed in the interest of our future welfare and that of our descendants.

232. In 2002, the World Summit on Social Development followed up on the United Nations Conference on Environment and Development to assess progress in implementing sustainable development (see also A/59/62/Add.1, para. 243). In particular, in the Johannesburg Declaration on Sustainable Development,[178] States noted the continuing loss of biodiversity and resolved to protect it, through decisions on targets, timetables and partnerships. The Johannesburg Plan of Implementation[179] encourages the application by 2010 of the ecosystem approach and underlines the need to promote the conservation and management of oceans at all levels and to maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, including in areas within and beyond national jurisdiction. It further calls for the implementation of the work programme arising from the Jakarta Mandate of the Convention on Biological Diversity; to develop and facilitate the use of diverse approaches and tools, including the ecosystem approach, the elimination of destructive fishing practices, the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012 and time/area closures for the protection of nursery grounds and periods; and to develop national, regional and international programmes for halting the loss of marine biology, including in coral reefs and wetlands.

233. In recent years, the General Assembly, including through the Informal Consultative Process established in its resolution 54/33 of 24 November 1999, has addressed issues relating to the conservation and sustainable use of marine ecosystems and biodiversity, both within and beyond national jurisdiction, under its agenda item on oceans and the law of the sea.

234. In 2002, on the basis of the recommendations of the third meeting of the Informal Consultative Process (see A/57/80) and of the Johannesburg Plan of Implementation, the General Assembly, in its resolution 57/141 of 12 December 2002, called upon States to develop national, regional and

international programmes for halting the loss of marine biodiversity, in particular fragile ecosystems, and to develop and facilitate the use of diverse approaches and tools, including the ecosystem approach, the elimination of destructive fishing practices, the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012 and time/area closures for the protection of nursery grounds and periods, proper coastal and land use and watershed planning, and the integration of marine and coastal areas management into key sectors. The Assembly reiterated its call in resolutions 58/240 of 23 December 2003 and 59/24 of 17 November 2004. In its resolution 57/141, the Assembly also encouraged relevant international organizations to consider urgently ways to integrate and improve, on a scientific basis, the management of risks to marine biodiversity of seamounts and certain other underwater features within the framework of UNCLOS. In its resolutions 58/240 and 59/24, the Assembly reiterated that need, addressing its call to States as well as international organizations and including cold-water corals and hydrothermal vents as ecosystems of concern.

235. On the recommendation of the fourth meeting of the Informal Consultative Process (see A/58/95, in particular para. 20 (c)), whose areas of focus included protecting vulnerable marine ecosystems, the General Assembly, in its resolution 58/240, called upon States to improve the scientific understanding and assessment of marine and coastal ecosystems as a fundamental basis for sound decision-making through the actions identified in the Johannesburg Plan of Implementation. It invited the relevant global and regional bodies, in accordance with their mandates, to investigate urgently how better to address, on a scientific basis, including the application of precaution, the threats and risks to vulnerable and threatened marine ecosystems and biodiversity in areas beyond national jurisdiction; how existing treaties and other relevant instruments could be used in this process consistent with international law, in particular with UNCLOS and with the principles of an integrated ecosystem-based approach to management, including the identification of those marine ecosystem types that warranted priority attention; and to explore a range of potential approaches and tools for their protection and management. The Assembly requested the Secretary-General to cooperate and liaise with the relevant bodies and to submit an addendum to his annual report to the General Assembly at its fifty-ninth session, describing the threats and risks to such marine ecosystems and biodiversity in areas beyond national jurisdiction as well as details on any conservation and management measures in place at the global, regional, subregional or national levels addressing these issues. The report of the Secretary-General in response to that request is contained in document A/59/62/Add.1.

236. Furthermore, in its resolution 58/14 of 24 November 2003, the General Assembly requested the Secretary-General, in his next report concerning fisheries, to include a section outlining current risks to the marine biodiversity of vulnerable marine ecosystems including, but not limited to, seamounts, coral reefs, including cold-water reefs, and certain other sensitive underwater features related to fishing activities, as well as detailing any conservation and management measures in place at the global, regional, subregional or national levels addressing those issues. That report of the Secretary-General is contained in document A/59/298 (see also A/59/62/Add.1, chap. V).

237. In 2004, the fifth meeting of the Informal Consultative Process organized its discussions around the issue of new sustainable uses of the oceans, including the

conservation and management of the biological diversity of the seabed in areas beyond national jurisdiction. The meeting noted the increasing levels of concern over ineffective conservation and management of the biodiversity of the seabed beyond national jurisdiction, which remained largely unexplored but contained, on the basis of current knowledge, areas rich in unique and diverse species and ecosystems, with high levels of endemism and in some instances with a relationship to the non-living resources of the Area (see A/59/122, para. 2).

238. In that connection, the General Assembly, in its resolution 59/24, reiterated its concern at the adverse impacts on the marine environment and biodiversity, in particular on vulnerable marine ecosystems, including corals, of human activities, such as overutilization of living marine resources, the use of destructive practices, physical impacts by ships, the introduction of alien invasive species and marine pollution from all sources, including from land-based sources and vessels, in particular through the illegal release of oil and other harmful substances and from dumping, including the dumping of hazardous waste such as radioactive materials, nuclear waste and dangerous chemicals. It called upon States and international organizations to take action urgently to address, in accordance with international law, destructive practices that have adverse impacts on marine biodiversity and ecosystems, including seamounts, hydrothermal vents and cold-water corals.

239. As noted in the introduction to the present report, the General Assembly has decided to establish an 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 and has requested the Secretary-General to prepare the present report for its consideration.

240. The sixth meeting of the Informal Consultative Process focused its discussions on fisheries and their contribution to sustainable development and marine debris, subjects directly relevant to the conservation and sustainable use of marine biodiversity. It adopted a number of elements to be suggested to the General Assembly for consideration at its sixtieth session (see A/60/99).

B. United Nations programmes and institutions

241. The Programme for the Development and Periodic Review of Environmental Law for the First Decade of the Twenty-first Century (Montevideo Programme III) of the United Nations Environment Programme (UNEP),[180] under the theme “conservation and management”, identifies the need to promote and improve the integrated management, conservation and sustainable use of coastal and marine resources and ecosystems. The conservation of biological diversity and its enhancement, the sustainable use of its components, biosafety and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources are important aspects of the Montevideo Programme III. The Programme was adopted by UNEP Governing Council by its decision 21/23 of 9 February 2001 (see A/56/25, annex).

242. The UNEP Regional Seas Programme was launched in 1974 to address the accelerating degradation of the world’s oceans and coastal areas, through the sustainable management and use of marine and coastal environments. The Programme involves neighbouring countries in comprehensive and specific actions to protect their shared marine environment (see also A/59/62/Add.1, paras. 279-

281). New regional seas strategic directions for 2004-2007 were developed by the sixth Global Meeting of the Regional Seas Conventions and Action Plans in 2004 and promote the implementation of biodiversity-related conventions such as the Convention on Biological Diversity, the Convention on International Trade in Endangered Species, the Convention on Migratory Species, the Convention concerning the Protection of the World Cultural and Natural Heritage and the Convention on Wetlands of International Importance, especially as Waterfowl Habitat. For example, Regional Seas Programmes are the main mechanism for implementing the Convention on Biological Diversity programme of work on marine and coastal biodiversity at the regional level. The collaboration between the secretariat of the Convention on Biological Diversity and the Regional Seas Coordinating Unit of UNEP currently focuses on two concrete activities: the development of a cooperative initiative for the management of marine alien species, also in collaboration with the Global Invasive Species Programme, and the establishment of regional marine protected area networks.

243. The Regional Seas Programme and the secretariats of the Endangered Species Convention, the Whaling Convention, the Convention on Biological Diversity and the Convention on Migratory Species are also collaborating in the Marine Mammal Action Plan. The central goal of the Plan is to generate a consensus among Governments on which to base their policies for marine mammal conservation under the auspices of UNEP. The Plan has helped to enhance the technical and institutional capacities for the conservation and management of marine mammals in several regional seas, in particular those of Latin America and the Caribbean, East Africa, West and Central Africa, the Black Sea and South-East Asia. Furthermore, the Regional Seas Programme and the secretariat of the Convention on Migratory Species have worked jointly on a publication entitled “Review on small cetaceans: distribution, behaviour, migration and threats”, to be published in 2005.

244. Other relevant activities under the Regional Seas Programme include development within the framework of the Global Environment Facility GEF/United Nations Development Programme (UNDP)/IMO Global Ballast Water Management Programme (GloBallast), of joint activities to reduce the transfer of harmful aquatic organisms and pathogens in ships’ ballast water, to implement the IMO Guidelines for the Control and Management of Ships’ Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens[181] and the new International Convention for the Control and Management of Ships’ Ballast Water and Sediments through the Programme; collaboration with GEF in the large marine ecosystems projects; and collaboration with the Intergovernmental Oceanographic Commission of UNESCO (IOC/UNESCO) in global scientific programmes for the marine environment, in particular to set up and implement the Global Ocean Observing System, including in the Mediterranean Sea, the Indian Ocean, the Western Pacific Ocean and the North-west Pacific Ocean.

245. The UNEP World Conservation Monitoring Centre marine programme compiles information on marine ecosystems, including on the conservation of species. The importance of the Monitoring Centre for assessing progress in achieving the internationally agreed target of significantly reducing the rate of biodiversity loss by 2010 was underlined by the seventh meeting of the Conference of the Parties to the Convention on Biological Diversity. UNEP analyses the status and trends in the distribution and condition of global biodiversity and provides early warning of emerging threats.

246. In partnership with the Regional Seas Programme and the World Conservation Union, the UNEP Coral Reef Unit will pursue a closer collaboration with regional fisheries bodies. This will include consideration of how to manage the risks and mitigate the adverse effects of destructive fishing practices on vulnerable marine ecosystems, including cold-water corals located beyond national jurisdiction. The Coral Reef Unit is also pursuing contacts and establishing collaboration with industry in regions with coral reef ecosystems beyond national jurisdiction, such as the submarine cable industry and the offshore oil and gas industry.

247. UNU, in particular through its Institute of Advanced Studies, has published a number of studies providing relevant information on the conservation and sustainable use of marine biodiversity beyond national jurisdiction. These include a report entitled *The International Regime for Bioprospecting: Existing Policies and Emerging Issues for Antarctica*,[182] and another entitled *Bioprospecting of Genetic Resources in the Deep Seabed: Scientific, Legal and Policy Aspects*.[34] These studies may assist the international community's discussion on the subject.

C. United Nations specialized agencies

248. FAO has promoted the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction through the implementation of its Code of Conduct for Responsible Fisheries, which provides a broad and comprehensive framework for the conservation, management and utilization of fisheries within and beyond areas of national jurisdiction. An important aspect of this is the institutional strengthening of human resource development in developing countries, in various aspects of fisheries conservation and management.

249. More specifically, FAO has carried out activities to implement the 1993 Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas[183] and the FAO international plans of action, as well as the FAO strategy on improving information on status and trends of capture fisheries. These plans of action and the strategy have been developed within the framework of the Code of Conduct for Responsible Fisheries to enhance fisheries conservation and management by targeting particular aspects of management that need special attention. In this connection, specific concern was expressed at the twenty-sixth session of the FAO Committee on Fisheries on the need to take urgent action regarding the implementation of the FAO International Plan of Action for the Conservation and Management of Sharks and the International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries.

250. FAO has also taken measures to encourage the strengthening of regional fisheries bodies to make them more efficient and cost-effective. Additional activities include: (a) identification of high-seas fish species through the setting up of a species identification and data programme to improve knowledge of marine organisms of actual and potential interest to fisheries; (b) collaboration with "FishBase", a global information system on fish with key data on the biology of all finfishes, many of which occur in the high seas; (c) partnership arrangement with the World Fisheries Resources Monitoring System to establish a framework for the promotion of reporting on status and trends for all fisheries resources;[184] and (d) promotion of the ecosystem approach to fisheries, including participation in the

management of the Canary Current large marine ecosystem and the Bay of Bengal large marine system projects, as well as cooperation with UNDP in the execution of the Benguela Current large marine system project.

251. The twenty-sixth meeting of the FAO Committee on Fisheries in March 2005 noted the particularly difficult challenge represented by the management of deep-water demersal fisheries. The deficiencies in the present legal framework were discussed and calls were made for improvements. The Committee requested its members to submit detailed catch information to FAO and called on the meeting of regional fisheries management organizations, held immediately after the Committee on Fisheries, to consider the issue. It also requested FAO to provide the General Assembly with information, technical advice and leadership. In addition the Committee on Fisheries highlighted the need for collection and collation of information concerning past and present deep-water fishing activities; undertaking an inventory of deep-water stocks and an assessment of the effects of fishing on deep-water fish populations and their ecosystems; and convening technical meetings to develop a code of practice and technical guidelines.

252. In relation to sea turtles, the Committee on Fisheries agreed on several recommendations, including to pay more attention to interactions between turtles and fisheries; to develop technical guidelines for the reduction of sea turtle mortality in fishing operations; to develop understanding and review progress on the issue; to broaden the mandate of regional fisheries management organizations to reduce fishing impacts on turtles; to strengthen links between environmental and fisheries agencies; to report on turtle stock status and trends and review progress; to coordinate research and promote information exchange, including through a website; and to facilitate harmonization of legislation and management within regions.

253. The Committee on Fisheries briefly addressed the issue of marine protected areas, recognizing that such areas could be useful as fisheries management tools if specifically designed through acceptable processes. The Committee recommended the elaboration of technical guidelines on the design, implementation and testing of marine protected areas and agreed that FAO should assist members in meeting the 2012 goals of the World Summit on Social Development in collaboration with other relevant intergovernmental organizations.

254. In the Rome Declaration on Illegal, Unreported and Unregulated Fishing, the ministerial meeting that followed the twenty-sixth meeting of the Committee on Fisheries agreed to renew efforts and cooperation to combat illegal, unreported and unregulated fishing; to revise legislation and increase deterrence; to implement catch certification schemes and adopt internationally agreed market-related measures; to require that all vessels fishing in the high seas be equipped with vessel monitoring systems no later than December 2008; to eliminate economic incentives leading to illegal, unreported and unregulated fishing; to develop and implement vessel boarding and inspection schemes; to strengthen measures by port States; to pursue the flags of convenience and genuine link debate; to strengthen regional fisheries management organizations; to exercise full control by flag States on vessels flying their flags; and to collect and submit to FAO and relevant regional fisheries management organizations the data on vessels authorized to fish in the high seas. They also asked for assistance to developing countries in these undertakings and for the strengthening of regional fisheries management organizations.

255. IMO is considered to be the competent international body to establish international measures facilitating navigation and ensuring common standards for worldwide shipping. It also establishes special protective measures in defined areas where shipping presents a risk to the marine environment and to marine biological resources. These measures include routing and discharge restrictions and reporting requirements.

256. Discharges from ships, both intentional and accidental, are regulated by the International Convention for the Prevention of Pollution from Ships, as modified by the Protocol of 1978 relating thereto. The Protocol regulates vessel design, equipment and operational discharge from all ships, both within and beyond national jurisdiction. It provides for the designation of special areas, where more stringent discharge rules apply in respect of oil, noxious liquid substances, refuse (marine debris) and air pollution. Special areas are defined as areas in which, for technical reasons relating to their oceanographical and ecological condition and to their sea traffic, the adoption of special mandatory methods for the prevention of sea pollution is required. IMO has developed Guidelines for the Designation of Special Areas to provide guidance to States parties in the formulation and submission of applications for the designation of special areas. Two special areas extending beyond national jurisdiction are the Antarctic and Southern Ocean (south of latitude 60 degrees south) and the Mediterranean Sea.

257. In 2001, the IMO Assembly, in its resolution A.927(22), adopted Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas. These areas are defined as areas which need special protection through action by IMO because of their significance for recognized ecological, socio-economic or scientific reasons, and which may be vulnerable to damage by maritime activities. The process of designating a particularly sensitive sea area offers a means for selecting the most appropriate mechanisms available through IMO to reduce or eliminate risks posed by shipping to the area or a specific portion thereof. Particularly sensitive sea areas may be designated within and beyond the limits of national jurisdiction. The Guidelines relating to such areas are currently under review within the IMO Marine Environment Protection Committee with a view to clarifying and, where appropriate, strengthening them.

258. In 1999, the IMO Assembly adopted a resolution calling on the Marine Environment Protection Committee to develop a legally binding instrument to address the harmful effects of anti-fouling systems used on ships. The resolution called for a global prohibition on the application of organotin compounds, which act as biocides in anti-fouling systems on ships, by 1 January 2003 and a complete prohibition by 1 January 2008. On 5 October 2001, IMO adopted the International Convention on the Control of Harmful Anti-fouling Systems on Ships, which includes such requirements. The Convention will enter into force 12 months after the date on which no fewer than 25 States, representing 25 per cent of the gross tonnage of the world's merchant shipping, have expressed their consent to be bound by it.

259. The introduction of harmful aquatic organisms and pathogens to new environments has been identified as the second greatest threat to the world's oceans. Because the uncontrolled discharge of ballast water and sediments from ships had already caused damage to the environment, human health, property and resources, the International Convention for the Control and Management of Ships' Ballast

Water and Sediments was adopted by IMO in 2004, in order to prevent, minimize and ultimately eliminate the risks arising from the transfer of harmful aquatic organisms and pathogens by ships. The Convention will enter into force 12 months after ratification by 30 States, representing 35 per cent of the world's merchant shipping gross tonnage.

260. Ballast water exchange is currently the only method used to minimize the transfer of harmful aquatic organisms and pathogens through ships' ballast water. Ships are required to conduct exchanges beyond 200 nautical miles from the nearest land, in water at least 200 metres in depth or, if this is not possible, at least 50 nautical miles from the coast and in water at least 200 metres in depth in accordance with the guidelines developed by IMO. The Marine Environment Protection Committee is developing a number of guidelines for the implementation of the Convention.

261. The Intergovernmental Oceanographic Commission of UNESCO has developed a number of initiatives under its programme on ocean ecosystems. In 2004, it launched a project on biodiversity and distribution of megafaunal assemblages in the abyssal nodule province of the eastern equatorial Pacific: management of the impacts of deep seabed mining. This initiative aims to propose a baseline reference of the environment and the structure of megafaunal assemblages and develop recommendations for the management of the impacts of deep seabed mining. The baseline reference includes a quantitative and qualitative analysis of faunal assemblages, a compilation of the morphological identification of the taxa, an assessment of the taxonomic richness, the faunal composition, the relative abundance of the megafauna and the assessment of functional and trophic groups within particularly well-explored areas.

262. In January 2005, UNESCO and the Government of France organized the International Conference on Biodiversity: Science and Governance.[185] The statement issued by the Conference recalled the global target of significantly reducing the rate of biodiversity loss by 2010 as a fundamental condition for sustainable development and for the achievement of the Millennium Development Goals. It was recognized that biodiversity was being irreversibly destroyed by human activities at an unprecedented rate, and that urgent and significant action was required to conserve, sustainably use and equitably share the benefits of biodiversity. One of the final recommendations of the Conference was that an international multi-stakeholder consultative process, guided by a steering committee, should be launched to assess the need for an international mechanism that would provide a critical assessment of the scientific information and policy options required for decision-making, building on existing bodies and activities. The recommendation was based on a proposal by the scientific committee of the Conference to establish an international mechanism that would include intergovernmental and non-governmental elements and that would build on existing initiatives and institutions, with a view to providing scientifically validated information on the status, trends and services of biodiversity, identifying priorities and recommendations for biodiversity protection and informing the relevant international conventions and their parties. The scientific committee also recommended that interdisciplinary research programmes should be set up to discover, understand and predict biodiversity, its status, trends and the causes and consequences of its loss and to develop effective science-based decision tools for its conservation and sustainable use; that biodiversity should be integrated without delay, based on existing knowledge, into the criteria considered in all

economic and policy decisions as well as environmental management; that education of citizens and public awareness programmes should be greatly strengthened and improved to reach these objectives; and that a major effort should be made to build the capacity, especially in developing countries, to undertake biodiversity research and implement biodiversity protection.

D. Other international organizations

263. Following the recommendations adopted by the first meeting of its Subsidiary Body on Scientific Technical and Technological Advice,[186] the second meeting of the Convention on Biological Diversity Conference of the Parties agreed on a programme of action for implementing the Convention in respect of marine and coastal biodiversity (decision II/10), known as the Jakarta Mandate on Marine and Coastal Biological Diversity. On the basis of the Jakarta Mandate, the fourth meeting of the Conference of the Parties adopted decision IV/5 on the conservation and sustainable use of marine and coastal biological diversity, which contained, in an annex, the programme of work arising from decision II/10. The programme of work was reviewed and updated at the seventh meeting of the Conference of the Parties (see decision VII/5, annex I).

264. In relation to biodiversity beyond national jurisdiction, in its decision II/10 the Conference of the Parties requested the secretariat of the Convention on Biological Diversity, in consultation with the Division for Ocean Affairs and the Law of the Sea, to undertake a study of the relationship between the Convention on Biological Diversity and UNCLOS with regard to the conservation and sustainable use of genetic resources on the deep seabed, with a view to enabling the Subsidiary Body on Scientific, Technical and Technological Advice to address at future meetings, as appropriate, the scientific, technical and technological issues relating to bioprospecting of genetic resources on the deep seabed (see also A/58/65, para. 147). The study was presented to the eighth meeting of the Subsidiary Body, in March 2003.[187]

265. The conservation and sustainable use of biological diversity in marine areas beyond national jurisdiction was an important issue at the seventh meeting of the Conference of the Parties. The resulting decisions addressed several aspects of the issue: (a) marine protected areas in areas beyond national jurisdiction; (b) conservation and sustainable use of deep seabed genetic resources beyond national jurisdiction; and (c) the conservation and sustainable use of biological diversity beyond the limits of national jurisdiction in general terms.

266. In decision VII/5, the Conference of the Parties noted that there were increasing risks to biodiversity in marine areas beyond national jurisdiction and that marine and coastal protected areas were extremely deficient in purpose, numbers and coverage in these areas. The Conference of the Parties agreed that there was an urgent need for international cooperation and action to improve conservation and sustainable use of biodiversity in marine areas beyond the limits of national jurisdiction, including through the establishment of further marine protected areas consistent with international law and based on scientific information, including areas such as seamounts, hydrothermal vents, cold-water corals and other vulnerable ecosystems.

267. Regarding conservation and sustainable use of deep seabed genetic resources beyond national jurisdiction, the Conference of the Parties considered the work of the Subsidiary Body resulting from a joint study of the relationship between the Convention on Biological Diversity and UNCLOS, undertaken by the secretariat of the Convention and the Division for Ocean Affairs and the Law of the Sea. In its decision VII/5, paragraph 54, the Conference of the Parties requested the secretariat, in consultation with parties and other Governments and the relevant international organizations, to compile information on the methods for identification, assessment and monitoring of deep seabed genetic resources in areas beyond the limits of national jurisdiction; and to compile and synthesize information on their status and trends, including identification of threats to such genetic resources and the technical options for their protection. The Conference of the Parties also invited States to identify activities and processes under their jurisdiction or control that might have significant adverse impacts on deep seabed ecosystems and species beyond the limits of national jurisdiction in order to address article 3 of the Convention on Biological Diversity.

268. The Conference of the Parties expressed its concern about the serious threats to biodiversity in these areas and expressed the need for rapid action to address such threats, on the basis of the precautionary approach and the ecosystem approach. Consequently, the Conference of the Parties suggested that the General Assembly and other relevant international and regional organizations should urgently take the necessary short-term, medium-term and long-term measures to eliminate and avoid destructive practices, consistent with international law, on a scientific basis, including the application of precaution, for example, by consideration, on a case-by-case basis, of interim prohibition of destructive practices adversely impacting the marine biological diversity associated with seamounts, hydrothermal vents and cold-water corals. It further recommended that parties to the Convention should urgently take the necessary short-term, medium-term and long-term measures to respond to the loss or reduction of marine biological diversity associated with these areas.

269. By decision VII/28 on protected areas, the Conference of the Parties adopted a programme of work and established an Ad Hoc Open-ended Working Group on Protected Areas. The overall objective of the Working Group was the establishment and maintenance, by 2012, of a comprehensive, effectively managed and ecologically representative national and regional system of marine protected areas that collectively, inter alia through a global network, contributed to achieving the three objectives of the Convention and the 2010 target to significantly reduce the current rate of biodiversity loss. The Working Group held its first meeting from 13 to 17 June in Montecatini, Italy. One of the four items on the agenda of that meeting related to options for cooperation for the establishment of marine protected areas in marine areas beyond the limits of national jurisdiction.

270. The main outcome of the meeting of the Working Group concerning the marine protected areas related to the initiation of work to compile and synthesize existing ecological criteria for future identification of potential sites for protection in marine areas beyond the limits of national jurisdiction, as well as applicable biogeographical classification systems. The Working Group expressed its appreciation to the Government of Canada for its offer to host a scientific experts' workshop for this purpose.

271. The Working Group recommended that the Conference of the Parties should note that the establishment of marine protected areas beyond national jurisdiction must be in accordance with international law, including UNCLOS, and on the basis of the best available scientific information, the precautionary approach and the ecosystem approach. Regarding scientific information, the Working Group recommended that the Conference of the Parties should request the Executive Secretary to work with relevant institutions to synthesize, with peer review, the best available scientific studies on priority areas for marine biodiversity conservation, and that relevant organizations should collaborate in filling data gaps. In addition, the Working Group recommended that the Executive Secretary should explore options with relevant international and regional organizations to verify and develop a spatial database of biodiversity in marine areas, building on the database developed as part of a scientific study presented to the meeting.

272. Regarding options for cooperation, the Working Group on Protected Areas recommended that the Conference of the Parties recognize that UNCLOS set out the legal framework within which all activities in oceans and seas must be carried out. The Working Group also recommended that the Conference of the Parties should urge parties to work towards cooperation and coordination among various institutions for the establishment of marine protected areas consistent with international law and to work to develop measures to combat illegal, unreported and unregulated fishing. The Working Group decided that the results of its work should be transmitted for information to the Ad Hoc Open-ended Informal Working Group established by the General Assembly in its resolution 59/24.

273. In relation to the issue of access to genetic resources and benefits sharing, the fifth meeting of the Conference of the Parties to the Convention on Biological Diversity established in 2000 an ad hoc open-ended working group with the mandate to develop guidelines on access and benefit sharing. The sixth meeting of the Conference of the Parties adopted in 2002 the Bonn Guidelines on Access to Genetic Resources and the Fair and Equitable Sharing of the Benefits arising from their Utilization.[166] The Guidelines aim to assist Governments and other stakeholders in developing an overall access and benefit-sharing strategy and in identifying the steps involved in the process of obtaining access to genetic resources and benefit-sharing. Decision VII/19 D, adopted by the seventh meeting of the Conference of the Parties on recommendation 44 (o) of the Plan of Implementation[179] of the World Summit on Sustainable Development, mandates the working group to elaborate and negotiate an international regime on access to genetic resources and benefit-sharing with the aim of adopting an instrument. The third meeting of the Working Group, held in February 2005, addressed the nature, scope, potential objectives and elements to be considered for inclusion in the international regime. Other issues addressed during the meeting included use of terms; other approaches, including consideration of an international certificate of origin, source and legal provenance; measures to support compliance with prior informed-consent procedures and mutually agreed terms; and the need and possible options for indicators for access and benefit-sharing. (See also section F below for more information on the work of other organizations on intellectual property rights.)

274. The Convention on International Trade in Endangered Species of Wild Fauna and Flora aims at preventing the overexploitation of certain species of wild animals and plants through the regulation of international trade. Protected species are listed in appendices, which include a number of marine species, some which are found on

the high seas (see also A/59/62/Add.1, paras. 263-264). Conditions for international trade in specimens of these species depend on the appendix in which they are listed, which reflects the degree of protection needed to ensure their survival in the wild. The term "trade" is defined in article 1 of the Convention to mean not only export, re-export and import, but also "introduction from the sea". The latter term is defined to mean "transportation into a State of specimens of any species which were taken in the marine environment not under the jurisdiction of any State". At its eleventh and thirteenth meetings, the Conference of the Parties to the Convention sought to clarify the concept of "introduction from the sea" but did not reach a final conclusion. Decision 13.18 directs the Standing Committee of the Convention to convene a workshop on introduction from the sea to consider implementation and technical issues, taking into account the two FAO expert consultations in 2004, on implementation and legal issues related to the Convention and issues associated with listing commercially exploited aquatic species.[188]

275. The secretariat of the Convention actively provides advice and assistance to parties on all aspects of the Convention, in areas of general implementation, science, legislation, compliance and enforcement, training and information. National and regional participation is promoted through regular meetings of the Conference of the Parties, technical committees and regional/national training workshops. Training is provided through workshops and various forms of electronic learning. The main priority for training is improving capacity to manage and regulate legal trade in specimens listed in the appendices to the Convention, including marine species, focusing on permits and certificates, non-detriment findings, border inspections and general compliance with the provisions of the Convention.

276. The Convention on Migratory Species aims at the conservation of avian, terrestrial and aquatic migratory species that cross national jurisdictional boundaries in the course of their migration. These include marine species (avian and aquatic) moving between areas of the national jurisdiction and the high seas.

277. Parties to the Convention that are range States for a migratory species have the obligation of taking individually or in cooperation appropriate and necessary steps to conserve such species and their habitat (article II, para. 1). Significant in this regard is the definition of a range State provided by the Convention (article I, para. 1(h)), according to which a range State in relation to a particular migratory species means any State which exercises jurisdiction over any part of the range of that species, or a State, flag vessels of which are engaged outside national jurisdictional limits in taking that migratory species. This implies that the obligation of the parties to conserve migratory species applies also to their flag vessels operating in the high seas.

278. Parties to the Convention on Migratory Species should provide protection to migratory species listed on appendix I to the Convention; that appendix includes species that are considered in danger of extinction. It includes at present 107 species, among which are nine species of whale, one species of seal, several species of seabirds, six species of marine turtle and one species of shark that occur predominantly or occasionally in the high seas.

279. Besides the obligations of individual parties, the Convention has actively promoted the conservation of these species by providing support to research and conservation projects aimed at addressing some of the threats they face, in particular by-catch. Guidance to the parties in addressing the issue of by-catch of migratory

species has been provided by the Conference of the Parties through resolution 6.2 (By-catch) and recommendation 7.2 (Implementation of resolution 6.2 on by-catch).

280. The Convention on Migratory Species also operates through the establishment of agreements among range States aimed at the conservation of individual species or groups of related species on a regional scale. Several of the agreements concluded so far under the auspices of the Convention cover areas in the high seas. These include: (a) the Agreement on the Conservation of Albatrosses and Petrels (the Agreement covers 22 species of albatrosses and 7 species of petrels throughout their entire range, covering most of the southern hemisphere and was negotiated with the main purpose of tackling the problem of by-catch of these birds in long-line fisheries); (b) the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (the Agreement covers all species of cetaceans occurring regularly or occasionally in the Agreement area); (c) the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (the Agreement covers all species of small cetaceans — all toothed whales with the exception of the sperm whale *Physeter Macrocephalus* — occurring in the Agreement area; once the extension of the Agreement area decided by the fourth meeting of the parties to the Agreement, held in Esbjerg, Denmark, in August 2004, enters into force, the Agreement will cover parts of the high seas); and (d) Memorandum of Understanding on the Conservation and Management of Marine Turtles and their habitats of the Indian Ocean and South-East Asia (the Memorandum covers six species of marine turtle in the Indian Ocean and South-East Asia and adjacent seas, extending eastwards to the Torres Strait).

281. The International Seabed Authority's basic function is to manage the mineral resources of the Area, which are the common heritage of mankind, in such a way as to give effect to the principles contained in part XI of UNCLOS and the 1994 Agreement for the Implementation of Part XI. By definition, the Area is the seabed and ocean floor and subsoil thereof beyond national jurisdiction. In managing the mineral resources, the Authority is required to ensure effective protection of the marine environment, and therefore biodiversity, from harmful effects which might arise both from exploration for, and subsequent exploitation of, these resources (article 145). In addition, the Authority has a general responsibility to promote and encourage the conduct of marine scientific research in the Area and to coordinate and disseminate the results of such research and analysis (article 143, para. 2). The Authority is carrying out its mandate by promoting and encouraging international cooperation, establishing databases on species to be found in potential exploration and mining areas and their distribution and gene flow and by encouraging the use of a uniform taxonomy and other standardized data and information in this regard.

282. The International Seabed Authority has developed and adopted regulations to govern prospecting and exploration for polymetallic nodules deposits in the Area. It is currently considering draft regulations on prospecting and exploration for polymetallic sulphides and cobalt-rich ferro-manganese crusts. Given the dearth of knowledge of the marine environment of the Area and the potential impact of exploration and mining on its biodiversity, these regulations have a strong environmental focus.

283. Threats to deep-sea biodiversity from mineral prospecting, mineral exploration or mineral exploitation in the Area need to be managed in such a way as to prevent species extinctions. In relation to the benthic ecosystem, the International Seabed

Authority is in the process of establishing a framework to manage successfully threats to the marine environment and its biodiversity from activities in the Area, through its regulations on prospecting and exploration. This framework includes the guidelines recommended by the Legal and Technical Commission of the Authority to contractors for environmental impact assessments, standardization of relevant environmental data and information and international cooperative scientific projects designed to increase the international community's knowledge of species ranges, species distribution and gene flow in the various mineral provinces of the Area.

284. Since 1998, the International Seabed Authority has held workshops and seminars on specific issues related to deep seabed mining, with participation by internationally recognized scientists, experts, researchers and members of the Legal and Technical Committee of the Authority as well as representatives of contractors, the offshore mining industry and member States. The workshops have dealt with a variety of topics, including the assessment of environmental impacts from activities in the Area, the development of technology for deep seabed mining, the status and prospects of deep-sea mineral resources other than polymetallic nodules, standardization of techniques for data collection and analysis and prospects for international collaboration in marine environmental research to enhance understanding of the deep-sea environment, including its biodiversity. Many of these workshops have had substantial components addressing the biodiversity of the Area.

285. As a direct result of the discussions in these workshops, the International Seabed Authority is currently collaborating in a major research project, referred to as the Kaplan project because of its main source of funding, the J. M. Kaplan Fund in New York. The Kaplan project is an international research project carried out in the Clarion-Clipperton Zone nodule province, in the Pacific Ocean. The aims of the Kaplan project are to measure biodiversity, species ranges and gene flow in the Clarion-Clipperton Zone. This information can be used to determine the level of risk introduced to the province's biodiversity as a result of mining for polymetallic nodules. The outputs will include a DNA database of species found in the Clarion-Clipperton Zone, the creation of a uniform taxonomy for the region and the integration of the results for the various taxa (polychaetes, nematodes, foraminifera and microbes) based on molecular and morphological approaches into a database. Genetic sequences will be included in this database, making it the first project to assess the genetic resources in the most significant polymetallic nodule province in the Area. A proposed component of this project is to train scientists from developing countries in the use of molecular techniques to study biodiversity. Therefore the project is aimed at both increasing the international community's knowledge of marine biodiversity in the Area and training of scientists to assess biodiversity better.

286. In 2004, the Legal and Technical Committee discussed the role of the International Seabed Authority in relation to the management of high-seas biodiversity. In his report to the Council, the Chairman of the Committee noted that the Commission's discussion during the session was for the purpose of gathering information and improving understanding of seabed biodiversity and the management and legal status of the living organisms of the Area. A paper on the legal implications related to the management of seabed living resources in the Area had been prepared by the Vice-Chairman of the Committee in her personal capacity, containing an analysis of the provisions of the Convention and the mandate of the

Committee.[189] The discussions revealed a need to address relevant issues taking into account the work of other organizations. Taking note of the Committee's discussions on issues relating to biodiversity in the Area, the President of the Council expressed the support of the Council for the work of the Committee in protecting the marine environment and managing the biological resources of the world's oceans.

287. During the 2004 session of the International Seabed Authority, a presentation was made by Census of Marine Life on its programmes, in particular on the work on the Biography of Deep-Water Chemosynthetic Ecosystems, and the Seamounts Group, as they cover the environments where polymetallic sulphides and cobalt-rich crusts deposits are found, respectively. As a result, the Authority is in communication with both bodies to investigate the potential for collaboration. It is hoped that the Authority can assist both of those bodies in terms of international cooperation, broadening the understanding of the effect these environments have on global biodiversity and how best to protect them.

288. While the International Seabed Authority is benefiting from close collaboration with those already conducting research on biodiversity in and around mineral deposits in the Area, it is also providing a forum for the discussion and development of principles for the management of this biodiversity.

289. The third World Conservation Congress of the World Conservation Union, held in November 2004, recognized the need to enhance the understanding of high-seas biological diversity, productivity and ecological processes. It called on States and international organizations to increase funding and support for marine scientific research, in particular capacity-building collaborative research, in order to improve knowledge and to ensure the sustainability of human activities. The Congress also called for cooperation to establish representative networks, to develop the scientific and legal basis for the establishment of marine protected areas beyond national jurisdiction and contribute to a global network by 2012. The Congress also requested States, regional fisheries management organizations and the General Assembly to protect seamounts, deep-sea corals and other vulnerable deep-sea habitats from destructive fishing practices, including bottom trawling, on the high seas.

290. A Task Force on High Seas Marine Protected Areas was established in 2004 by the World Commission on Protected Areas of the World Conservation Union. This is intended to facilitate the development of marine protected areas, particularly in vulnerable environments such as seamounts and deep-sea coral habitats. Under the Global Marine Species Assessment project, the Union and its partners are launching a global assessment to improve knowledge of marine species.

291. The 1946 International Convention for the Regulation of Whaling provides the International Whaling Commission with the dual mandate of both conserving whale stocks and managing whaling. The Convention applies both in areas under national jurisdiction and on the high seas. The Commission's activities relate mostly to the conservation of cetaceans and the sustainable use of whale stocks through consumptive or non-consumptive use (such as whale watching).

292. Since the International Whaling Commission agreed on a moratorium on commercial whaling in 1982, its Scientific Committee has developed conservative scientific methods for determining safe catch limits explicitly taking uncertainty into account. In 1994, the Commission adopted the Revised Management Procedure

for determining commercial whaling catch limits, but agreed that it would not be implemented until a Revised Management Scheme was developed to ensure that catch limits were not exceeded. Since no agreement has yet been reached on the Scheme, the moratorium on commercial whaling continues to be in force.

293. Although the management procedures of the International Whaling Commission take into account environmental factors in a precautionary manner, they are essentially single-species approaches. However, the Commission's Scientific Committee has begun to examine the links between fisheries and cetaceans, including how any change in the abundance of cetaceans is likely to be influenced by changes in fishery catches. A recent workshop on these issues was inconclusive. The Scientific Committee has either completed or is continuing in-depth assessments of a number of whale populations under its management. It has expressed concern over the status of a number of small populations of large whales, particularly the North Atlantic right whale and the western North Pacific grey whale.

294. There are currently two whale sanctuaries in which commercial whaling is prohibited: the Indian Ocean and the Southern Ocean. These include areas beyond national jurisdiction. Whale sanctuaries have been proposed in the South Pacific and the South Atlantic but have not been adopted. All sanctuaries are subject to periodic review: the Indian Ocean sanctuary was reviewed in 2002, while the Scientific Committee completed in 2004 the review of the Southern Ocean sanctuary.

295. The International Whaling Commission has been involved since the early 1990s in aspects of whale watching as a sustainable use of cetacean resources. A series of objectives, principles and guidelines have been adopted for managing whale watching. It has cooperated with FAO and the secretariats of the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas and the Agreement on the Conservation of Cetaceans of the Black Sea, the Mediterranean Sea and Contiguous Atlantic Area, in addition to general calls to States to take measures to reduce by-catch. The Commission has invited member States to raise the issue of ship strikes at IMO.

296. In order to investigate the effects of environmental change on cetaceans, the Scientific Committee has conducted two research projects: "POLLUTION 2000", aimed at determining whether predictive and quantitative relationships exist between biomarkers of exposure to and/or effect of PCBs and PCB levels in certain tissues, as well as at validating and calibrating sampling and analytical techniques; and "SOWER 2000", aimed at examining the influence of temporal and spatial variability in the physical and biological Antarctic environment on the distribution, abundance and migration of whales.

297. In addition, the Scientific Committee held a mini-symposium in 2005 to consider its possible assistance in the development and interpretation of studies aimed at elucidating the potential impacts of anthropogenic noise on cetaceans.

E. Other international entities

298. The International Coral Reef Initiative was established in 1994 to conserve, restore and promote the sustainable use of coral reefs and related ecosystems. Coral reefs are located both within and beyond national jurisdiction. Furthermore, the

potentially harmful impacts (and the solutions that might apply) on vulnerable biodiversity such as reefs and the contribution they make to other sectors such as fisheries, are similar whether that biodiversity is found within areas of national jurisdiction or beyond.

299. The activities of the International Coral Reef Initiative are facilitated by the International Coral Reef Action Network, an operational network established in 2000. The Network has created a globally integrated action plan to manage and protect coral reefs, thereby supporting the implementation of the call to action and framework for action adopted under the Initiative and other internationally agreed goals, objectives, targets and commitments related to coral reefs. Field projects have been developed to assist in the realization of the abstract agreements on marine biological diversity. The Global Coral Reef Monitoring Network was established in 1995 with the aim of improving the management and sustainable conservation of coral reefs by monitoring and assessing the status and trends of the reefs and how people use and value their resources. As an operational network under the Initiative, the Monitoring Network produces, among other products, regular biennial reports on the status of coral reefs of the world. The latest report was in December 2004 and includes a chapter on the status of cold-water coral reefs.[190] The UNEP Coral Reef Unit was established in 2000 as the focal point for coral reefs within UNEP and the United Nations system. Promoting a diverse portfolio of coral-reef work, the Unit has led the implementation of UNEP's Governing Council decisions on coral reefs and guided UNEP's programme support and policy analysis on the conservation, management and sustainable use of coral reefs and the resources and services they provide.

300. In July 2004, the International Coral Reef Initiative adopted a decision on cold-water coral reefs, which, inter alia, widened the remit of the Initiative and called on an ad hoc committee to prepare a draft work programme on cold-water coral reefs. The General Meeting of the Initiative, held in the Seychelles from 25 to 27 April 2005, endorsed the establishment of a cold-water corals committee and agreed on a work programme for the committee, which will report progress at the next meeting of the Initiative.

F. Organizations working on intellectual property rights

301. As the United Nations specialized agency responsible for the promotion and protection of intellectual property, WIPO has considered intellectual property issues related to genetic resources. In 1998, UNEP and WIPO jointly produced a study on the role of intellectual property rights in the sharing of benefits arising from the use of biological resources.[191] The same year, the WIPO Standing Committee on the Law of Patents, which is the body mandated to harmonize patent law, discussed issues related to intellectual property and genetic resources. In the context of its work on a draft substantive patent law treaty, the Standing Committee has continued to consider issues related to genetic resources, including the disclosure of origin of genetic resources. Furthermore, in 1999 the WIPO Working Group on Biotechnology issued a questionnaire to gather information about the protection of biotechnological inventions. The questionnaire addressed aspects related to intellectual property and genetic resources.

302. In 2000, the WIPO General Assembly established the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore, which deals with a range of issues concerning the interplay between intellectual property and genetic resources. The work of the Intergovernmental Committee covers three main areas: defensive protection of genetic resources through measures that prevent the grant of patents over genetic resources that do not fulfil the requirements of novelty and non-obviousness; intellectual property aspects of access to genetic resources and equitable benefit-sharing arrangements (including the commissioning of a database to serve as a capacity-building tool and to help inform policy debate); and disclosure requirements in patent applications that relate to genetic resources and associated traditional knowledge used in a claimed invention.

303. Responding to an invitation from the sixth Conference of the Parties to the Convention on Biological Diversity in 2002, WIPO prepared a technical study on patent disclosure requirements related to genetic resources and traditional knowledge.[192] In 2003, the Working Group on Reform of the Patent Cooperation Treaty discussed proposals regarding the declaration of the source of genetic resources in patent applications. In response to an invitation from the seventh meeting of the Conference of the Parties, WIPO is currently examining the interrelation between access to genetic resources and disclosure requirements in intellectual property rights applications. To that end, the WIPO General Assembly decided to convene an ad hoc intergovernmental meeting on genetic resources and disclosure, which met in June 2005 to discuss a consolidated document of all comments and observations submitted by member States concerning the issues above. The results of the meeting were presented to the Intergovernmental Committee, which also met in June 2005.

304. The 2001 Doha Declaration[193] instructed the Trade-Related Aspects of Intellectual Property Rights Council, the body responsible for administering the Agreement on Trade-Related Aspects of Intellectual Property Rights, in its review of article 27.3 (b) of the Agreement, to examine the relationship between the Agreement and the Convention on Biological Diversity.[34] In 2002, the WTO secretariat prepared a summary of the issues raised and points made by delegations in the Council on the relationship between the Agreement and the Convention. During the Council's discussions, the following topics were raised: ways of applying provisions of the Agreement on patenting biological inventions, including the extent to which life forms should be patentable; ways to implement the Agreement and the Convention together and whether the Agreement should be amended to avoid potential conflicts; whether patents should disclose the source of genetic material; and the type of approval necessary prior to using genetic material. Discussions are ongoing in the Council regarding disclosure requirements.

IV. Conclusions

305. As the conservation and sustainable use of biodiversity in general and marine biodiversity including in areas beyond national jurisdiction in particular, are increasingly attracting attention as an integral part of socio-economic development, the question arises as to how this goal can be achieved. Key issues and questions requiring further consideration and more detailed background studies, as well as possible options and approaches for the promotion of cooperation and coordination

in the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction, are set out below.

306. As scientific information and data on the diversity of deep-sea organisms, the biogeography of the deep sea floor biota and the distribution of key habitats and ecosystems functions are highly insufficient, there is an urgent need to expand and increase such scientific research programmes and studies. In particular, further research and studies are required to promote the conservation and sustainable use of marine biodiversity, bearing in mind the precautionary approach.

307. Enhanced scientific research will require the development of new and more targeted technologies, including sampling techniques. These technologies should be environmentally sound in order to minimize effects on marine ecosystems.

308. Since scientific research programmes utilizing highly sophisticated technology are very costly and labour intensive, cooperation and collaboration among States, competent international organizations, research institutions, funding agencies, academia and private sectors, should be encouraged, including through partnerships and joint ventures. This cooperation could result not only in a sharing of costs, but also in an increased geographical coverage, better sharing of information and a contribution to capacity-building. In this regard, consideration could be given to greater involvement of scientists from developing countries in scientific research programmes and activities in areas beyond national jurisdiction.

309. As biodiversity is increasingly acquiring importance from the perspective of economic development, there is an urgent need to balance economic benefits of such development with long-term conservation and sustainable use of biodiversity. In order to achieve this balance, the value of ecological goods and services should be taken into account, including indirect and non-use values. This would enable the preparation of a cost-benefit analysis for the conservation and sustainable use of biodiversity. However, as it is difficult to obtain the information necessary to assign an appropriate value to biodiversity and as there is also a need to identify the procedure for subsequent analysis of such information, more research and economic studies are required to examine these issues. The use of market-based approaches and incentives, such as those described in chapter II.C above, could be explored to improve conservation and sustainable use of marine biodiversity.

310. The loss of marine biological diversity can greatly limit socio-economic benefits derived from it for future generations, hence the importance of using biological resources in a sustainable manner. Socio-economic aspects of marine biodiversity beyond national jurisdiction need to be given a more prominent role when designing, developing or implementing conservation and management measures. In that context, conservation measures should be an essential component of economic planning, in order to attain sustainable development. Furthermore, socio-economic assessments should be included in cost-benefit analysis for the conservation and sustainable use of biodiversity.

311. Marine biodiversity is increasingly affected by a wide range of anthropogenic stresses related to existing and emerging activities. Further research is also urgently required to understand better environmental issues relating to marine biodiversity, including its assimilative capacity, in order to ensure its conservation and sustainable use as an integral part of economic development. Further studies are also

needed to understand better the impacts of current and future anthropogenic stresses on marine biodiversity in order to identify means to mitigate them.

312. Since fishing activities are recognized to have a significant impact on marine biodiversity beyond national jurisdiction, cooperation and coordination in conservation and management of fish stocks through relevant organizations should be enhanced. Biodiversity concerns should therefore be taken into account in developing measures for the conservation and management of fish stocks and fishing should be considered as one of the activities to be addressed in the conservation and sustainable use of marine biodiversity.

313. As highlighted in chapter II.F, UNCLOS provides the legal framework for all activities in the oceans, including for the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction. A number of specialized international instruments supplement UNCLOS by directly or indirectly providing measures for the conservation and sustainable use of biodiversity beyond national jurisdiction. Increased membership in these treaties, their implementation and strict compliance with their provisions will promote the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction. The effective implementation of the voluntary instruments mentioned in chapter II.F, would also be beneficial in this regard. A coordinated approach to the implementation of all these instruments is also essential.

314. As not all activities affecting biodiversity beyond national jurisdiction, including their cumulative effects, and not all components of marine biodiversity are specifically regulated by UNCLOS and other instruments, the establishment of new measures and regulations for the conservation and sustainable use of marine biodiversity consistent with UNCLOS and, where necessary, regulatory mechanisms, may be considered.

315. This is of particular relevance to the issue of genetic resources. Different views have been expressed on whether, in accordance with UNCLOS, deep seabed genetic resources beyond national jurisdiction fall under the regime for the Area or under the regime for the high seas. Consequently, the status of these resources and the nature of activities relating to them should be clarified, in the light of the general principles contained in UNCLOS.

316. Another area that needs to be clarified in the context of conservation and sustainable use of marine biodiversity, is the relationship between high-seas activities, in particular fishing, and a coastal State's sovereign rights over the sedentary species of the continental shelf.

317. Lastly, public awareness about the benefits derived from the conservation and sustainable use of marine biodiversity beyond national jurisdiction should be promoted. Improved communication strategies and education campaigns for the general public as well as decision-makers are essential to achieve the objectives of conservation and sustainable use as an integral part of social and economic development.

Notes

[1] United Nations *Treaty Series*, vol. 1833, No. 31363.

[2] Ibid., vol. 1760, No. 30619.

[3] Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: Biodiversity Synthesis* (Washington D.C., World Resources Institute, 2005).

[4] The following experts contributed to the present report: J. Beddington, E. Escobar, J. A. Koslow, P. A. Loka Bharathi, C. Perrings, A. Rogers, C. R. Smith and R. Sumaila; valuable information was also provided by the Japan Agency for Marine-Earth Science and Technology and the French Research Institute for Exploitation of the Sea.

[5] Escobar: R. Kassen and P. B. Rainey, "The ecology and genetics of microbial diversity", *Annual Review of Microbiology*, vol. 58 (October 2004); T. Stevens, "The deep subsurface biosphere", *Biodiversity of Microbial Life: Foundation of Earth's Biosphere*, J. T. Staley and A. L. Reysenbach, eds. (New York, Wiley-Liss, 2001).

[6] Contributed by Rogers.

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[157] The present section supplements part II of the report of the Secretary-General contained in document A/59/62/Add.1 and part II of the report of the Secretary-General contained in document A/59/298, which provided greater detail on the instruments mentioned.

[158] The relationship between the two conventions is articulated under articles 237 and 311 of the United Nations Convention on the Law of the Sea and article 22 of the Convention on Biological Diversity. For a study on the relationship between those conventions with regard to the conservation and sustainable use of genetic resources on the deep seabed, see UNEP/CBD/SBSTTA/8/INF/3/Rev.1.

[159] Additional information on these instruments can be found at www.unep.org/regionalseas.

[160] Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area (ISBA/6/A/18, annex) contain a definition of "marine environment". See also the recommendations for the guidance of the contractors for the assessment of the possible environmental impacts arising from exploration for polymetallic nodules in the Area (ISBA/7/LTC/1/Rev.1).

[161] For further information on the instruments that provide for the protection of specific areas and species, see UNEP/CBD/WG-PA/1/INF/2.

[162] Such criteria and guidelines have not yet been developed.

[163] See UNEP/CBD/COP/5/INF/7.

[164] *Deep Sea 2003 ...*, see in particular the account of the Workshop on Bioprospecting in the High Seas.

[165] Articles 15 to 21 deal, respectively, with access to genetic resources; access to and transfer of technology; exchange of information; technical and scientific cooperation; handling of biotechnology and distribution of its benefits; financial resources; and the Financial Mechanism.

[166] UNEP/CBD/COP/6/20, annex to decision VI/24 taken by the Conference of the Parties at its sixth session.

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

[168] The information in the present section was taken primarily from *WIPO Intellectual Property Handbook: Policy, Law and Use* (WIPO publication No. 489 (E)) and from document UNEP/CBD/WG-ABS/3/2.

[169] The Patent Cooperation Treaty was adopted in 1970, amended in 1979 and modified in 1984 and 2001.

[170] The Patent Law Treaty was concluded on 1 June 2000 and entered into force on 28 April 2005.

[171] As at 28 January 2005, there were 36 such authorities: seven in the United Kingdom of Great Britain and Northern Ireland, three each in the Republic of Korea and the Russian Federation, two each in China, Italy, Japan, Poland and the United States of America and one each in Australia, Belgium, Bulgaria, Canada, the Czech Republic, France, Germany, Hungary, Latvia, India, the Netherlands, Slovakia and Spain.

[172] The information in the present section was primarily taken from document UNEP/CBD/WG-ABS/3/2.

[173] The Agreement on Trade-Related Aspects of Intellectual Property Rights entered into force on 1 January 1995.

[174] *Report of the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972* (United Nations publication, Sales No. E.73.II.A.14 and corrigendum), chap. I.

[175] General Assembly resolution 37/7, annex.

[176] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992* (United Nations publication, Sales No. E.93.I.8 and corrigenda), vol. I: *Resolutions adopted by the Conference*, resolution 1, annex I.

[177] Ibid., annex II.

[178] *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum), chap. I, resolution 1, annex.

[179] Ibid., resolution 2, annex.

[180] UNEP/Env.Law/4/4, annex I.

[181] International Maritime Organization resolution A.868 (20).

[182] *The International Regime for Bioprospecting: Existing Policies and Emerging Issues for Antarctica* (United Nations University, Institute of Advanced Studies, 2003).

[183] Food and Agriculture Organization of the United Nations resolution 15/93.

[184] The Fisheries Resources Monitoring System is expected to monitor the state of high-seas biodiversity.

[185] The Conference, organized by the French Government and sponsored by UNESCO independently from intergovernmental negotiations, was held in Paris from 24 to 28 January 2005. For more information see http://www.recherche.gouv.fr/biodiv2005paris.

[186] See report of the first meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (UNEP/CBD/COP/2/5).

[187] See documents UNEP/CBD/SBSTTA/8/9/Add.3/Rev.1 and UNEP/CBD/SBSTTA/8/INF/3/Rev.1.

[188] Fisheries Report No. 741 and Fisheries Report No. 746 (Rome, Food and Agriculture Organization of the United Nations, 2004).

[189] Paper by F. Armas Pfirter on legal implications related to the management of seabed living resources in the Area under UNCLOS.

[190] C. Wilkinson, ed., *Status of Coral Reefs of the World: 2004*, vols. 1 and 2 (Townsville, Australian Institute of Marine Science, 2004).

[191] Publication No. 769 (E), World Intellectual Property Organization.

[192] See UNEP/CBD/WG-ABS/2/INF/4.

[193] World Trade Organization decision WT/MIN(01)/DEC/1.

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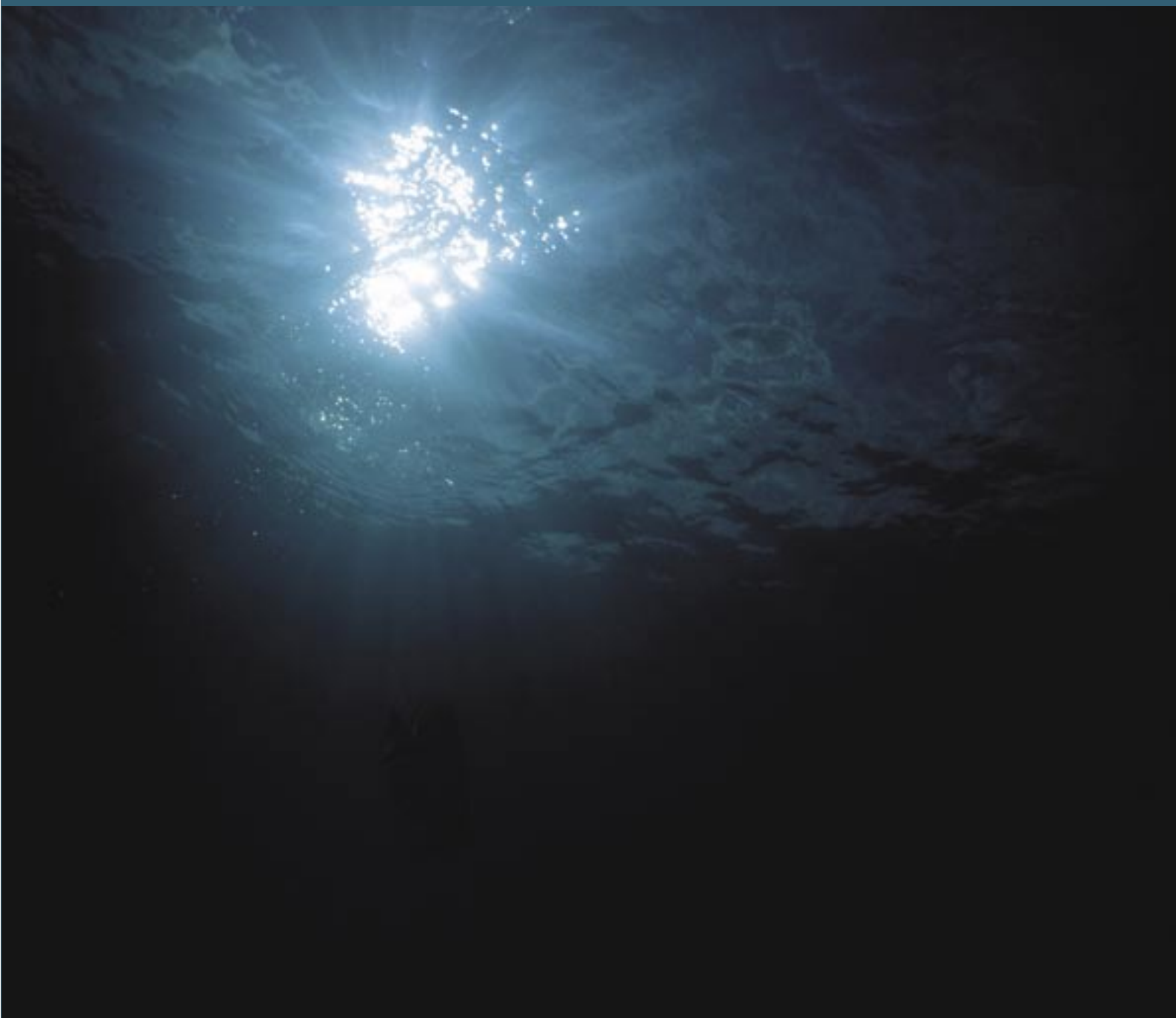
Bioprospecting of Genetic Resources in the Deep Seabed: Scientific, Legal and Policy Aspects



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UNU-IAS Report

Bioprospecting of Genetic Resources in the Deep Seabed: Scientific, Legal and Policy Aspects

Contents

Foreword 6

Executive Summary 7

1 Introduction 8

2 Characteristic features of deep seabed ecosystems 9

2.1. Various deep seabed ecosystems 9

2.1.1. Hydrothermal vents 9

2.1.2. Cold seeps and other similar deep sea ecosystems 11

2.1.3. Seamounts 11

2.1.4. Similarities and differences between deep seabed ecosystems 12

2.2. Deep seabed ecosystems and the origin of life 13

2.3. Information on researched sites 13

3 Review of bioprospecting activities in the deep seabed 15

3.1. The object and nature of bioprospecting 15

3.1.1. Marine bioprospecting and marine scientific research 15

3.1.2. Genetic resources, genetic material and microorganisms 16

3.2. Analysis of the type and level of activities involving genetic resources from the deep seabed 16

3.2.1 Review of relevant research programmes 16

3.2.2. Review of various uses of deep seabed genetic resources 19

3.2.2.1. The role of patents with regard to deep seabed genetic resources 19

3.2.2.2. Review of patents related to deep seabed genetic resources 20

3.3. Information on recorded or potential impacts of research activities carried out in the deep seabed 21

3.4. Technological constraints and opportunities for deep seabed bioprospecting 22

3.5. Consequences for management resulting from the features of, and threats to, deep seabed ecosystems, as well as from technological aspects 24

4 Overview of global biotechnology and bioprospecting trends 25

4.1. General industry trends 25

4.2. Bioprospecting for marine resources 27

4.3. Bioprospecting for extremophiles: the case of Antarctica 28

5 International instruments and ongoing activities relevant to deep seabed bioprospecting 30

5.1. United Nations Convention on the Law of the Sea 30

5.1.1. Genetic resources under the UN Convention on the Law of the Sea 30

5.1.2. Bioprospecting in the High Seas: the regime of living resources under Part VII 30

5.1.3. Bioprospecting in the Area: Part XI and the role of the International Seabed Authority 31

5.1.4. The Regulations of the International Seabed Authority 32

5.1.5. Part XIII: Marine scientific research 33

5.1.6. Part XIV: Development and transfer of marine technology 34

5.1.7. Part XII: Protection and preservation of the marine environment 34

5.2. The UN General Assembly and the UN Informal Consultative Process on Oceans and the Law of the Sea 35

5.2.1. UN General Assembly resolutions and reports of the Secretary-General 35

5.2.2. Further activities of the General Assembly, including the UN Informal Consultative Process on the Law of the Sea 36

5.3. The Convention on Biological Diversity 38
5.3.1. Deep seabed genetic resources under the Convention on Biological Diversity 38
5.3.2. Bioprospecting under the Convention on Biological Diversity 40
5.4. Intellectual property rights instruments 41
5.4.1. Intellectual property rights and genetic resources 41
5.4.2. Activities of the World Intellectual Property Organization 42
5.4.3. The Agreement on Trade-Related Aspects of Intellectual Property Rights of the World Trade Organization 43
5.5. Other relevant international instruments and activities 44
5.5.1. Regional marine environmental-related instruments 44
5.5.1.1. Convention for the Protection of the Marine Environment of the North-East Atlantic 44
5.5.1.2. Noumea Convention 44
5.5.1.3. The Mediterranean Action Plan 45
5.5.1.4. The Antarctic Treaty System 45
5.5.2. The World Summit on Sustainable Development 47
5.5.3. Intergovernmental Oceanographic Commission of UNESCO 47
5.6. Non governmental initiatives 47
5.6.1. Codes of conduct 47
5.6.2. Other initiatives 48
5.7. Reporting requirements under international instruments 48
5.7.1. Reporting requirements under the UN Convention on the Law of the Sea 48
5.7.2. Reporting requirements under the Convention on Biological Diversity 49
5.7.3. Reporting requirements under other instruments 49

6 Outline of domestic measures of selected countries 51
6.1. Domestic measures on marine scientific research and bioprospecting 51
6.2. Indirect regulation of bioprospecting: marine protected areas 51
6.2.1. Canada: the Endeavour Marine Protected Area 51
6.2.2. Portugal: the Lucky Strike and Menez Gwen Marine Protected Areas 52

7 Conclusions and possible approaches to bioprospecting in the deep seabed 53
7.1. Main findings of the report 53
7.1.1. Status of, and threats to, deep seabed ecosystems 53
7.1.2. The value of deep seabed ecosystems and resources 53
7.1.3. Trends in deep seabed research 54
7.1.4. Current legal and policy framework 55
7.1.4.1. Bioprospecting within national jurisdiction 55
7.1.4.2. Bioprospecting beyond national jurisdiction 55
7.2. Issues to be addressed and areas requiring further study 57
7.3. Feasible approaches to designing a regime for bioprospecting in the deep seabed 58
7.3.1. Retaining the *status quo* 58
7.3.2. Using regional frameworks 58
7.3.3. Adoption of guidelines by the General Assembly 59
7.3.4. Using the framework of the Convention on Biological Diversity 59
7.3.5. Applying the regime of the Area 60

Endnotes 62

Abbreviations

AIMS Australian Institute of Marine Science
ATS Antarctic Treaty System
CCAMLR Convention on the Conservation of Antarctic Marine Living Resources
CRAMRA Convention on the Regulation of Antarctic Mineral Resources Activities
CBD Convention on Biological Diversity
CNRS French National Scientific Research Center
CoML Census of Marine Life
COP Conference of the Parties
DSRV Deep Submergence Research Vehicle
EEZ Exclusive Economic Zone
EIA Environmental impact assessment
FAO Food and Agriculture Organization of the United Nations
GEOSS Global Earth Observing System of Systems
HBOI Harbor Branch Oceanographic Institution
ICP (also UNICPOLOS) United Nations Informal Consultative Process on the Law of the Sea
IDA International Depositary Authorities
IFREMER French Research Institute for the Exploitation of the Sea
IGC WIPO's Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore
INSERM French National Institute of Health and Medical Research
IOC Intergovernmental Oceanographic Commission
IPRs Intellectual Property Rights
ISA International Seabed Authority
JAMSTEC Japan Agency for Marine-Earth Science and Technology
LTC ISA's Legal and Technical Commission
MA Millennium Ecosystem Assessment
MAP Mediterranean Action Plan
MarBEC Marine Bioproducts Engineering Center
MATs Mutually agreed terms
MPA Marine protected area
MSR Marine scientific research
NCI US National Cancer Institute
NOAA US National Oceanic and Atmospheric Administration
NSF US National Science Foundation
OSPAR Organization for the Protection of the Marine Environment of the North-East Atlantic
PIC Prior informed consent
R&D Research & development
ROV Remote Operation Vehicles
SBSTTA Subsidiary Body on Scientific Technical and Technological Advice
TRIPS Agreement on Trade-Related Aspects of Intellectual Property Rights
UNCLOS United Nations Convention on the Law of the Sea
UNDOALOS United Nations Division for Ocean Affairs and the Law of the Sea
UNEP United Nations Environment Programme
WIPO World Intellectual Property Organization
WSSD World Summit on Sustainable Development
WTO World Trade Organization
XBR Extremobiosphere Research Center of JAMSTEC

Foreword

The growing commercial interest in deep seabed research and the use of the unique genetic resources that this research has discovered raises key policy, ethical and moral questions. For example, who owns these resources, how should they be used and how should the benefits of this research be distributed, are just some of the issues that need attention.

Although some aspects of this type of use are adequately addressed by existing policies, there is uncertainty about the rules governing the use of these genetic resources.

The absence of clear rules governing the use of deep seabed genetic resources restricts use of these resources, and this affects stakeholders in significant ways. For industry, the uncertainty about the use and ownership of samples inhibits their support and involvement for this type research. For scientists, a lack of clear protocols for exchanging information arising from commercial activities inhibits their ability to work with companies and adapt to the changing nature of basic research around the world. For governments, it has proven difficult to decide about the need for, and modalities of, conservation measures for the deep seabed environment and also to negotiate how benefits of commercially orientated research are adequately shared.

The debate so far has indicated a strong need for more information and analysis. It is important that this information and analysis be neutral, balanced and accurate.

This study aims to provide a factual review of the scientific, legal and policy aspects related to bioprospecting in seabed areas beyond national jurisdiction.

The United Nations University Institute of Advanced Studies (UNU-IAS) was established in 1996 as a research and training centre of UNU to undertake research and postgraduate education on emerging issues of strategic importance for the United Nations and its Member States. Pursuant to its Statute, UNU-IAS undertakes its work in an independent, neutral and objective manner. A key purpose of the Institute is to promote interaction between the UN System and other bodies. Development of this report is part of the wider programme on biodiversity at the Institute. The programme is also looking at bioprospecting in the Antarctica, certificates of origin for genetic resources and training for developing country officials.

I hope that this study will contribute to filling a gap in knowledge regarding deep seabed bioprospecting, thereby helping further advance policy debates on the issue.

A.H. Zakri
Director, UNU-IAS
May 2005

Executive Summary

Governments and international policy-makers are increasingly requesting information on various aspects of activities carried out in remote areas beyond the limits of national jurisdiction. This study focuses on deep seabed bioprospecting, loosely defined as the search for, and exploitation of, valuable compounds from genetic resources of the seabed beyond national jurisdiction. It provides an overview of the scientific, legal and policy aspects related to the issue, and explores various policy options that exist to address deep seabed bioprospecting at the international level.

A more detailed overview of the study is provided in Section 7, which outlines the report's main findings and possible approaches to addressing deep seabed bioprospecting.

Scientific research related to deep seabed genetic resources, whether purely academic or commercially-oriented, is restricted to a very few, who own the necessary technological capacity and the financial resources to access these remote areas. This raises development and ethical issues, among others, since the potential applications of deep seabed genetic resources to various sectors, including the health and food sectors, are manifold but the legal status of these resources is still uncertain.

Deep seabed ecosystems and associated genetic resources offer great opportunities in terms of bioprospecting and scientific interest. Seamounts are host to an extremely rich macrofauna, while hydrothermal vents provide valuable information with regard to the adaptation of life to extreme conditions. More generally, the study highlights the importance of deep seabed ecosystems and associated genetic resources from the ecological, scientific, economic, and ethical points of view.

The study demonstrates that bioprospecting for deep seabed genetic resources is taking place and that related commercial applications are being marketed. Deep seabed bioprospecting is placed within the broader context of the biotechnology sector, as well as bioprospecting for marine resources and for extremophiles. The study notes a shift from conventional techniques for the screening of potentially-valuable molecules to genomics and bioinformatics-driven approaches. These latter approaches provide an opportunity to link access and benefit-sharing arrangements regarding deep seabed genetic resources.

Deep seabed ecosystems and microorganisms attract the interest of marine scientists and bioprospectors alike. In this respect, partnerships between public and private research organizations are common, if not the norm. These partnerships and joint ventures have been fundamental in expanding the scope of original oceanographic research to more practical research, including prospecting. Without public-private partnerships, the potential of deep seabed ecosystems and resources would remain unexplored and unexploited.

A lack of availability of information regarding the specific terms of public-private partnerships, including access to deep seabed genetic resources and benefit-sharing arrangements, is noted. Shortcomings are also highlighted with regard to the limited availability and disclosure of information regarding the practical applications of deep seabed genetic resources, as well as the current patent classification system, which does not allow easy identification of patents based on the use of deep seabed genetic resources.

The study shows that there is currently a legal lacuna with regard to commercially-oriented activities targeting the biodiversity of seabed areas beyond the limits of national jurisdiction. The current international legal framework, composed of provisions to be found in several instruments, including the United Nations Convention on the Law of the Sea (UNCLOS), the Convention on Biological Diversity (CBD), intellectual property rights instruments, and regional marine-related instruments, does not address, in an exhaustive and integrated manner, the conservation of, access to, and benefit-sharing related to, deep seabed resources.

Some of the legal gaps highlighted by the study relate to, *inter alia*:

- the uncertain legal status of deep seabed genetic resources, which are excluded from the regime of the Area, defined under UNCLOS as the seabed and ocean floor and its subsoil beyond the limits of national jurisdiction, and are therefore not considered as common heritage of humankind;
- whether, on the basis of the distinction between sedentary and non-sedentary species, deep seabed genetic resources fall under the regime of living resources in the High Seas under UNCLOS;
- the lack of an international definition of bioprospecting, which is difficult to distinguish, in practice, from pure marine scientific research – for which an internationally-agreed definition is also required;
- issues raised by the uncertain delineation of the Area;
- treatment of information and research results, as well as possible conflicts between the provisions of UNCLOS addressing treatment of research results from marine scientific research and those of intellectual property rights instruments;
- the legitimacy of asserting intellectual property rights over resources deemed of public interest, and what constitutes a patentable invention with regard to genetic resources; and
- the principle for, and modalities of, sharing of ensuing benefits, including through technology transfer, capacity building, information sharing and disclosure requirements within patent applications.

The study presents examples illustrating that uncertainty over access to marine biota can act as a deterrent to investment in research, thereby hampering the potential for benefits to both private companies and society as a whole. Marine research and bioprospecting undertakings are most effective when supported by clear and practical rules.

The study concludes by weighing the advantages and disadvantages of various possible options to address deep seabed bioprospecting. These non-mutually exclusive options include: retaining the *status quo*; using regional frameworks; the adoption of guidelines by the United Nations General Assembly, complemented by a voluntary code of conduct; using the framework of the CBD; and bringing deep seabed genetic resources within the regime of the Area.

1 Introduction

Oceans are experiencing rapid and, in many cases, dramatic changes as a result of human activity. Data indicate that at the global level, the abundance of large fish species has declined by ninety percent as compared to pre-fishery levels. Because the world's oceans remain a source of livelihood for hundreds of millions of people, their sustainable and equitable use must continue to be promoted.

Over the last twenty to twenty-five years, new uses of the oceans and their resources have emerged. Most of these changes have been driven by technological developments and knowledge acquired as a result of scientific explorations of previously unknown oceanic areas. An example of new use of the oceans is bioprospecting, i.e. the search for, and commercial development of, valuable natural compounds. More particularly, marine scientists and bioprospectors have paid increasing attention to species which have developed unique biological and physiological properties to survive in extreme environmental conditions. These species, called extremophiles, are found in areas such as Antarctica and the deep seabed. In the absence of an internationally-agreed definition of the term "deep seabed," this report uses the term to designate the seabed and ocean floor and its subsoil beyond the limits of national jurisdiction. Under the United Nations Convention on the Law of the Sea, this is also called the "Area."

As technology develops and becomes more widely available, scientific research in these extreme environments is likely to increase. Not only will this allow expanding our knowledge of extreme ocean ecosystems in order to improve their conservation and sustainable use, but this will also provide opportunities to discover valuable resources and compounds of potential application to the food, industrial and pharmaceutical sectors, among others.

There is currently no specific international regime addressing bioprospecting in the deep seabed, and in recent years, concerns have been raised regarding uncontrolled collection and exploitation of genetic resources from the deep seabed. The issues that governments, scientists and representatives of the civil society have highlighted as requiring particular attention include: the lack of knowledge about deep sea ecosystems, which are still largely unexplored; the need to identify the impacts that marine scientific research and other activities, including fishing practices, have on these ecosystems; the need to ensure the sharing of benefits arising from utilizing deep seabed genetic resources; and whether the recovery of deep seabed genetic resources and subsequent development of commercial products is, or should be, subject to an international legal regime, and if so, to which regime and how.

The international community has taken steps towards addressing these issues, some of which were brought to the attention of States by the UN Secretary-General as early as 1995. Parties to the Convention on Biological Diversity have agreed, at their seventh meeting in 2004, to carry out information-gathering activities regarding the status and trends of, and threats to, genetic resources beyond national jurisdiction, as well as activities and processes under Parties' jurisdiction or control, which may have significant adverse impact on deep seabed ecosystems. At its 59th session in 2004, the United Nations General Assembly established an *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. This Working Group is likely to have to consider such activities as the search for, and commercial development of, deep seabed genetic resources, including whether there is a need for a unified regime to address them.

Regulating activities relating to deep seabed genetic resources requires taking into account a broad range of considerations, including environmental, scientific, economic, ethical, legal and political aspects. On the environmental front, there is a need to balance the sustainable use of these resources with conservation needs. On the scientific side, questions include the role of scientists, either publicly or privately funded, since they often represent the first point of access to deep seabed resources, identify the potential of these resources for biotechnology, and contribute to, and benefit from, the development of commercial products derived from them. From an economic point of view, which is linked to the ethical aspect, deep seabed genetic resources are a potential source of significant profit for the private companies and scientific institutions involved in their development and application. This raises questions about whether and how exclusive private rights can be obtained over genetic resources recovered from the seabed beyond national jurisdiction, whether sharing the benefits derived from their utilization is required, and if so, how. Legal and political issues include: the status of deep seabed genetic resources as open-access or as common heritage of humankind; the development of a *sui generis* system of intellectual property rights; and States' obligations with regard to activities carried out under their jurisdiction or control in international areas.

This report, elaborated on the basis of publicly available information, aims to provide the necessary information to help address possible scientific, legal and policy gaps related to deep seabed bioprospecting. The report, which focuses on activities carried out with respect to genetic resources found in seabed areas beyond national jurisdiction, begins with a description of the main features of deep seabed ecosystems, followed by a review of bioprospecting activities in the deep seabed, put in the context of similar activities elsewhere. A review of relevant international instruments and activities is then provided, and a brief overview given of measures adopted at the national level. Some possible approaches to address deep seabed bioprospecting are proposed in conclusion.

2 Characteristic features of deep seabed ecosystems

On the basis of available scientific literature,[1] this section briefly depicts the types of environments and ecosystems in which deep seabed genetic resources are found, in order to help understand some of the scientific and policy issues associated with bioprospecting of these resources.

The world's oceans can be divided into various oceanic realms, according to the difficulty and necessary technology to explore them.[2] The realm of human reach encompasses near-shore waters, coastal and margin zones, which correspond, respectively, to the intertidal zone, the continental shelves and continental slopes. The realm of central waters, far from the coastline, corresponds to the abyssal plains at the bottom of the oceans. The ice realm corresponds to those areas that are covered with ice most of the year, i.e. Antarctica and the Arctic. The realm of hidden boundaries is made up of the seabed area and its subsoil, in particular the continental shelf and contiguous continental slopes, as well as part of the abyssal plains. The realm of active geology is constituted by areas of active volcanic activity, mainly the mid-ocean ridges, as well as by the remains of past geological activity, such as seamounts. The last realm is the 'crosscutting' realm of microorganisms. See Figure 1.

The realm of active geology and part of the realm of hidden boundaries are the foci of this report. The realm of active geology corresponds to about two percent of the total area covered by the world's oceans. This realm hosts seamounts,[3] which are no longer geologically active but are very active biologically in most cases, and hydrothermal vents, which are both geologically and biologically active. Hydrothermal vents are associated with mid-ocean ridges in which extreme environmental conditions, in terms of temperature, pressure and toxicity, prevail. The processes occurring at hydrothermal vents are powered by chemical energy rather than sunlight. Because of the peculiar characteristics in which life develops in these ecosystems, hydrothermal vent organisms represent a subject of interest from both a scientific and a commercial point of view. Seamounts, which are highly important ecological deep seabed systems, are also the subject of bioprospecting. Reaching and exploring the above-mentioned deep sea ecosystems requires sophisticated, expensive technology, which is at the reach of only a few countries.[4]

The realm of hidden boundaries is made of unstable continental sediments of the oceans' slopes and by the sediments of the abyssal plain.[5] This realm hosts ecosystems known as cold seeps, characterized by microorganisms feeding upon groundwater, methane or oil seeping out of rocks. Although the ecological and biological characteristics of cold seeps are different from those of hydrothermal vents, they constitute a matter of similar scientific and commercial interest since their inhabitant species are also adapted to thriving in extreme conditions of depth and toxicity. Continental slopes[6] are part of the continental margin, the outer edge of which is the limit of States' continental shelves under the United Nations Convention on the Law of the Sea (UNCLOS). The abyssal plain is part of the Area, defined under UNCLOS as the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction.[7] Organisms which depend on methane hydrates as a source of energy, as well as organisms found in brine pools – features similar to lakes at the bottom of the ocean, which result from the higher salinity of water bodies above certain areas of the ocean floor where significant amounts of salt deposits are buried – are also of potential interest to marine scientists and bioprospectors as a result of their unique physiological characteristics.

It is noteworthy that there is no international legal definition of the term "deep seabed." While the seabed can fall either within or beyond the limits of national jurisdiction as delineated by UNCLOS, the term deep seabed is generally used to identify the Area. [8] This report uses the terms deep seabed and the Area interchangeably.

The following sections provide a detailed description of the main ecological and biological features of deep seabed ecosystems.

2.1 Various deep seabed ecosystems

2.1.1. Hydrothermal vents

Hydrothermal vents are found along mid-ocean ridges, where magma from the deep parts of the Earth emerges. A vent is typically formed as seawater penetrates the crust, is heated by the magma, and goes back into the ocean through a hot vent, bringing with it mineral substances.

While it was thought that hydrothermal vents were more frequent at locations where the rate of ridge spreading was higher, this correlation has proven incorrect. Vents have been found in areas of mid-ocean ridges characterized by ridge spreading rates that span from very moderate to very significant. The combination of high or focused magmatic activity with effective intrusion of seawater into the seafloor due to tectonic faulting is such that it determines the origin of vents.[9] Thus, vents can be expected much more frequently than originally thought. For example, the Southwest Indian ridge, which hosts vent ecosystems, spreads at the very slow rate of 11 mm/year. This contradicts the model of a linear relationship between ridge spreading rate and vent activity, i.e. the faster ocean ridges spread, the more intense hydrothermal activity is. [10]

The term "black smokers," commonly used to designate hydrothermal vents, indicates intense and dense fluid emissions from the ocean floor. These emissions are the result of magmatic activity and are characterized by very high temperatures (300°C and more). They support a dense microbial community, but rarer macrofaunal assemblages, than cooler vents. Moreover, hydrothermal vents located up to a few tens of kilometers away from ocean ridges have been discovered. These vent systems are defined as "off-axis" and are characterized by much cooler emissions (40-75°C) and much more alkaline conditions than black smokers. One of these off-axis vent systems, the Lost City Found, located at 30° N 15 km away from the eastern intersection between the Mid-Atlantic Ridge and the Atlantis fracture zone, features carbonate pinnacles, some of which are as high as 60 meters. There is good evidence that off-axis vents are much more frequent than

previously thought, and that they may even be frequent along the Mid-Atlantic, Indian Ocean and Arctic Ridges. [11] The discovery of off-axis vent systems has important policy implications, because it demonstrates that large portions of the oceanic crust support hydrothermal activity and associated life.

Hydrothermal vents can also be found within seamounts where the type of volcanic activity and interaction between the ocean water and the ocean floor allow their formation.

Hydrothermal vents are qualified as either chronic or transient plumes, [12] depending on the intensity and duration of the venting phenomenon. All vents are characterized by extremely high pressure due to the depth at which they are located, by extremely high temperatures and pH values, and by extreme salinity and toxicity due to the minerals that escape from the Earth crust.

Microorganisms, which are at the basis of the vents' trophic chains, and correspondingly at the basis of the functioning of the whole vent ecosystem, depend on these mineral substances. Vent microorganisms do not utilize the light as a source of energy in the process of forming organic substances (also known as "primary production"). As a result, they are referred to as "chemolytotrophic" organisms as opposed to photosynthetic. Hydrothermal vent communities show differences in structure, depending on surrounding physical and geological oceanographic processes, such as gradients in the toxicity of vent fluids. [13] For example, one tubeworm vent species seems to have developed an adaptive physiology for its survival, responding to the scarce availability of sulfide and thus being able to colonize areas with very limited vent flow.[14]

There is evidence that not only prokaryote species but also eukaryotes[15] living in vent ecosystems are tolerant to extreme conditions. For example, observations conducted in the M-Vent site (9° 50.6' N, 104° 17' W) in the Axial Summit Caldera on the East Pacific Rise[16] have allowed to measure the tolerance of a deep seabed worm (*Alvinella pompejana*) to temperatures as high as 81°C and to a one hour-lasting gradient of up to 60°C along the body of the worm. This species was the most thermotolerant and eurythermal (temperature gradient) eukaryote known when these research results were published in 1998.[17]

The main characteristic of hydrothermal species is their tolerance to extreme conditions and their very peculiar physiology. These organisms mostly belong to the domain Archaea – an evolutionary branch that is separate from those of Bacteria and Eukarya. Archaea's adaptation mechanisms to extreme toxicity, pressure, temperature and pH values make them particularly attractive to industry and the pharmaceutical sector.

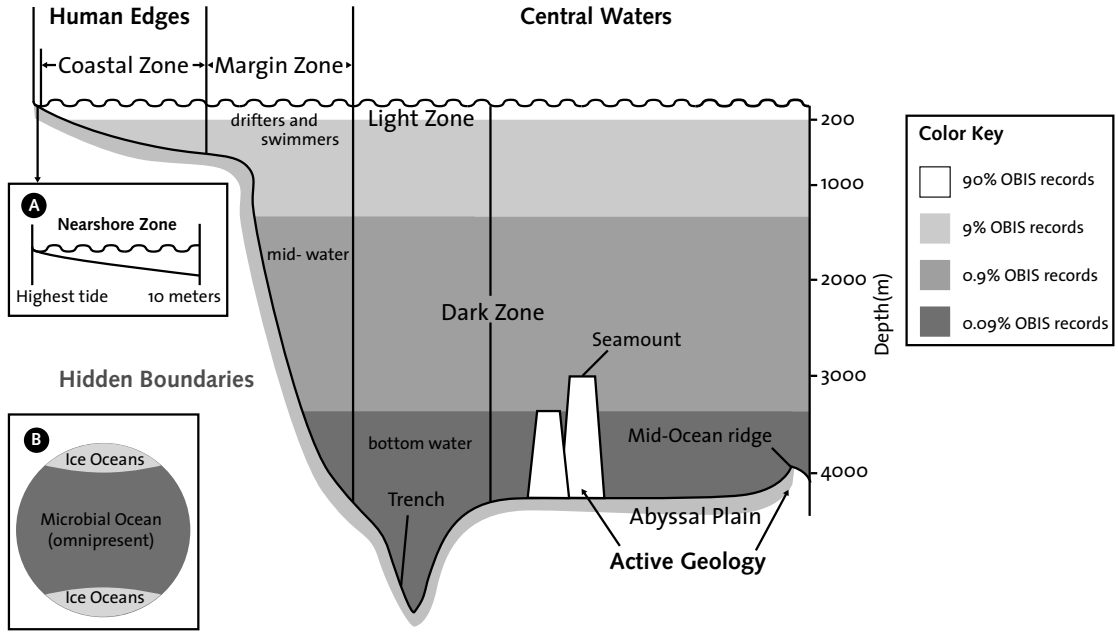

Figure 1. Ocean realms and zones. The realms are diagrammed in the cross section on the basis of the difficulty to explore them. The near-shore zone, the nearest to people and the coastal zone, the area of fishermen's activity, constitute the realm of human edges. Unstable continental margins and the sediment of the abyssal plain constitute the hidden boundaries of the oceanic bowl. Small drifters, such as plankton, and swimmers, like fish, inhabit the upper light zone of the central waters. A different type of creatures inhabits the dark waters below 200 meters from the surface. The realm of active geology includes ghost volcanoes, called seamounts, which rise from the abyssal plain, and hot vents, located in the plain. The ice realm surrounds the poles. The microscopic realm cuts across all realms. Inset A illustrates in detail the near shore zone. Inset B compares the respective coverage of the oceans and ice. OBIS is the Ocean Biogeographic Information System – the information component of the Census of Marine Life (see Box 1). Source and courtesy of: Baseline Report of the Census of Marine Life.

Hydrothermal vents also contribute to the cooling of the planet as a whole, to its thermal balance, and to the chemical balance of the oceans and the atmosphere.[18] In addition to performing an important geophysical role, vent ecosystems are areas where life develops and from which it spreads. There is clear evidence that hydrothermal plumes are associated with upper zooplankton communities, which are supported by both ascending and descending organic matters. It is thought that hydrothermal vents contribute to ascending organic matters.[19] Zooplankton communities located close to hydrothermal vents are trophically complex and behave opportunistically.[20] An example is the medusa *Stygiomedusa gigantea*, which lives within 10 km from vent areas.[21] Hydrothermal vent ecosystems participate in the global carbon cycle since the organic substance originated at hydrothermal vents support the transfer of energy through resident species and probably also through upper water column species.

2.1.2. Cold seeps and other similar deep sea ecosystems

Cold seeps are deep soft-bottom areas where water, oil or gases seep out of the sediments. These are extreme areas due to high pressure and toxicity levels. However, in contrast with hydrothermal vents, temperatures have the same moderate values as those of the surrounding waters. Hypersaline or "brine" pools are a legacy of ancient subfloor deposits that progressively dissolve into the upper water column. These environments can host both prokaryotic and eukaryotic species, some of which are capable of living and reproducing at salt concentrations close to saturation, previously thought to be incompatible with life.[22] Mud volcanoes are geological structures characterized by mud and fluid seeping out of the seafloor, rich in observed fauna and the size of some of the species they host.[23]

Geomorphologic variations may influence the composition of the communities inhabiting cold seeps, brine pools and mud volcanoes, but one common factor to methane seeps is that they are soft-seabed ecosystems, which support two types of interlinked chemosynthetic metabolism: sulfide-oxidizing organisms; and methanotrophs.[24]

Methane is present in deep sea sediments as a consequence of geochemical or microbial production. This methane is anaerobically oxidized into bicarbonate by a combination of organisms belonging to the Archaea group and sulphate-reducing bacteria, and thus does not escape into the ocean.[25] This process contributes to the global carbon cycle and the regulation of greenhouse gases.[26]

Solid crystallines made of methane surrounded by water molecules, called "methane hydrates," are in certain instances associated with cold seeps.[27] These crystallines have a strong potential as a source of energy and, if utilized, would constitute a positive greenhouse gas.[28] Because methane is a powerful greenhouse gas, there is evidence that gas hydrates constitute a methane buffer and therefore a buffer to the greenhouse effect. At the same time, deep seabed methane systems are also considered to provide a thriving ground for surrounding biological communities.[29]

Despite important differences among hot and cold deep seabed ecosystems, they are all characterized by extreme conditions. Certain taxonomic groups (taxa) have adopted similar life patterns in deep seabed environments presenting different but equally extreme characteristics. An example is the polychaete (marine worm) belonging to the genus *Meganerilla*, which inhabits deep anoxygenic bacterial mats in the Santa Barbara Basin, and is in symbiosis with external bacteria (ectosymbiosis). The same type of symbiotic arrangement occurs in the case of *Alvinella pompejana*, a hydrothermal vent polychaete species.[30] However, despite evolutionary links between the multicelled animals inhabiting the different anoxic habitats of the deep seabed, there are very few shared species.

2.1.3. Seamounts

Seamounts, which are millions of years old, are the remains of past geological activity. They do not normally present active geological features, although some vent systems can be found within seamounts. Seamounts are characterized by active water circulation processes, which result in great richness of species belonging to the functional group of suspension feeders;[31] taxa typical of seamounts are deep sea corals, sponges, crinoids, hydroids and ophiuroids.[32] Seamounts also provide a habitat to several species of fish of commercial interest, such as orange roughy, and are visited by swordfish, tuna, sharks, turtles and whales.[33]

One study conducted in six seamounts along the Norfolk Ridge and four seamounts belonging to the Lord Howe Rise, both located between New Zealand and Australia, demonstrated that an increased sampling effort revealed an increase in species richness. This indicates that the number of seamount species yet-to-be discovered is much larger than that already discovered (see Figure 2). This finding also applies to other deep seabed habitats, namely the continental slopes and abyssal plains, which have only been poorly sampled so far, due to their large size (they cover most of the ocean's bottom).

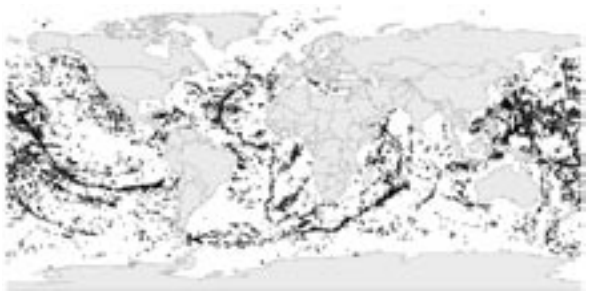

Figure 2. Distribution of large seamounts.[34] This map displays approximately 14,000 particularly well-defined (conical), seamounts. Including a wider range of seamount shape and size could increase their number to 100,000. Source and courtesy of: Convention on Biological Diversity.

The same study also showed, on the basis of data obtained from sampling along 14 seamounts located in the South of Tasmania that for seamounts separated by a distance of more than 1,000 km, there were differences in species

composition when those seamounts were situated at different longitudes. There was even a complete substitution of species in the case of seamounts located at different latitudes.[35]

Several other studies have shown that seamounts are characterized by very high rates of endemism.[36] For example endemism reaches 31% for the Lord Howe Island seamounts, 35% for seamounts off Tasmania, 36% for seamounts on the Norfolk Ridge, and 44% for fish and 52% for invertebrates on the Nasca and Sala-y-Gomez seamount chain off Chile.[37]

Some species inhabiting seamounts possess conservative larval dispersal strategies. This has biogeographic implications.[38] Some authors consider seamounts as ecological exceptions in the deep sea, in comparison with soft-bottom ecosystems, the communities of which may show strong affinities even at great geographic distances.[39]

2.1.4. Similarities and differences between deep seabed ecosystems

Species inhabiting deep seabed ecosystems may have very different biological characteristics: some are transient migrants; some may be carried from one area to another as a consequence of water circulation; some have a free living-larval stage; and some microorganisms originate in the sub-seabed biosphere. Moreover, some organisms can move by themselves or with the help of outside forces. Vent organisms include free-living microorganisms around up-welling vent fluids or rocks and chimneys, microorganisms living within vent water plumes, and symbiotic microorganisms associated with vent macrofauna. Depending on their biology, those microorganisms may be considered as sedentary or not.[40] This has implications with regard to their treatment under UNCLOS, as will be shown in section 5 of this report.

One study has shown that microbial community composition within two hydrothermal sites at separate locations (one, the Snake Pit site, in the Mid-Atlantic Ridge at 23° 22' N, 44° 57' W, and the other at 9° 22' N, 104° W) was highly similar, as 92% of the genes encoding small subunit ribosomal DNA were the same in sequence.[41] Different vent biogeographic provinces have been identified.[42] Atlantic vents are dominated by shrimps and clams, while Pacific vents mainly host giant tube worms and clams. Some vent species are restricted to small geographic regions. It is likely that microorganisms from vents may have a wider distribution.[43]

Some vent species are characterized by high dispersal strategies, possibly because of the ephemeral nature of hot vents. For example, it has been shown that the larvae of the giant tubeworm *Riftia pachyptila* have an average lifespan of 38 days, which equates to a maximum distance of 100 km in the specific hydrodynamic conditions of the ridge site where the study was conducted (9° 50' N in the East Pacific Rise).[44] Shrimp larvae of the family Bresiliidae have been reported to have attained the dispersal value of more than 100 km.[45]

Dispersal of larvae of hydrothermal vent organisms is facilitated by megaplumes – transient, separated volumes of warm water resulting from submarine volcanic activity and rising up to 1,000 meters above the ocean floor.[46] In the case of seamounts, one study identified active circulation processes as the factor responsible for the retention of hydroid larvae along a limited vertical gradient of a few hundred meters and a much more extended horizontal gradient (up to 40 km away from the seamount).[47]

It has been hypothesized that the patterns of behavior of cold seep communities are close to those of seamount communities, when endemism is concerned.[48]

Despite important differences, especially in terms of species' metabolism and dispersal strategies, hot and cold deep seabed ecosystems also show some similarities. For example, a giant white clam, found in large population quantities in the Sagami Bay of Japan at the depth of 1,100 meters, and dependent on sulphide-rich cold water seeps, appeared to belong to the same genus of clams – *Calyptogena* – as that found in hydrothermal vents in the eastern Pacific. The two species share the same dependence on sulphide-oxidizing microorganisms, which are symbiotically hosted within the clams.[49]

A team of Japanese scientists demonstrated that the spawning of the Sagami Bay giant white clam was induced by minimal changes in water temperature (between 0.1 and 0.2°C), thus indicating that deep seabed organisms respond dynamically to surrounding environmental variations.[50] Surrounding environmental conditions can also affect species' growth rates. In environmentally dynamic ecosystems, species grow quickly, and their dispersal strategies are well developed. In the case of hydrothermal vent species, scientific studies have demonstrated that changes in hydrothermal flux temperatures were likely to affect vent communities.[51] A study monitoring the evolution of a new hydrothermal vent following an eruption has indicated that recruitment of new species at the site took place within a year, and that within the second year, one-third of the vent species found in the region had populated the site.[52]

In less dynamic environments, species tend to grow slowly. Extreme cases recorded so far are those of cold water reefs of up to 8,000 years old[53] and a species of tubeworm (*Lamellibranchia sp.*) living on oil seeps at depths of more than 500 meters along the continental margin of Louisiana. Conservative estimates of the tubeworm's growth rate indicate a lifespan comprised between 170 and 250 years.[54]

Further studies would be needed regarding the role of slow-growing deep seabed species, such as *Lamellibranchia sp.*, in providing habitats and energy to other species, including transient ones, in areas that are normally deprived of shelters and sources of nutrition.[55] Similarly, it has been hypothesized, on the basis of evidence from comparative rRNA analysis of mytilids living on decomposing wood and whale bones, that wood and whale bones have acted as vectors for the colonization of vent systems by these organisms.[56]

The unusual physiological characteristics of organisms inhabiting hydrothermal vents, cold seeps and other deep seabed ecosystems, resulting from these ecosystems' extreme (although different) conditions, make them particularly interesting to scientists and bioprospectors alike.

Similarities and differences of deep seabed ecosystems may have implications for their management.

2.2 Deep seabed ecosystems and the origin of life

Some scientists advance the idea that the beginning of life at hydrothermal vents corresponded with the development of life on Earth, thus supporting the theory that life developed at submarine hotsprings.[57] Other scientists favor the 'hyperthermophile Eden' hypothesis, which assumes that life developed in both hydrothermal and non-hydrothermal environments.[58] In both cases, hydrothermal systems seem to have played a key role in the development of life on Earth, and the differentiation of a common ancestor into Bacteria and Archaea. Nowadays, species can be differentiated on the basis of their ribosomal RNA (rRNA). This technique has revealed that the phylogenetic tree of Archaea has emerged as a different domain of life than those of Bacteria and Eukarya, thus proving the importance of hydrothermal vents for phylogeny and evolution.[59]

Geological evidence has shown that life has been present on Earth for at least 3.5 Gyr (billion years), with demonstrated records of photosynthesis activity dating as long as some 3.8 Gyr ago.[60] By way of comparison, sulphate-reducing microorganisms – organisms that produce sulphide by oxidizing hydrogen or organic matter with sulphates – are typical of hydrothermal vent ecosystems and as ancient as 3.47 Gyr.[61] Evidence has also been brought of hydrothermal vent microbial activity dating 3,235 million of years.[62]

Deep water is also thought to have provided an area for diversification of eukaryote organisms, in that it provided them a shelter from ultraviolet radiation, which causes damage to DNA. In modern deep sea microbial mats systems, such as those found in the Santa Barbara Basin (34°15'N, 120°02'W, maximum depth: 600 meters), symbiotic relationships between prokaryotes and eukaryotes have allowed the latter to overcome the anoxygenic conditions of the milieu and to diversify.[63] These symbioses are important in light of the increase of oxygen-depleted habitats due to human activities (also called 'dead zones'), and may play a crucial role in guaranteeing certain processes in the oceans, such as nutrient cycling.[64] Deep seabed organisms can show "endosymbiosis" such as intracellular symbiotic sulphide-oxidizing bacteria within *Lamellibranchia satsuma* and *Calyptogena laubier*i,[65] or "ectosymbiosis" such as the filamentous bacteria along the body of *Alvinella pompejana*.

There is thus evidence that both oxygenic and anoxygenic photosynthetic life, as well as non-photosynthetic life, have existed around hydrothermal vents for more than 3 Gyr. Molecular biology techniques have also provided data showing that chemosynthetic life at hydrothermal sites preceded photosynthetic life.[66]

The role of hydrothermal vents with regard to the origin of life may also have implications for their management, because of their scientific and emblematic importance.

2.3 Information on researched sites

A number of databases containing information on deep seabed resources and expeditions exist. The InterRidge website, for example, hosts several relevant databases, including the Hydrothermal Vent Database, the Mid-Ocean Ridge Backarc Basin (MOR & BAB) Cruise Database, and the Hydrothermal Vent Faunal Database. The latter, which contains almost 500 species, is currently being merged with the ChEss database, a project of the Census of Marine Life.[67]

The Hydrothermal Vent Database was originally created in 1994, and published on the InterRidge website in 1999.[68] This database, which counted 212 sites as of 1 December 2004, includes ascertained and suspected hydrothermal vent sites, that is, sites where the presence of geological activity indicating vent formation was observed but no hydrothermal vent was located. This database also contributes to the International Seabed Authority (ISA) Central Data Repository (CDR), developed in 2000 by the ISA Secretariat to collect and centralize all public and private data and information on marine mineral resources. In addition to information on ferromanganese crusts and polymetallic nodules, the CDR comprises data originally assembled by the Geological Survey of Canada on the worldwide distribution of seafloor polymetallic sulphides sites (327 sites).

The ISA CDR contains specific data on the geochemical composition of samples of seafloor polymetallic sulphides and metainformation such as latitude and longitude, depth, jurisdiction, site description (geology and biology), types of hydrothermal activity, description of mineral deposits, tectonic setting, and bibliographic references. Data are organized according to different geographic zones of mid-ocean ridges (North Pacific, North West Pacific, Central Pacific, South West Pacific, Chile Rise, Antarctica, South Atlantic, Mediterranean, etc.), and a distinction is made between active and fossil vents. However, information on the biology of recorded hydrothermal vents is very limited.[69]

The InterRidge MOR & BAB Cruise Database contains 432 records corresponding to the period 1992-2003. This database provides a proxy for identifying the sites that are most subject to scientific research. An analysis of the information contained in this database showed that the most visited sites were the Juan de Fuca Ridge in the Northeast Pacific (72 cruises) and the Mid-Atlantic Ridge located between 20°N and 40°N (61 cruises). These are followed by the Northern East-Pacific Ridge (42 cruises) and the Mid-Atlantic Ridge comprised between 0°N and 20°N (24 cruises), as well as the Manus & Woodlark Basins in the Pacific Ocean (21 cruises). The only site extensively studied in the Indian Ocean is the Southwest Indian Ridge (17 cruises). In the Arctic, the most researched site is the Kolbeinsey

Ridge (6 cruises), while the Pacific-Antarctic Ridge area was visited 6 times. Overall, the sites in the Pacific Ocean lead with a number of 218 cruises, followed by Atlantic Ocean sites (129 cruises), Indian Ocean sites (40 cruises) and the Arctic Ocean (16 cruises).[70]

According to the InterRidge databases, in the case of the above-mentioned most researched sites, out of the 21 sites located in the Juan de Fuca Ridge, 12 fall under Canadian jurisdiction while nine are located in the Area. Sites comprised between 20°N and 40°N in the Mid-Atlantic Ridge are located in the Area, except for the Menez Gwen and Lucky Strike sites, which fall under Portugal's jurisdiction. The sites of the Kolbeinsey Ridge (Northern Atlantic) all fall within Iceland's jurisdiction. Ascertaining the jurisdiction of sites comprised between 0°N and 20°N in the Mid-Atlantic Ridge was difficult. Regarding the 50 vent sites recorded in the Northern East-Pacific Ridge, the jurisdictions of Canada (the 12 sites mentioned above), the US (six sites) and Mexico (seven sites) have been identified. 11 sites fall outside national jurisdiction and, for some vents, it is unclear whether these fall within or beyond national jurisdiction. The 12 sites recorded in the Indian Ridge fall either in the Area or it is unclear whether they are located within or beyond national jurisdiction. Out of the 12 sites listed for the South-East Pacific, Chile is thought to have jurisdiction over two to four sites, while the others seem to be located in the Area. Of the 35 sites in the South-West Pacific, nine fall under Papua New Guinea's jurisdiction (including six sites in the Manus & Woodlark Basins), one under the Solomon Islands' jurisdiction, five under Fiji's jurisdiction, and two under New Zealand's jurisdiction. The other sites are located in the Area or it is unclear whether they are located within or beyond national jurisdiction.

The table below provides an overview of the jurisdiction over the 212 hydrothermal vent sites recorded in the InterRidge Hydrothermal Vent Database. As a preliminary conclusion, and taking into account remaining uncertainties, it seems that an even number of sites fall either within (61 ascertained sites) or beyond (55 ascertained sites) national jurisdiction. It is important to note that no information is provided on the InterRidge site regarding the criteria used to identify the jurisdiction under which the sites fall. It is assumed that this information is based on the information provided by research teams.

Records in the database can be sorted according to, *inter alia*, the scientific objectives of cruises. A search based on biology-related keywords (e.g. biology, physiology, ecology, etc.) demonstrated an increase in time in the number of cruises aimed at fulfilling biology-related scientific objectives. This is of particular relevance to bioprospecting.

In addition to the InterRidge and the ISA databases, an equally authoritative source of information regarding the location of hydrothermal and cold seep sites of interest to science and bioprospectors are peer-reviewed scientific articles including details of sites' location and samples. Such articles are found in journals such as Deep-Sea Research I and II.

Country under the jurisdiction of which vents are located (number of vents)	Total of 61 sites divided as follows: Canada (12), USA (12), Papua New Guinea (8), Fiji (5), Italy (5), Japan (4), Mexico (4), Chile (2), Greece (2), New Zealand (2), Portugal (2), Norway (1), Russia (1), Solomon Islands (1)
No national jurisdiction	55 (plus 2 uncertainly so)
No specified jurisdiction	28
Uncertain jurisdiction	Chile (2), Japan (2), USA (2)
Sites qualified with a question mark (?)	33
Uncertain meaning of the information contained in the database	12
Likely errors in the database	11

3 Review of bioprospecting activities in the deep seabed

This section describes the main type, intensity, and impacts of both scientific research and commercial activities related to deep seabed ecosystems and genetic resources. Some key working definitions are provided in introduction, followed by an overview of the applications made of deep seabed genetic resources, as well as the technology required for deep seabed research and bioprospecting.

3.1 The object and nature of bioprospecting

In the absence of an internationally-agreed definition of bioprospecting, an attempt is made in this section to identify what types of activities constitute bioprospecting. Definitions of genetic resources are also considered.

3.1.1. Marine bioprospecting and marine scientific research

A common distinction is made between scientific research undertaken for non-commercial purposes, also called "pure scientific research," and commercially-oriented research, also called "applied scientific research." Bioprospecting in the marine environment could be considered as a form of applied marine scientific research. With regard to deep seabed activities, which are usually undertaken thanks to partnerships between public research institutions, such as universities, and private companies (see section 3.2.1.), it is difficult to differentiate between pure marine scientific research and applied research. In order to ensure that the costs of research expeditions are met, links are increasingly established between pure marine scientific research activities and onshore commercial bioprospecting activities,[71] whereby organisms collected following non-commercial marine scientific research are passed on to industry.[72]

There are currently no internationally-agreed definition of the terms "marine scientific research" and "bioprospecting." However, defining what these terms cover is crucial in order to determine the legal regime applicable to activities related to deep seabed genetic resources.

Bioprospecting is neither used nor defined in the Convention on Biological Diversity (CBD) or UNCLOS, and the expression seems to cover a broad range of activities. The CBD does not make the distinction between pure and applied research, and only requires Parties to promote and encourage research that contributes to the conservation and the sustainable use of biological diversity in general.[73] However, a note prepared by the CBD Secretariat defined bioprospecting as "the exploration of biodiversity for commercially valuable genetic and biochemical resources" and further as "the process of gathering information from the biosphere on the molecular composition of genetic resources for the development of new commercial products."[74]

Elements of definitions of bioprospecting are provided in several domestic laws, ranging from restrictive definitions limited to the search for resources, to broader definitions encompassing collection and application. Under New Zealand's Biodiversity Strategy, bioprospecting is "the search among biological organisms for commercially valuable compounds, substances or genetic material."[75] Within the context of the European Community, bioprospecting "entails the search for economically valuable genetic and biochemical resources from nature."[76] The South African 2004 Biodiversity Act defines bioprospecting as "any research on, or development or application of, indigenous biological resources for commercial or industrial exploitation, and includes the systematic search, collection or gathering of such resources or making extractions from such resources for purposes of such research, development or application (...)."[77] The 2001 Philippines' Wildlife Resources Conservation and Protection Act defines bioprospecting as the "research, collection and utilization of biological and genetic resources for purposes of applying the knowledge derived therefrom solely for commercial purposes."[78] Fiji's draft Sustainable Development Bill refers to bioprospecting as "any activity undertaken to harvest or exploit biological resources for commercial purposes... [including] investigative research and sampling."

While definitions still diverge as to whether bioprospecting covers the subsequent stages of the search and sampling of resources, including further application and development,[79] this brief survey shows that there is an emerging common understanding that the term "bioprospecting" involves research for commercial purposes. Possible elements of a definition of bioprospecting include:

- systematic search, collection, gathering or sampling of biological resources for purposes of commercial or industrial exploitation;
- screening, isolation, characterization of commercially useful compounds;
- testing and trials; and
- further application and development of the isolated compounds for commercial purposes, including large-scale collection, development of mass culture techniques, and conduct of trials for approval for commercial sale.

As with the term "bioprospecting", there is no internationally-agreed definition of "marine scientific research." While UNCLOS provides for a regime for marine scientific research (MSR), it does not define what MSR is. With regard to the right of coastal States to withhold consent to MSR projects proposed by other States or international organizations in their Exclusive Economic Zone (EEZ) or on their continental shelf, UNCLOS draws a distinction between MSR intended to increase scientific knowledge for the benefit of all humankind, and MSR "of direct significance for the exploration and exploitation of natural resources."[80] The distinction between those two types of research, which equate to pure scientific research for the former and applied research for the latter, is not made with regard to MSR undertaken beyond national jurisdiction.

The difficulty of distinguishing, in practice, between pure scientific research and applied research, prompted the drafters of UNCLOS to include a specific provision requesting States "to promote through competent international organizations the establishment of general

criteria and guidelines to assist States in ascertaining the nature and implications of marine scientific research."[81] To date, such criteria and guidelines have not been developed.

The study prepared by the Secretariat of the CBD and the United Nations Division for Ocean Affairs and the Law of the Sea (UNDOALOS) on the relationship between the CBD and UNCLOS with regard to deep seabed genetic resources noted that "in the absence of a formal definition, marine scientific research could be defined as an activity that involves collection and analysis of information, data or samples aimed at increasing humankind's knowledge of the environment, and is not undertaken with the intent of economic gain."[82]

This definition implies that MSR, in the context of UNCLOS, for research undertaken in areas beyond national jurisdiction, would equate to pure marine scientific research, and differ therefore from bioprospecting. In this respect, a parallel can be drawn between bioprospecting and prospecting, as defined within the context of UNCLOS. The International Seabed Authority's Regulations on Prospecting and Exploration for Polymetallic Nodules define prospecting as the search for deposits of polymetallic nodules in the Area, including estimation of the composition, size and distributions of polymetallic nodule deposits and their economic values, without any exclusive rights.[83] Prospecting differs from MSR undertaken to increase scientific knowledge of the oceans in that it is undertaken with the specific aim of estimating the economic value of a resource prior to its future commercial exploitation. Data and information resulting from prospecting may be retained as confidential, in accordance with the regulations.[84] However, like MSR, prospecting does not confer any rights over the resources.[85]

It is noteworthy that the UN Secretary-General, in his 57th report to the UN General Assembly stressed potential problems resulting from the fact that UNCLOS "does not adequately distinguish between the terms 'marine scientific research,' 'prospecting' and 'exploration,' nor does it make a distinction between 'pure' and 'applied' scientific research."[86]

Academic researchers play a key role at the forefront of biodiversity and biotechnology sciences. The use of the word "bioprospecting" to describe their activities is reductive, because the discovery of drugs with potentially important medical applications often represents a side effect of scientists' continuous search for new knowledge.

Since marine scientific research and bioprospecting can have the same object, i.e. sampling of biological organisms, the distinction between those two types of activities resides mainly in their intent and purpose. In theory, the distinction is clear. However, as has been noted above, the difference in practice remains difficult to establish, particularly regarding research carried out in the deep seabed. Identifying a coherent comprehensive legal regime for activities related to deep seabed genetic resources is relatively difficult as a result of these practical impediments.

3.1.2. Genetic resources, genetic material and microorganisms

Article 2 of the CBD defines genetic resources as genetic material of actual or potential value. Genetic material is defined as any material of plant, animal, microbial or other origin containing functional units of heredity. It follows that marine genetic resources are marine plants, animals and microorganisms, and parts thereof containing functional units of heredity that are of actual or potential value. This definition applies to deep seabed organisms. It is noteworthy that photosynthetic organisms are not found in deep seabed ecosystems as a result of the absence of solar light.

While the Oxford University Press Dictionary of Biology defines microorganisms as organisms that "can be observed only with the aid of a microscope [and] include bacteria, viruses, protoctists (including certain algae), and fungi,"[87] there is currently no common definition of microorganisms. Scientific definitions tend to converge towards a description of microorganisms as organisms that are not visible to the human eye, and that include individual living cells of the domains of Bacteria and Archaea, as well as non-visible eukaryotes such as microscopic nematodes (although from an ecological point of view these are defined as part of the 'meiofauna'). What really distinguishes taxonomic groups of organisms are therefore genetic analogies or differences based on ribosomal RNA techniques, while size only determines whether living organisms fall within macro or and micro organisms.[88] Oldham notes problems raised by the lack of definition of microorganisms within specific intellectual property rights instruments, including the Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organization (WTO), and the International Patent Classification system. In practice, a wide range of categories of material have been accepted as microorganisms, including biological and genetic material derived from macroorganisms, such as tissue cultures and plasmids, as well as viruses, undifferentiated human, animal or plant cells, and protozoa.[89] The understanding of microorganism under intellectual property rights (IPRs) instruments seems therefore broader than the scientific definitions.

This report adopts a broad definition of genetic resources and microorganisms as encompassing the definition provided by the CBD as well as the practice of IPRs instruments.

3.2 Analysis of the type and level of activities involving genetic resources from the deep seabed

3.2.1. Review of relevant research programmes

The exploration of deep seabed areas started at the end of the nineteenth century with the British research oceanographic vessel Challenger (1872-1876). However, it was not until 1977 that hydrothermal vents were discovered with the help of the submersible Alvin during a survey of

the Galapagos Rift in the Eastern Pacific Ocean at depths of more than 1,000 meters.

Today, a host of exploration activities are undertaken to study the ecology, biology and physiology of deep seabed ecosystems and species. Different types of research activities allow the subsequent commercial exploitation of genetic material from the deep seabed.

The majority of activities are scattered, small-scale, independent research activities and programmes, ongoing in many universities and research institutions in the world.[90] While most of these activities are of an exploratory nature and are not directly commercially oriented, they represent the backbone of any commercial application of deep seabed genetic resources since they generate the necessary scientific information for bioprospecting. Some of these research activities are a joint effort between the scientific communities of two or more States, such as the 2001 Arctic Mid-Ocean Ridge Expedition (AMORE), conducted by US and German scientists.[91]

More ambitious programmes, which require a strong international scientific cooperation as well as joint ventures between public and private institutions, are also ongoing, such as The New Challenger Global Ocean Expedition, organized by Deep Ocean Expeditions, the P.P. Shirshov Institute of Oceanology, the Russian Academy of Sciences, and Diversa Corporation.[92] One of these research programmes, the Census of Marine Life (CoML), which has a strong focus on deep sea species, is described in detail in Box 1 below.

Box 1: The Census of Marine Life

CoML's mission is to assess and explain the diversity, distribution and abundance of marine life. It is a time-bound project, at least in its first phase, which will be completed in 2010. CoML addresses four main questions:

- What lived in the oceans? (History of Marine Populations project – HMAP)
- What does live in the oceans? (Ocean Realm Field Projects, which deals with technologies and protocols)
- What will live in the oceans? (Future of Marine Populations project – FMAP)[93]
- How to access and visualize data on living marine resources? (Ocean Biogeographic Information System – OBIS)

According to the Census, at 3,000 meters of depth, the probability of a new record being a new species is about 50:50 in the deep sea. Life is therefore not lacking, but suitable sampling tools are missing. Consequently, less than 0.1% of abyssal plains have been sampled. Out of 15,000 estimated isolated seamounts, only 250 have been sampled thus far.[94]

CoML activities are organized according to boundaries. Those most relevant to the issues dealt with in this report are the: Continental Margins activities; Abyssal Plain activities (coordinated by the French Research Institute for the Exploitation of the Sea – Ifremer – in France), including on the Diversity of Abyssal Marine Life (CeDAMar);[95] Ice Oceans activities, including on the Arctic Ocean Biodiversity (ArcOD, coordinated by the US and Russia); Census of Antarctic Marine Life (coordinated by the Scientific Committee for Antarctic Research (SCAR) of the International Council for Science); Active Geology activities, including on Chemosynthetic Ecosystems (ChEss, coordinated by the UK); Census of Seamounts (coordinated by New Zealand's National Institute of Water and Atmospheric Research); and the Central and Deep Oceanic activities, including on the Mid-Atlantic Ridge Ecosystems (MAR-ECO, coordinated by Norway).[96]

The Census relies on national and regional CoML committees to promote the Census and decide on priorities. Such committees are currently being established in Australia, Canada, Europe, Japan, South America and the US.

Public research organizations in some countries devote significant time and energy to deep sea research. Ifremer is a French public research institute, the mission of which is to: promote the development of technological and commercial applications related to the identification and sustainable exploitation of marine resources; undertake observations, forecast and protection of the marine environment; and explore possibilities for the economic development of maritime activities. Between 1993 and 2001, a programme on ocean ridges, the Dorsales programme, was co-funded and implemented by Ifremer and the French National Scientific Research Center (CNRS). Currently, Ifremer's main programmes related to the exploration and exploitation of the ocean floor include: a programme on cold seeps on the Mediterranean continental margins called Nautinil (as part of the European Science Foundation-sponsored EUROMARGINS programme[97]); a programme on evaluating the impacts of oil-related activities and research on chemosynthetic ecosystems on the Gabon-Angola margin called Biozaire; the Ocean Ridges programme, which focuses both on developing deep ocean-related technology and on the biodiversity of deep water ecosystems; and studies and activities associated with the establishment of ocean floor observatories. More particularly, Ifremer implements a programme on biotechnological transfer from deep water species, which focuses on the oncological, cardiovascular and tissue regeneration applications of deep sea bacterial exopolysaccharides and on new anti-tumor strategies. This programme is conducted in cooperation with the University of Western Brittany, the Regional University Hospital Center in Brest, INSERM (the French National Institute of Health and Medical Research), CNRS and the Faculty of Odontology of the University of Paris V.[98]

The US National Oceanic and Atmospheric Administration (NOAA) runs a Vents Programme, which provides a framework for research activities on the impacts and consequences of submarine volcanoes and hydrothermal venting on the global ocean. This is an integrated research programme, which focuses on research activities in relation to the distribution and evolution of hydrothermal plumes, their geological, physical, chemical and geophysical characteristics, as well as their continued monitoring at

various sites (five in the Northwestern Pacific, one in the Western Pacific, one in the East Pacific, and one in the North Atlantic). [99] The NOAA Vents Programme, although an ambitious one, seems to only indirectly contribute to the collection of information important to bioprospecting of deep seabed genetic resources.

Another type of research activity is that of applied programmes that promote the systematic collection and culture of, and research on, deep sea organisms. This type of activity entails describing the genetic and physiological features of deep sea organisms and assessing their potential for biomedical, industrial, environmental and other types of applications. Such research is being carried out, among others, by the Extremobiosphere Research Center of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC). JAMSTEC's activities are further described in section 3.4 of this report.

Marine genomics has recently attracted the interest of the J. Craig Venter Institute, a non-profit research organization based in the US.[100] In the spring of 2003, staff at the Institute, in collaboration with scientists of the Bermuda Biological Station for Research, embarked in a pilot expedition in the Sargasso Sea – the Sorcerer II Expedition. The expedition, undertaken in an area considered as poor biologically, found more than 1,800 species of marine bacteria, 150 of which had not been described, and more than a million "new" genes, previously unsequenced, in about 200 liters of sampled sea water. In February 2004, the Institute announced the launch of its Marine Microbe Genome Project, which aims to sequence the genome of more than 100 of the key marine microbes stored in culture collections around the world, and provide a baseline against which to interpret the structure and functions of marine microbial genes, including the new genes discovered during the Sorcerer II Expedition. For this project, the Institute received a grant of US$8.9 million from the Gordon and Betty Moore Foundation. All the results of this project will be made public through the National Center for Biotechnology Information (NCBI).[101] Although the Institute's activities have focused on water column species, some of the techniques used may be relevant to future studies on deep seabed genetic resources.

Another type of research is situated at the interface of research and development (R&D). R&D activities are usually specifically designed at bridging the gap between discovery and commercialization, hence responding to the needs of private companies. In most instances, partnerships between public and private research institutions and commercial companies are required to undertake bioprospecting of deep seabed genetic resources. A specific example of how programmes of this type are designed is the Marine Bioproducts Engineering Center (MarBEC) research programme, outlined in Box 2.

Box 2: The Marine Bioproducts Engineering Center Research Programme

MarBEC is a US National Science Foundation (NSF) Engineering Research Center established through a time-bound NSF grant (November 1998- March 2004), which resulted from a partnership between the University of Hawaii at Manoa and the University of California, Berkeley, US.

The Center was established on the basis of the realization that many microorganisms found in various marine environments can, through biotechnology, provide new products and processes for use in many sectors, including the chemical, health, energy, food, and environmental sectors as well as national security.

MarBEC is structured in such a way as to bridge research activities with development of products and processes. Working with a range of marine microorganisms, including extremophiles, the Center's activities span from discovery and screening of new organisms to the design of cultivation and purification systems, towards the production of marine bioproducts such as polyunsaturated fatty acids, antibiotics, antivirals and enzymes.

MarBEC has developed techniques for deep sea sampling while maintaining deep sea temperatures and pressures *ex situ*. Genetic engineering techniques are used to transfer metabolic pathways of marine microorganisms into common industrial organisms (such as *E. coli*). Production systems, including bioreactors for extremophiles, were developed. A biological bank was set up. Engineering and life science students were trained as the Center's contribution to forming the next generation of engineering and scientific leaders and practitioners in marine biotechnology.

A specific programme – the MarBEC Industry Sponsor Program – was set up to interact with industrial sponsors, with the aim of building a group of industry participants in the Center's activities, following the termination of the financial support by the NSF.

The Center has developed an industrial strategy made of the following main strategic axes: recruiting member companies from the pharmaceutical, chemical, food and similar industries; identifying the needs of those companies; developing patents; conducting directed and industry-sponsored research; and positioning MarBEC as a global leader in the exploration, development, and production of novel compounds and marine natural products. The NSF financial allocation to MarBEC for its fifth and last year (November 2002- October 2003) amounted to US$ 949,231.[102]

MarBEC's Industry sponsors are Cyanotech Corporation, Diversa and BiophoriX. Hawaii Biotech, Coast Seafoods, Ceatech USA and Ocean Nutrition Canada LTD are affiliate sponsors.

Expeditions aimed at raising awareness of deep sea areas are also implemented, such as the American Museum of Natural History Black Smokers Expedition. These expeditions have an impact on deep seabed ecosystems. For example, the second Black Smokers expedition in 1998 led to the collection of four chimneys of several tons each

from the Endeavor segment of the Juan de Fuca Ridge, at the depth of 2,300 meters.[103] Educational missions are also undertaken, such as the REVEL expedition. This project, sponsored by the US NSF and the University of Washington, was conceived as a teacher development programme, and allowed scientists and teachers to jointly conduct observations in the Juan de Fuca Ridge.[104]

According to the InterRidge database, since 1992, deep seabed expeditions have been led by scientists from the US (196 cruises), followed by France and Japan (67 cruises each), Germany (34 cruises), Canada (27 cruises), Russia (13 cruises) and Portugal (11 cruises). This information from the InterRidge database may underestimate the scale of international collaboration, since researchers from certain countries participate in other countries' research expeditions.

Overall, it has proven difficult to determine the level of participation of the private sector in publicly-driven expeditions, as well as the type of arrangements that may have been agreed upon between private and public partners with regard to access to sampled resources and sharing of benefits following eventual commercialization. This difficulty stemmed from limited public availability of information, as well as lack of response to requests for information from the main actors.[105] Because this report shows the importance of public-private ventures in deep seabed research, it is necessary to further study the role and modalities of public-private partnerships for deep seabed research so as to better assess the type of international regime required, if any.

3.2.2. Review of various uses of deep seabed genetic resources

From discovery and recovery of an organism from its original habitat to practical application of the organism, several steps take place. For example, in the case of pharmaceutical applications, the cycle of development can be summarized in the following phases:

- research phase: this phase encompasses screening for lead compounds, patent application, and the pre-clinical development phase (selecting candidates on the basis of pharmacology and toxicity);
- clinical trials phase: these are performed during three different clinical phases and consist in testing candidates for toxicity, efficacy and pharmacology in in vivo models;
- administrative procedures: this phase includes registration and marketing authorization, as well as licensing of the patent;
- production and launching of the product.

The cycle lasts about 15 years, with the research and clinical phases lasting up to 13 years and the administrative phase between two to three years. The last phase, called "pharmacovigilance," lasts about five years. Some of these phases, especially the research phase, can be shortened by using various methods. For example, in vaccine production, "reverse vaccinology" is proposed as an approach to significantly reduce the time of production. The approach, which is based on computerized analyses of genome sequences and the development of test vaccines on the basis of the results of those analyses, is also thought to allow the discovery of vaccines otherwise impossible to realize through conventional techniques and to reduce the health risks associated with the toxicity of vaccine discovery.[106]

This sections aims to provide a preliminary assessment of the type and level of current or potential uses for deep seabed genetic resources. The examples outlined in this section were gathered from a variety of sources, namely: information contained in national patent databases as well as international patent metadatabases; information available in the public domain (Internet and published material, both peer-reviewed and gray literature, as well as information brochures); and information obtained through e-mail or phone interviews with scientists or managers at research institutions and commercial companies.

At the outset, it is worth noting that assessing the type and level of activities using genetic resources from the deep seabed proves relatively difficult for several reasons. First, public information, including patents, do not necessarily point out at the practical applications (although, in several cases, they do indicate their potential applications). Second, with the current configuration of the patent classification system, it is difficult, if not impossible, to readily map trends for microorganisms arising form bioprospecting in the deep seabed or even on land if the organisms do not fall into known categories of the system.[107] Last, information regarding the origin of the samples used is not always disclosed, even in patents' descriptions.

3.2.2.1. The role of patents with regard to deep seabed genetic resources

Patents, which are a method to assert IPRs over an invention, confer upon their holders more or less extensive rights for a certain period of time, in exchange of publication of information thereon. IPRs are usually used as a way to stimulate research and innovation through rewards.

There are usually three criteria for patenting: the invention must be new (or novel); the invention must involve an inventive step, i.e. be non-obvious; and the invention must be capable of industrial application, i.e. be useful or of utility. Patents may be granted to public or private research institutions, private companies, as well as to individuals. Whether the object of the patent is a source material itself or an invention derived therefrom, third parties need the consent of the holder of the intellectual property to access or use the invention. It is noteworthy that while a patent may have been claimed for non-commercial purposes, a subsequent license to use the invention may be granted to companies that intend to apply the invention for commercial purposes. Besides the type of uses that can be made from the invention licensed, this raises questions about the sharing of benefits ensuing from the commercial application of the invention, with the patent holder. Licenses can specifically exclude certain types of uses, as well as include provisions regarding sharing of benefits.

There are two scenarios with regard to patenting of genetic resources:

- direct patenting of a source material, whereby the patent claims genetic resources or organisms obtained from a separate source as an invention, on the basis of their novel physical, chemical or biological properties; and
- patenting of inventions derived from the source material, whereby a patent claims an invention derived from or using genetic resources or organisms. [108]

A distinction can also be drawn between product-oriented and process-oriented patents. Product-based patents relate to the isolation of compounds from deep seabed samples and to the creation (through molecular engineering techniques) of new organisms of potential use in pharmaceuticals and many other fields, such as food processing. Process-based patents relate to the isolation or creation (also through molecular engineering techniques) of compounds and derivates (usually proteins having an enzymatic function) that improve the pace of industrial processes and/or the quality of ensuing products. It is noteworthy that both types of patents can result in *per se* claims over the source organisms.

The following section provides examples of the type of patents granted with regard to genetic resources recovered from the deep seabed.

3.2.2.2. Review of patents related to deep seabed genetic resources

A brief search of selected Patent Office Databases has revealed that several deep seabed organisms have been used for commercial application. Most inventions concern the genomic features of deep seabed species, the isolation of active compounds, and sequencing methods. Others relate to the isolation of proteins that present enzymatic activity of potential for industrial applications. Several inventions concern the cell components and biological compounds themselves, which offer interesting properties for use in biomedical applications.

The company Sederma, located in France, has used enzymes isolated from deep sea bacteria[109] to develop commercial skin protection products providing higher resistance to UV and heat exposure. These inventions have been the object of patents.[110] The enzymes used for these products, isolated from the extremophile *Thermus thermophilus*, are effective in counteracting free radicals that form as a result of UV action, especially at high temperatures, thus preventing the skin from damage. Sederma was granted the authorization to commercially exploit some of the samples collected during expeditions by the CNRS. Enzymes derived from *T. thermophilus* are also used by the California-based company California Tan for developing and commercializing the same type of products.[111]

T. thermophilus and other species of thermophiles are also the subject of research by the company Roche. Roche's patents relate to improvements in the amplification of nucleic acids, and include a number of inventions based on thermophiles such as a DNA sequence using a *Thermus aquaticus* DNA polymerase (patent US5075216), a *Thermus thermophilus* polymerase (patent US5407800), a mutated thermostable polymerase from *Thermotoga maritima* (patent US5420029), a mutated thermostable polymerase from *Thermus sp*. (patent US5455170), a thermostable polymerase from *Pyrodictium sp*. (patent US5491086), and a thermostable polymerase from *Thermosipho africanus* (patent US 5968799).[112] These products are used in conventional molecular biology such as sequencing.

The California-based company Diversa Corporation has been granted a significant number of patents related to discoveries involving genetic resources from deep seabed organisms.[113] Products have been commercialized largely thanks to partnerships between Diversa and market companies such as BASF, The Dow Chemical Company, Givaudan Flavors Corporation, Invitrogen Corporation, Syngenta AG and others.[114] As of November 2004, Diversa has commercialized several products developed on the basis of deep sea organisms,[115] including: the Pyrolase™ 160 enzyme, derived from a hydrothermal organism and used in industry to reduce viscosity;[116] and the thermostable ThermalAce™ DNA Polymerase, derived from a non-declared Archaea species, and used in DNA sequencing.[117]

The company New England BioLabs Inc., headquartered in Beverly, Massachusetts, US, has an extensive list of commercialized products derived from deep seabed organisms. Examples include: the Deep VentR® DNA Polymerase, obtained from a bacterium carrying polymerase genes, *Pyrococcus sp.* – a hydrothermal vent species found at 2010 meters of depth and growing at temperatures of up to 104°C;[118] and the Therminator[a] DNA Polymerase, obtained from a genetically-engineered form of the DNA polymerase of *Thermococcus sp*.[119]

The company Aquaartis, based in France, has developed BactoScreen™ – a library of extracts of some 1,000 marine bacteria isolated from marine organisms and sediments. Most likely, several of these microorganisms belong to deep seabed environments.[120]

The US NOAA reports that several marine compounds are under clinical investigation as possible anti-cancer products, including metabolites obtained from deep seabed organisms, such as lasonolides, obtained from the deep sea sponge belonging to the genus *Forcepia*, commonly found in deep sea habitats in the Gulf of Mexico. Reference is also made to the discovery of discodermolide, a potent anti-tumor agent, isolated from a deep sea sponge by the Harbor Branch Oceanographic Institution, Inc. (HBOI), a not-for-profit oceanographic research and education organization based in Florida, US, which has been conducting expeditions aimed at sampling organisms of potential interest to identify compounds of biomedical importance. Discodermolide was subsequently licensed to Novartis.[121]

Many other examples of applications of genetic material derived from deep seabed organisms can be found in the public domain, such as:

- the *Thermus aquaticus* DNA polymerase Taq Red, commercialized by the company HyTest Ltd., based

in Turku, Finland. HyTest manufactures and markets cardiac markers, hormones, toxins, human proteins, and infectious and autoimmune disease reagents.[122] Taq Red is used as an enzyme for molecular biology;
- the thermostable *Tth* DNA Polymerase[a] commercialized by the company Promega, headquartered in Madison, Wisconsin, US.[123] This product is also used as an enzyme for molecular biology.

There are many patents involving genetic resources from the deep seabed. However, for many of these patents, it is difficult to demonstrate whether or not practical applications have been developed. Following are some examples of patents for which commercial applications have not been identified yet:

- Diversa is among the applicants of patent WO03093434,[124] concerning the genome of the hyperthermophilic *Nanoarchaeum equitans*, its proteins (including enzymes), identified genes encoding these proteins, and also the isolated *Nanoarchaeum* equitans;
- patent US2003235902[125] concerns the production of thioredoxin from the hyperthermophilic *Aeropyrum pernix* and *Pyrococcus horikoshii*, growing at temperatures between 90 and 100°C. Thioredoxin has an interest for the pharmaceutical industry, including as an agent detoxifying snake venom protein and preventing skin inflammation caused by UV radiation. This protein is relevant to the food industry as a compound that eliminates food allergens, and to the cosmetic industry for development of products used as protection against adverse effects of UV radiation;[126]
- patent US2003129734[127] relates to the copper-tolerant yeast *Cryptococcus sp*., isolated from deep sea sediments;
- patent US5989587[128] concerns the production of novel ether lipids from the Archaea *Methanospirillum hungatei, Methanococcus jannaschii, Methanococcus voltae, Methanosarcina mazei, Methanobrevibacter smithii and Halobacterium cutirubrum*. These liposomes (lipid vesicles) prove to be very stable, making them good candidates for many liposome applications, including as components of biological membrane systems for the study of processes such as trans-membrane transport, immunological adjuvant, carriers of drugs, skin care compounds, and insecticides;
- patent application US2002010666O[129] relates to the structure of the 30S ribosome unit of *Thermus thermophilus*, on the basis of which 30S inhibitors can be developed, and potentially used as antibiotics;
- at least 21 patents meet the search criteria 'Archaea' under the metadatabase of the European Patent Office.[130] These span from methods for detecting and identifying DNA in a sample (patent US2004176584) to novel extreme halotolerant and halophilic (patents TW579390 and WO0130934) as well as thermostable enzymes (patents US2004002075, US6391604, WO9833895), the formation of stable lipids from Archaea's lipid extracts (WO9308202), and the genome of particular species, such as patents related to the genome of the hyperthermophile *Methanopyrus kandleri*;
- the patent database of HBOI[131] lists more than 120 patents related to compounds obtained from marine species, several of which are from the deep seabed. These include anti-tumor and antiviral compounds, anti-inflammatory and anti-allergy agents, and anticoagulant agents. Patents also cover inventions related to methods for determining the composition of those compounds as well as their possible uses. The database does not specify whether or not the isolated compounds have been commercialized. Funding for this research has been provided by the US government agencies, including NOAA and the National Cancer Institute (NCI). Partnerships were established with universities, as well as with biotechnology and pharmaceutical industries.

3.3 Information on recorded or potential impacts of research activities carried out in the deep seabed

As shown in section 3.2 of this report, distinguishing between pure marine scientific research and applied marine scientific research is difficult in practice. Deep seabed activities driven by commercial objectives would not be possible without strategic partnerships with academic institutions, the interest of which lays generally in furthering our knowledge of deep seabed ecosystems.[132] For the purposes of this section, pure marine scientific research and bioprospecting activities are considered jointly.

Research in the deep seabed has both positive and negative impacts. Among the positive impacts, marine research contributes to expanding our knowledge of the deep sea. Thus, in Resolution A/RES/59/24 (Oceans and the law of the sea), the UN General Assembly called "upon States, individually, or in collaboration with each other or with relevant international organizations and bodies, to improve understanding and knowledge of the deep sea, including, in particular, the extent and vulnerability of deep sea biodiversity and ecosystems, by increasing their marine scientific research activities in accordance with the Convention [i.e. UNCLOS]."[133]

Without marine scientific research, industry and academia would not be in a position to continue exploring the value of deep seabed genetic resources for health and industrial applications. Marine scientific research is the most immediate means to increase our knowledge about the structure, functioning and role of deep seabed ecosystems, as well as their value and that of deep seabed genetic resources to human well-being. Marine scientific research is also the most immediate means to build an informed

basis upon which to make management decisions, including conservation measures.

Marine scientific research will also assist in revealing the unknown, as well as determining what cannot yet be known, as far as life in the deep seabed is concerned.[134] The Baseline Report of the Census of Marine Life estimates that six thousand species have yet to be discovered in the oceanic realm of active geology.[135] This figure may be much larger, as patterns in discoveries are not clear.[136] These discoveries will have implications for scientific knowledge, including with regard to theories on the origin of life and evolution, and for regulating conservation of, access to, and the sharing of the benefits deriving from the utilization of deep seabed genetic resources.

At the same time, marine scientific research represents a source of potential and actual adverse impacts on deep seabed ecosystems. Marine scientific research may entail physical disturbance or disruption, e.g. the removal of parts of the vent physical infrastructure and/or of the associated fauna. Research vessels and scientific equipment installed to carry out long-term measurements may also negatively impact on the deep seabed physical environment. As has been shown, alteration of environmental conditions is likely to impact on the organisms living in those areas. Alterations can occur for example, in the context of *in situ* experiments aimed at clarifying the reproductive biology of some organisms, bringing changes in water temperature. Introducing light and noise in an environment that is naturally deprived of the former, and in which characteristic patterns of noise are very different from those induced by human activities, is also likely to cause alterations.[137] Moreover, marine scientific research may entail pollution in the form of debris or biological contamination due to disposal of biological material in areas different from the sampling area.[138]

The frequency of research expeditions is also a source of negative impact. Among the few hundred hydrothermal vents discovered so far, only a few are visited once a year, and others once every few years.[139] It is likely that some deep seabed sites may become the subject of systematic observations under various monitoring programmes.[140] The reference document for the draft implementation plan of the Global Earth Observing System of Systems (GEOSS) calls for repeated observations in the deep seabed in the years to come.[141]

An international programme on Monitoring the Mid-Atlantic Ridge (MOMAR), sponsored by the European Commission, will conduct systematic abiotic and biodiversity observations over a five to ten-year period using equipment and performing sampling that may have a bigger impact than sporadic measurements and observations.[142] The North-East Pacific Time-series Undersea Networked Experiments (NEPTUNE) plans to implement a permanent system of deep seabed multidisciplinary observations on the entire Juan de Fuca plate, using 3,000 km of fiber-optic cable, while the European Sea Floor Observatory Network (ESONET) will undertake repeated real-time observations in the seabed on the Atlantic and Mediterranean coasts. Japan will set up an Advanced Real-time Earth Monitoring Network in the Area (ARENA) along the Japan Trench.[143] Some monitoring programmes are already fully operational, such as the New Millennium Observatory (NEMO), which focuses on the impacts of volcanic activity on hydrothermal vents.[144]

Scientific activities can interfere with each other and are sometimes incompatible. Concerned about the impacts of their increasing activities on deep seabed ecosystems, scientists have cooperatively agreed to address these impacts, including through coordination of site visits to minimize conflicting uses and simultaneous expeditions, as well as through the development of codes of conduct. Such codes of conduct are outlined in section 5 of this report. In order to conduct scientific research in the most possible undisturbed conditions, the InterRidge website hosts requests by scientists conducting deep seabed research and observations to consider a given site as a scientific reserve.[145] In 1998, five requests were put forward by scientists operating in the East Pacific Rise for: Biotransect (9°49.6'N - 9°50.4'N, 104°17.4'W), East Wall (9°50.54'N, 104°17.52'W), M vent and X5 (9°50.7'N, 104°17.52'W), Riftia Fields (9°50'N, 104°W) and Worm (or Tevnia) Hole (9°48.95'N, 104°17.31'W).[146] In the mid-Atlantic Ridge, requests concerned Eiffel Tower (37°17.356'N and 32°16.486'W - 1695 meters), «PP24» (37°17.646'N and 32°16.888'W) and Rainbow, markers PP28 (36°06.690'N, 33°11.290'W), 35 and PP37. These last requests were put forward between 1998 and 1999.[147]

Overharvesting of marine resources for bioprospecting purposes poses a conservation and sustainable use problem, as explained in more details in section 4.2 of this report. Other threats are to be highlighted, including mining activities and climate change. According to some, climate change represents the widest and most significant threat to the largest number of species in the deep sea. Fossil records show that past episodes of global warming have led to widespread dysaerobia in deep sea ecosystems, wiping out much of the fauna. Recent studies have shown that even relatively small changes in the quality of phytoplankton at the surface can change the abundance of species at the seabed, 4,000m below.[148]

In order to assess the status of various deep sea ecosystems and improve management of risks to such ecosystems, States have agreed, within the CBD and the UN General Assembly, to engage in information-gathering activities (see section 5).

There seems to be a common understanding that marine scientific research can be run and fulfill its objectives in a way that minimizes potential disruption to deep sea ecosystems, while remaining one of the freedoms of the High Seas as set out under UNCLOS, as will be detailed in section 5 of this report.

3.4 Technological constraints and opportunities for deep seabed bioprospecting

Important technological considerations have to be taken into account when discussing bioprospecting of deep seabed genetic resources. These are due to the difficulties in

accessing environments that are extreme in terms of depth, pressure, and temperature, as well as in preserving collected samples *ex situ* in order to identify culture and further study them.[149]

Reaching deep seabed extreme environments and maintaining sampled organisms intact and alive, as well as culturing them, requires sophisticated and expensive technologies. Typically, the technology associated with research on deep seabed genetic resources involves: manned or unmanned submersible vehicles (the latter are normally referred to as Remote Operation Vehicles or ROV);[150] *in situ* sampling tools; technology related to culture methods, including pressurized aquaria to maintain sampled organisms at original pressure conditions; molecular biology technology and techniques; and the technology associated with the different steps of the commercialization process of derivates of deep seabed genetic resources. With the exception of basic molecular biology techniques, most of the technology necessary for accessing the deep seabed and studying and isolating organisms from the deep seabed is owned by research institutions, both public and private.[151] To date, only very few countries have access to these technologies.

On the other hand, emerging techniques such as that of DNA Barcoding may soon be available on a large scale and help study deep seabed ecosystems and organisms.[152] As sequence-based techniques for determining microbial community composition have limitations, a combination of rapid assessment and conventional techniques, including culturing the sampled microorganisms, will probably have to be applied when studying the properties and potential applications of deep seabed genetic material.[153]

A limited number of institutions worldwide own or operate vehicles that are able to reach areas deeper than 1,000 meters below the oceans' surface, and can therefore be actively involved in deep seabed research. A larger number of institutions operate vehicles that are capable of reaching shallower depths.[154] In either case, developing and operating deep sea technology is a highly consuming exercise, financially as well as time-wise.

Many institutions undertaking deep sea research and owning and/or operating deep sea vehicles and associated technologies are publicly owned. Partnering with private companies interested in possible commercial applications/uses of deep sea genetic resources is common in order to ensure that the costs of deep sea expeditions are adequately covered.

Box 3 contains a brief description of the technology owned and operated by an institution active in deep seabed research: JAMSTEC.[155]

Box 3: The Japan Agency for Marine-Earth Science and Technology

JAMSTEC is an independent administrative institution undertaking research and development activities in the field of marine environmental sciences, with particular attention to interactions between geological features and biological communities on the deep sea floor. The objectives are to: understand changes in the global environment; provide knowledge on natural disasters so as to protect people; provide knowledge and information that contribute to social and economic development; and deepen and broaden human knowledge about the ocean and the Earth to enrich the intellectual property of humankind.

JAMSTEC Headquarters host the Extremobiosphere Research Center (XBR). The Center's mission is to search for new organisms and investigate ecosystems so as to: explore and understand their characteristic functions; carry out research on the functions and ecology of organisms through experiments and simulations; and contribute to social and economic development through industrial applications. One of the stated objectives of the work of JAMSTEC-XBR is "to establish new fields of biotechnology by discovering unique microbes and enzymes, analyzing their genomes, and identifying industrial applications for the knowledge obtained through such study." XBR has several programmes relevant to research on deep seabed genetic resources, such as the Extremophiles Research Program, which specializes in the establishment of partnerships with private companies with a view to developing commercial applications based on the findings of research activities undertaken by XBR.

JAMSTEC owns and operates several vehicles to undertake deep seabed research. These include: the manned Deep Submergence Research Vehicle (DSRV) SHINKAI 6500, which can reach depths of 6,500 meters;[157] the unmanned vehicle DOLPHIN-3K and the ROV "Hyper Dolphin" System going at maximum depths of 3,300 and 3,000 meters respectively, and used for sampling and taking images with specialized TV cameras;[158] the ROV KAIKO 7000, which can reach a maximum depth of 7,000 meters, and is used for sampling and imaging;[159] and the Autonomous Underwater Vessel (AUV) URASHIMA for autonomous deep sea cruising at depths of 3,500 meters, and which allows to detect deep seabed geological and biological activity and generate topographical data when coupled with direct imaging and sonar techniques.[160] A drilling ship, the CHIKYU, which will allow drilling several thousands of meters below the ocean floor to study the origin of the Earth and life, is under construction.[161]

Particularly innovative is a device called "Deep Bath" (Deep-Sea Baro/Termophiles Collecting and Cultivating System), developed by JAMSTEC and operated since the early 1990s, which allows maintaining samples at *in situ* conditions of pressure and temperature. Such conditions are a precondition for the survival of piezophiles – organisms that can only survive at very high pressure. Deep Bath is composed of four subsystems: a sediment sampler; a dilution device; an isolation device; and a culture vessel. While only 5ml of samples of sediment can be collected at a time, a mass cultivation of microorganisms of 1000ml can be obtained through dilution.

To date, JAMSTEC has been able to isolate 180 microbial species from the Mariana Trench, the deepest point on Earth at 10,898 meters, located off the Mariana Islands in the

Pacific Ocean. The aim was to have more than 3,500 strains of deep sea microorganisms preserved in liquid nitrogen by the end of 2004. JAMSTEC's website hosts a metadatabase of the genomes of several deep sea microorganisms that have been sequenced by JAMSTEC and other scientific institutions in the world.[162]

According to interviews conducted with both a senior manager and a senior scientist at JAMSTEC in November 2004, only a few countries possess the technology to conduct deep seabed expeditions at depths greater than 1,000 meters. These are: France, Japan, Russia, and the US.[163] These countries all have DSRVs capable of reaching depths of 6,000 meters. While China is in the process of building adequate technology for this type of research, the US is developing a vehicle that could reach greater depths.

Some private companies also own deep sea research vehicles, but their capability of operating is limited to much shallower environments (< 1,000 meters). In the case of JAMSTEC, only a small percentage of its research budget is contributed from the private sector.

Other research institutions, including Ifremer in France and the Woods Hole Oceanographic Institution in the US, use technology similar to that of JAMSTEC.[164]

~~Considering the technological issues outlined in this section~~ as well as the potential value of deep seabed genetic resources to humanity, organizing technology transfer seems particularly relevant. While such transfer may result in increased research in the deep seabed, thereby putting at risk these ecosystems, the transfer of so-called "clean technologies" may allow sustainable research practices and at the same time respond to the need to expand our knowledge of the marine realm. It is anticipated that options for making those technologies available to developing countries will be found under "opportunity programmes," i.e. programmes combining activities such as oil drilling or commercial fishing with scientific research. Requirements for technology transfer of marine science technology are provided for in a number of international instruments outlined in section 5 of this report.

3.5 Consequences for management resulting from the features of, and threats to, deep seabed ecosystems, as well as from technological aspects

The slow growth rate, limited longevity, late sexual maturity and restricted distribution of certain species inhabiting deep seabed ecosystems make them potentially vulnerable to changes in the surrounding environment.[165] As indicated above, slight changes in those environmental conditions might significantly influence key biological processes of those species, such as reproduction. Hence, conservation and sustainable use measures for deep seabed ecosystems have to take into account the biology of species and the ecological characteristics of the ecosystems of which they are part, for example in terms of resilience.[166]
Seamount ecosystems host deep sea fish of commercial interest. The use of some deep sea fishing techniques, such as bottom trawling, has caused the destruction of many seamount ecosystems and of associated communities of sponges and other sessile invertebrate organisms. Unsustainable fishing activity at seamounts has also caused the depletion or collapse of long-lived, slow-growing deep sea fish stocks that are very vulnerable to overfishing.[167] Associated ecosystems such as cold-water coral reefs have also been significantly impacted by these activities. A study on the patterns of species richness in marine areas beyond national jurisdiction concludes that the high degree of endemism at seamounts, combined with the high degree of threats, suggests that there is a need to focus conservation efforts on these ecosystems. The study highlights specific seamount areas in the tropical Indo-Pacific, Pacific, Indian and Atlantic Oceans as priority areas for conservation.[168]

Vent and other deep seabed ecosystems are the subject of increasingly significant marine scientific research and bioprospecting. The precarious nature of hydrothermal vents and cold seeps – a vent may appear and then disappear in a decade or two, and the sediments on which cold seeps are located are intrinsically physically unstable – should not act as an impediment to conservation and sustainable use measures for these ecosystems and their associated resources. While the question may be asked of the relevance of conserving systems that are transient or unstable, the necessity of such conservation is clear. First, these ecosystems will better inform us about life in the deep seabed in general, a subject still very poorly known as "at best the technology to explore these dark, deep waters is brand new, and at worst it is still inadequate."[169] Second, only a very limited amount of vents and cold seeps have been found and explored, since vents typically cover only a few tens of square meters, which makes them difficult to detect.[170] The knowledge gathered from already and yet-to-be discovered deep seabed ecosystems and species will generate important information on how these systems are structured and function in general, on their value to humankind, and on the way in which they should be managed. Moreover, vent biogeographic provinces may provide important information and become essential elements of possible systems of ecologically representative marine protected areas (MPAs) in areas beyond the limits of national jurisdiction, as called for recently under various international fora, including the CBD.

With regard to adverse impacts of marine scientific research on deep seabed ecosystems, new sophisticated technologies have been developed to study deep seabed ecosystems. Examples are devices to sample vent fluids at temperature and pressure values as high as 420°C and 600 bar and to maintain samples at original pressure values *ex situ*, which may reduce the intensity of sampling.[171] Rapid assessment methods, including using taxon richness as a surrogate for species richness, can also be used to assess deep seabed communities, which would facilitate their study and management.[172] This would suggest that new knowledge and technology should be made use of in order to reconcile the needs of pure and applied science with the conservation of deep seabed ecosystems.

4 Overview of global biotechnology and bioprospecting trends

Bioprospecting for genetic resources from the deep seabed has to be considered within the broader context of the biotechnology sector, the development of new products based on the use of natural resources, and the consolidation of genomics as a basis for both biotechnology and bioprospecting. This section provides a brief overview of global trends in these areas, as well as of bioprospecting for marine resources and other extremophiles such as those from Antarctica.

4.1 General industry trends

Industry sectors involved in bioprospecting include biotechnology, waste, agriculture, and the pharmaceutical and cosmetics industry. To varying degrees, all these sectors are increasingly using biotechnology to develop new products.

According to Ernst & Young's Global Biotechnology Report 2004, the global biotechnology sector, which went through a phase of significant recession between 2001 and 2002, has fully recovered. The report notes that the biotechnology industry worldwide, led by the US, rebounded in 2003 and 2004, making the global biotechnology industry a leader in the creation of a new health economy in which biotechnology, pharmaceutical, and medical device companies are converging with health care providers. The number of publicly-traded biotechnology companies declined slightly in 2003 to 611 from 619 in 2002, but these companies earned 17% more in revenues and hired more workers, boosting employment by 9%, while reducing R&D spending by 16% and improving their net loss by 65%.[173] New investments, including from governments, are directed towards the biotechnology sector.

Worldwide, biotechnology supported almost 200,000 employees and generated revenues of up to US$ 46.6 billion in 2003, increasing by 9% and 17% respectively, compared to the 2002 figures. Between 1998 and 2003, revenues from the biotechnology industry have increased by 115% in the US, 246% in Canada and 754% in Europe. In the same period, the number of people employed by the biotechnology sector has increased by 38% in the US, 176% in Canada and 184% in Europe. The global distribution of revenues is as follows: 77% for the US, 16% for Europe, 4% for Canada, and 3% for Asia and the Pacific. These numbers show a decline of Europe's share from 21% in 1998, and an increase of the US share from 72% in 1998.[174]

According to Ernst & Young, on the basis of the number of public and private biotechnology companies located in those countries, the top 12 biotechnology countries are: the US, Canada, Germany, the United Kingdom, France, Australia, Sweden, Israel, Switzerland, China and Hong Kong, India and Denmark.[175]

Regional trends suggest that biotechnology in the Asia-Pacific region is a tool for improving the provision and nutritional value of food from agriculture as much as it is for developing health applications.[176] Japan has developed a strong supporting policy with regard to biotechnology, marking a shift from the conventional pharmaceutical sector, through public investments and the recognition of intellectual property.[177] China is also intensifying its protection of intellectual property; its pharmaceutical sector, which is the world's second largest chemical pharmaceutical producer, continues expanding at a rate of 15-17% per year.[178] In 2003, Singapore directed US$ 1 billion to the development of its biotechnology sector.

In North America, a major shift from research into novel organisms and compounds to development of products based on known metabolites has occurred, due to the fact that the hit rate of new products based on biodiversity has been low.[179] In the US, the approval of new drugs increased by 25% in 2003, with some 300 biotechnology products based on natural compounds currently undergoing Phase III trials.[180] In Canada, financing for biotechnology in 2003 increased by 15% as compared to 2002.

The European biotechnology sector has shown contradictory signs in 2003. While financial investments do not seem to be a limiting factor, the number of marketable products is low, and the sector remains fragmented with very little concentration between companies. The public health sector and commercialization of new drugs are strictly regulated within most European countries. In 2003, both public and private biotechnology companies have experienced losses in revenues, number of companies and employees, and have reduced their R&D expenses. In terms of number of companies per country, Germany leads the European biotechnology sector (350 companies, 11 of which are public), followed by the UK (334 companies, 43 of which are public) and France (246 companies, six of which are public). Within all European countries, private biotechnology companies outnumber public ones.[181]

In Latin America, 432 biotechnology companies have been counted in 14 countries, the most active of which are Argentina, Brazil, Chile, Colombia, Cuba and Mexico. The region sees an increasing number of partnerships between biotechnology companies and national and regional professional societies such as the Latin American Federation of Biotechnology Companies and Associations (FELAEB).[182]

With regard to sectoral trends, the role of biotechnology in the health care industry is increasing, and more and more partnerships are being created between biotechnology and pharmaceutical companies. From 22 in 1993, companies using biotechnology for the health sector ("biologics") now number 190, 13 of which are "blockbusters" that sell over US$ 1 billion each annually.

Biotechnology is emerging as a sector that increases cooperation between pharmaceutical companies and other biotechnology companies, academic researchers, non-profit institutions, medical centers and foundations.[183] For example, the US-based company Targeted Genetics has entered into a collaboration with the International AIDS Vaccine Initiative, which aims at producing a vaccine at an accessible cost for developing countries and which can also be commercialized in developed countries. The nature of partnerships between biotechnology and pharmaceutical companies is changing: instead of simply

out-licensing their products, biotechnology companies increasingly demand a partner role in most phases of the commercialization phase, including the sharing of royalties.[184]

With the advent of recent technologies in genome mapping, genomics – the study of genes and their functions – has significantly developed as a research area, with 1182 projects on genome mapping being listed on the Genomes Online Database as of 14 September 2004 (representing a 47% increase over a one-year period, from 2003 to 2004).[185] Among these projects, 522 are about prokaryotic species, including Archaea (most of the deep seabed microorganisms belong to the class Archaea). Genomics, proteomics and biotechnology are associated with a shift in the balance of relationship within "the triple helix" of innovation, composed of government, universities and industry, towards universities. The majority of registered worldwide genome mapping projects appears to be conducted by universities or non-profit organizations. Oldham notes that this shift in the structure of innovation towards publicly-funded research may provide important ways forward in developing an international regime on access to genetic resources and benefit-sharing. The dominance of publicly-funded R&D in these areas would provide opportunities to develop alternative incentives directed towards internationally-agreed goals and alternative models for access and benefit-sharing that minimize the externalities of the patent system and maximize the benefits for global welfare.[186]

The development of genomics has been favored by the advent of biological informatics or "bioinformatics," which can be loosely defined as the application of information technologies to biodiversity studies and their applications. Bioinformatics plays a key role in the identification of candidate compounds for pharmaceutical and many other purposes in that it allows the rapid screening and selection of potential compounds for further testing.[187] For example, in the US, the biotechnology company Incyte has been selling non-exclusive access to its genome sequence databases and the use of its bioinformatics software for the analysis of this data. The company also negotiated royalties regarding drugs developed on the basis of this data.[188] Since the technology and software associated with bioinformatics is increasingly being made available, including through 'open source' software, bioinformatics is likely to change the way biotechnology research is conducted in the future, with trends suggesting that there is a decreasing dependence on physical transfers of biological material in favor of electronic transfers. Bioinformatics is also likely to reduce R&D costs. Oldham notes that one of the opportunities is to link access and benefit-sharing arrangements with transfers of bioinformatics technology and knowledge.[189] The role of bioinformatics with regard to deep seabed genetic resources, the genomics of which has only started, should not be overlooked in these respects.

Quantifying the contribution that natural genetic resources make to the biotechnology market is difficult. Figures are often difficult to obtain due to the competitive nature of product development. Moreover, the contribution made by natural biochemical processes is frequently only one of many aspects leading to the final product. However, a study of small-molecule new chemicals introduced globally as drugs between 1981 and 2002 showed that 61% can be traced to, or were inspired by, natural products. This figure rose to 80% in the year 2002-2003.[190] Compounds from natural products are considered more agreeable to consumers and two-thirds of the anti-cancer drugs, for example, are derived from both terrestrial and marine natural products.[191] This may lead to greater examination of novel genetic resources and biochemical processes as part of the product development phase of various sectors.

According to the Millennium Ecosystem Assessment (MA), biodiversity continues to be an important source of material for pharmaceuticals. Products and industries that depend on microbial diversity include enzymes for industrial applications such as waste treatment, chemical engineering, wood and pulp processing, biological mining and production of fuel from biomass. Macroscopic species have led to products such as antibiotics and other clinical drugs, surgical drugs, pest repellants, fibers and materials based on biomimetics, industrial adhesive and pigments, and antifouling paints. Industries, some of which are new, encompass bioremediation and ecological restoration, biomonitoring, agriculture and biological control, health, care/cosmetics and nanotechnology. Both the trend in bioprospecting and the ensuing commercial benefits in these industries are predicted to increase.[192] Among the findings of the MA, it is noteworthy that bioprospecting partnerships are most effective when supported by a range of international and national laws, as well as self-regulation measures including codes of ethics.

Novel products and industries do not necessarily come from biodiversity-rich areas. The history of the discovery of new products from biodiversity shows that new products have been derived from both tropical and non-tropical species. There is currently no reliable way to assess the potential of species or ecosystems to provide such novel products, but the pace of discovery of new species as well as of products that are potentially useful to pharmacology is higher for marine and microbial than for terrestrial organisms.[193]

A way of quantifying the contribution of biodiversity to novel products and processes is to analyze the number and nature of patents deposited that relate to inventions based on, or making use of, natural material. The European Patent Office Database, esp@cenet, contains information from 73 national patent offices, as well as regional patent organizations and the WIPO Patent Cooperation Treaty. As of 2004, there were an estimated 45 million documents within esp@cenet, 36.1 million of which were patent descriptions. A search of esp@cenet showed that patents pertaining to microorganisms and enzymes – the focus of this report – dominate over other patents. [194]

The relation between intellectual property, including patents, and biodiversity or natural resources, has been the subject of several studies and intense debates within intellectual property-related fora, such as the World Intellectual Property Organization, and environment-related fora, mainly the CBD. This relation is further

addressed in section 5 of this report, but a question that has often arisen is whether genome-related patent claims represent true innovations or are simply presumed inventions.[195] Moreover, as noted by Oldham, the nature of genetic homologies between organisms signifies that intellectual property claims related to the biological or genetic components of one organism may lead to intellectual property claims in relation to the biological or genetic components of other organisms.[196] Another concern relates to the potential commodification of life ensuing from patenting of natural products.[197]

The trends presented above suggest that biotechnology is a flourishing industry worldwide, and that it will most probably continue to grow in scope, activities and applications. Within this trend, biodiversity will continue providing an important basis for the development of new products and processes. It is also noticeable that small biotechnology companies have replaced large pharmaceutical companies as the drivers of innovation in drug discovery based on natural products. Large companies are no longer interested in screening natural product samples as a result of the longer time span to characterize and develop them than for synthetic molecules.[198]

In such a dynamic context, deep seabed genetic resources, which are among those that are increasingly undergoing bioprospecting activities, are likely to become an important socioeconomic issue.

4.2 Bioprospecting for marine resources

The world's oceans appear to host 32 out of the discovered 34 phyla on Earth, and a diversity of species per area unit as high as 1000 species per square meter in the Indo-Pacific Ocean.[199] Because of their extraordinary diversity and properties, marine organisms hold promises for drug development.

Significantly, the ratio of potentially useful natural compounds to compounds screened is higher in marine-sourced materials than with terrestrial organisms.[200] There is, therefore, a higher probability of commercial success. Potential applications for marine organisms include: pharmaceuticals; enzymes; cryoprotectants; cosmaceuticals; agrichemicals; bioremediators; nutraceuticals; and fine chemicals. All the major pharmaceutical firms, including Merck, Lilly, Pfizer, Hoffman-Laroche and Bristol-Myers Squibb, have marine biology departments. Estimates put worldwide sales of marine biotechnology-related products at US$ 100 billion for the year 2000.[201] Profits from a compound derived from a sea sponge to treat herpes were estimated to be worth US$ 50 million to US$ 100 million annually, and estimates of the value of anti-cancer agents from marine organisms are up to US$ 1 billion a year.[202]

Marine drugs can be used as antioxidant, anti-fungal, anti-HIV, antibiotic, anti-cancer, anti- tuberculosis and anti-malarial. Applications for the treatment of Alzheimer's disease, cystic fibrosis and impotence are also considered.[203] Several marine compounds are currently at various phases of development, including anti-cancer agents and immuno-suppressants. Considerable hope is placed in drugs based on marine organisms in light of the shortcomings of current anti-cancer drugs, which have either been limited to the treatment of specific cancers or to which patients have often become resistant.[204] The hormone calcitonin, extracted from salmon, has been found effective in preventing osteoporosis. Protamine sulfate, also derived from salmon, provides an antidote to the anticoagulant heparin. Research has also shown that cryptophycins produced by cyanobacteria also have anti-cancer potential, as well as being effective against viral diseases such as HIV.[205] Other useful compounds include anti-inflammatory compounds such as manoalide and topsentin, and the cosmaceutical anti-irritant pseudopterosin. The anti-tumor compounds bryostatin-1, ecteinascidin 743, dolastatin-10, halichondrin and spongistatin, have been obtained from organisms such as sponges and ascidians.[206] Sponges are particularly targeted as potential sources of pharmaceutical products. Over 30 years, one of the most effective treatments for leukemia has been based on derivatives of a sponge.[207] A compound, IPL576092 based on the sponge steroid contignasterol, completed US Phase I trials as an asthma drug in 2000.[208] Cytotoxins from deep water sponges found on the Chatham Rise, 400 km off New Zealand, are also under investigation.[209] Other work in progress includes research on: the *Conus* venoms; cytotoxic organic extracts; *Eleutherobia sp*., derivatives of which could treat breast and ovarian cancer and are at the preclinical development phase; *Sarcodictyon roseum*, derivatives of which are at the preclinical development phase; and *Cacospongia mycofijiensis* at the preclinical development phase.[210] It is estimated that many more compounds, in the order of low hundreds, could be developed from the marine compounds that have already been isolated.[211]

However, marine research is expensive as a result of the high cost associated with the necessary technology for sampling and laboratory investigation, among others. The odds of success are slim; only one to two percent of preclinical candidates actually become commercially produced.[212] The following figures illustrate the quantity of lead material yielded from original material: 450 kg of acorn worms yielded 1 mg of cephalostatin; 1,600 kg of sea hares yielded 10 mg of dolastatin; and 2,400 kg of sponge yielded less than 1 mg of spongistatin.[213] It has been estimated that one kilogram of shallow-water marine invertebrate collected, prepared for sampling, identified and transported, costs approximately US$ 1,000 per sample. From the one-kilogram sample, only approximately 20 to 50 grams of liquid and 4 to 15 grams of organic material will be extracted, costing approximately US$ 200 per sample. Subsequent testing may cost as much as US$ 300 per sample. If all associated costs, such as laboratory staff and equipment, are included, the total cost rises to tens of thousands of dollars per sample. These figures need to be assessed against the limited odds of success.

In spite of these odds, sampling from shallow water is economically more viable than from the deep sea, from which specimens are even more difficult to retrieve and investigate. The US NCI was one of the first organizations to begin systematic large-scale collection of marine invertebrates and, in the mid-1980s, formal collection

programmes were initiated to protect access to the original material. NCI's deep sea programme was later suspended due to the high costs involved. The HBOI has successfully synthesized a molecule, discodermolide, from a previously undescribed deep sea sponge. Another compound, halichondrin B, has also been isolated from a sponge species by a New Zealand joint venture. In the latter case, one metric ton of sponge was harvested, which yielded 300 mg of pure halichondrin B. This process cost approximately US$ 500,000.[214] The example of an institution actively working in the field of marine bioprospecting, the Australian Institute of Marine Science (AIMS), is outlined in Box 4.

The above figures highlight the importance of sustainable harvesting, as well as, whenever feasible depending on the biological characteristics of the targeted microorganisms, the need to use various alternatives, such as chemical synthesis, aquaculture, and cell and tissue culture. In the case of fish proteins, for example, it was noted that the proteins could be replicated from genetically modified organisms, and did not require the direct harvesting of fish. Similarly, most bacteria and sponges can be cultured.[215]

Box 4: Marine Biotechnology at the Australian Institute of Marine Science

AIMS activities in the field of marine biotechnology are oriented towards the development of pharmaceutical and healthcare products, agrichemicals for crop protection, and novel bioremediation agents for environmental protection.

The Bioactive Molecule team at AIMS collects samples from Australia's waters to discover compounds which may be developed by industrial partners into clinically-useful drugs or other beneficial products. To date, AIMS researchers have discovered novel marine-derived antioxidants that may have commercial application in cosmetics and food processing. Several lead compounds are being evaluated in medicine for use in the prevention of neurological disorders, such as Alzheimer's and Parkinson's disease. Several anti-cancer agents from marine sponges are currently in the first stage of pharmaceutical development.

AIMS possesses one of the world's largest publicly owned collections of biotic extracts for bioactive chemical discovery, including material from around 20,000 marine macroscopic and microscopic organisms from around Australia. The collection, which holds a relatively small quantity of a large number of organisms, is designed specifically for bioprospecting, primarily for screening purposes.[216]

The former Marine Bioproducts Project at AIMS, now discontinued, also sought to investigate mariculture, culture of microorganisms, molecular approaches and chemical synthesis as alternatives to wild bioharvesting. Since only an estimated one percent of microbial diversity can be cultured using standard techniques, a large proportion of the microbiology effort at AIMS is spent on the development of novel culture and fermentation procedures.[217]

Prior to 1994, AIMS sampled organisms on the basis of scientific research permits, which restricted use of the resources. The permits did not include any benefit-sharing provisions. The caution and concern of management authorities regarding lack of sharing of the potential benefits resulting from the exploitation of sampled organisms, created an environment whereby conditions on access were made more stringent. This seems to have limited AIMS' biotechnology R&D activities, and affected the Institute's capacity to attract commercial R&D funding. More generally, uncertainty over access to marine biota can be a major impediment to potential benefits.

In the absence of a clear regulatory framework, AIMS started entering into agreements on both access and benefit-sharing with industry and governments. In 2000, AIMS signed a Deed of Agreement with the Queensland Government to share the benefits of any scientific and commercial exploitation arising from biodiscovery research undertaken by AIMS on biota sampled from Queensland's seabed. Under the Agreement, the benefits to be shared include non-monetary outcomes (e.g. capacity building and sharing of scientific knowledge), as well as potential commercial profit (15% of the profits to be transferred to the State). Royalties are only a small part of the arrangement, which includes other benefits, some of which are more certain and available in a shorter time frame, including documentation of biodiversity to aid better management, opportunity for intellectual property development in new discoveries, innovative biotechnology industry, and a new sustainable resource-based industry. While access to the resources must still be sought from resource management agencies since the Agreement only deals with benefit-sharing, permit conditions are limited to environmental concerns. The Queensland Agreement has been thought to provide an improved legal framework, which is more favorable to attract R&D investment from industry.[218]

4.3 Bioprospecting for extremophiles: the case of Antarctica[219]

The application of extremophiles in industrial processes ranges from their use in liposomes for drug delivery and cosmetics, waste treatment, molecular biology, to the food industry. A eukaryotic homologue of the myc oncogene product from halophilic Archaea, for example, is being used to screen cancer patients' sera.[220] Enzymes isolated or adapted from extremophiles are also used in clinical chemistry, pulp industries, food processing, cleaning, dyeing technologies, or refining and bioremediation.[221]

Scientists and bioprospectors are interested in Antarctica for two reasons. First, the lack of knowledge surrounding Antarctic biota provides an opportunity to discover novel organisms of potential use to biotechnology. Second, Antarctica's environmental extremes, such as cold temperatures and extreme aridity and salinity, present conditions in which biota have evolved unique characteristics for survival. Thus, bioprospecting opportunities include, *inter alia*, the discovery of novel bioactives in species found in cold and dry lithic habitats,

novel pigments found in hypersaline lakes, and anti-freezes in sea-lakes.[222]

Amongst the many examples of commercially-useful compounds discovered, is a glycoprotein which functions as the 'anti-freeze' that circulates in some Antarctic fish, preventing them from freezing in their sub-zero environments.[223] The application of this glycoprotein in a range of processes is being considered, including to: increase the freeze tolerance of commercial plants; improve farm-fish production in cold climates; extend the shelf-life of frozen food; improve surgery involving the freezing of tissues; and enhance the preservation of tissues to be transplanted.[224]

Patents applied for or granted so far based on bioprospecting of Antarctic biota are manifold. A patent database search, which is not deemed exhaustive but indicative of existing patents, has revealed that companies applying for patents include: Bayer AG (Germany), Henkel KGAA (Germany), SmithKline Beecham, Astra, Novonordisk (Denmark), Du Pont (US), Chisso Corporation (Japan), Loders Croklaan (The Netherlands), Haarmann & Reimer GmbH (Germany), Unilever (UK), Lysi HF (Iceland), DSM NV (The Netherlands), Jujo Paper Co Ltd (Japan), Mitsubishi Gas Chemical Company Inc (Japan), Higashimaru Shoyu Company Ltd (Japan), Tokuyama Corporation (Japan), Lion Corporation (Japan), and Nippon Soda Company Ltd (Japan).

Of the 18 companies that have applied for patents based on resources from Antarctica, most applicants are Japanese-based companies, followed by German ones. The patents examined indicate a recent decrease in patents granted. Thus, between 2002 and 2003, six patents were issued, whereas 10 patents were granted between 1996 and 1997. Prior to this, fewer patents were granted, with one being issued between 1990 and 1991. Most patents filed are process- rather than product-based, with many relating to the yeast *Candida antarctica*.

Examples of process-based patents relate to:

- the preparation of esters in the presence of *Candida antarctica* lipase A, or a variant thereof. The esters are useful as ingredients in fat blends such as margarine (WO0153511);
- the enzymatic synthesis of polyesters in the presence of a lipase derived from, amongst others, *Candida antarctica*. The polyesters are useful in formulating products such as skin cream and cosmetics as they normally function as thickeners or softeners in such formulations (US5962624);
- the preparation of an optically-active ester using an enzyme originating from *Candida antarctica*. The ester can be used for preparing pharmaceuticals such as benzothiazepines and benzazepines (US5407828);
- the hydrolosis (the chemical breakdown of molecules and addition to them of water molecules) of water-insoluble ester in the presence of a lipase derived from a strain of *Candida antarctica*. The ester hydrolosis can be applied to hydrolosis of resin ester. This is useful as some types of pulp made from wood have high resin content, and the resin can create disturbances in the process of pulp manufacture and may have negative effects on the properties of the final pulp product (WO9218638);
- the use of a glycoprotein produced by *Pseudoalteromonas antarctica* in the preparation of pharmaceutical, veterinary and cosmetic compositions for topical or mucosal application aimed at the treatment and re-epithelialisation of wounds (WO02102406);
- the use of an extract from the green alga *Prasiola crispa spp. antarctica* for cosmetic skin treatment, care or protection, including as sun protector and after-sun cream (WO0238121).

Product-based patents relate to:

- the development of frozen confectionary products, such as ice cream, comprising one or more anti-freeze proteins derived from plants, including from the Antarctic-based *Nothofagus antarctica*, *Deschampsia antarctica* and *Umbilicaria antarctica*. The anti-freeze proteins inhibit ice recrystallization and thus provide a good texture to frozen confectionary product (GB19970014412);
- a glycoprotein obtained by culture of the bacterial species *Pseudoalteromonas antarctica* CECT4664, which is useful for coating liposomes in order to improve their stability in relation to external factors such as surfactants (WO9842731);
- the production of a particular stimulating agent containing the extract of an alga belonging to the genus Durvillea, including *Durvillea antarctica*. The stimulating agent prevents the development of skin wrinkles (JP9176036).

5 International instruments and ongoing activities relevant to deep seabed bioprospecting

There is currently no specific international regime addressing bioprospecting in the deep seabed. However, a number of international instruments are relevant. This section focuses on relevant provisions of, and activities under, UNCLOS, the UN General Assembly, the CBD, as well as instruments addressing IPRs. Other relevant instruments and activities are also briefly considered.

5.1 United Nations Convention on the Law of the Sea

UNCLOS, which was adopted in 1982 and entered into force on 16 November 1994, aims to establish "a legal order for the seas and oceans which will facilitate international communication, and will promote the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment."

UNCLOS also aims to develop the principles embodied in UN General Assembly Resolution 2749 (XXV) of 17 December 1970. This Resolution declared that the area of the seabed and ocean floor and the subsoil thereof, beyond the limits of national jurisdiction, as well as its resources, are the common heritage of humankind, and that their exploration and exploitation shall be carried out for the benefit of humankind as a whole, irrespective of the geographical location of States.[225]

In order to achieve its objectives, UNCLOS sets out the rights and obligations of Parties on the basis of maritime zones, delineated according to distance from the coastline on the basis of set baselines. States have sovereignty over their internal waters, territorial seas and archipelagic waters, and sovereign rights over the resources in their EEZ and continental shelf. Cooperation between States is required to manage the High Seas as well as the seabed and ocean floor and subsoil thereof beyond the limits of States' continental shelves. This is referred to as "the Area" under UNCLOS, [226] which are areas beyond national jurisdiction. UNCLOS defines the extent of the rights and obligations of States within the various maritime areas.[227]

It is worth noting that the specific delineation of the Area is still uncertain as a result of the possibility for States to establish the outer limits of their continental shelf beyond the 200 nautical miles limit, as provided for under Article 76 of UNCLOS. Claims to an extended continental shelf are to be submitted to the Commission on the Limits of the Continental Shelf within 10 years of entry into force of UNCLOS for Parties wishing to make such claims.[228] Because this creates uncertainty regarding the specific boundaries of areas within and beyond national jurisdiction, it is unclear whether activities carried out in some areas of the seabed are to be governed by national law or international regulations.[229]

5.1.1. Genetic resources under the UN Convention on the Law of the Sea

UNCLOS does not use the term "genetic resources." However, considering the object and purpose[230] of UNCLOS as set out in its Preamble and outlined above, it is assumed that such resources, which are living resources, are covered by the provisions of UNCLOS related to living resources. 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 evolutionary interpretation of treaties supports this observation.

Within national jurisdiction, on the basis of Article 77(4), the regime applicable – i.e. that of the EEZ or that of the continental shelf – to genetic resources found on the seabed depends on whether these fall within the definition of sedentary species or not. UNCLOS defines sedentary species as organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil.[231] It is noteworthy to recall that microorganisms found in hydrothermal vents and cold seeps are considered sedentary or not depending on their biology (see section 2). Most species currently of interest to bioprospectors are those considered as sedentary because these have evolved chemical compounds to deter predators, parasites and competitors, which may be of particular value for pharmaceutical research.[232]

Thus, following the definition of sedentary species, deep seabed genetic resources found within the 200 nautical miles limit of national jurisdiction and considered as sedentary fall under the regime of the continental shelf pursuant to Article 77(1) and (4) of UNCLOS, while non-sedentary resources are covered by the regime of the EEZ. Non-sedentary species and their genetic resources found on, or above, the continental shelf beyond the 200 nautical mile limit, fall under the regime of the High Seas.

It is noteworthy that, by operation of Article 76(3), the deep ocean floor and its oceanic ridges and the subsoil thereof are excluded from the continental shelf regime. It is assumed that resources associated with these features, whether living or not, are also excluded from the continental shelf regime. While non-living resources associated with these features clearly fall under Part XI of UNCLOS and the regime of the Area (which is described below), it is unclear whether the living resources, more particularly genetic resources, of oceanic ridges and the seabed in general would fall under the regime of the Area or that of the High Seas. So far, discussions related to deep seabed genetic resources have focused on the question of their status, which is deemed either analogous to that of living resources under Part VII of UNCLOS, i.e. open-access, or common heritage of humankind. While it is beyond the scope of this report to provide an answer to this question, which may only be clarified by the Parties to UNCLOS themselves, the following sections set out the consequences attached to the regime of the High Seas and that of the Area.

5.1.2. Bioprospecting in the High Seas: the regime of living resources under Part VII

In the High Seas, which are all parts of the seas beyond the limits of the EEZ, States enjoy the freedom of the High Seas, which includes navigation, laying of submarine cables and pipelines, construction of artificial islands and other installations, fishing and scientific research.[233] These freedoms are to be exercised subject to treaty obligations and measures for the conservation of resources, as well as with due regard for the interests of other States in their exercise of the freedom of the High Seas, and with due regard for their rights with respect to activities in the Area. The freedoms enumerated under Article 87 are not exhaustive and could presumably include activities such as collection and sampling of genetic resources and organisms. Under the regime of the High Seas, hydrothermal vent species would therefore be openly available for all to access and sample, subject to measures for the conservation of living resources and the protection of the marine environment.

Activities carried out on the High Seas, which would include bioprospecting, are subject to flag State jurisdiction, i.e. the laws and regulations of the State under whose flag the vessel is operating. Clearly establishing the "genuine link" between vessels and States is essential in this respect. In adopting regulation for activities carried out on the High Seas, flag States are bound by the provisions of a number of international agreements, including those on ship safety and pollution control. Moreover, under UNCLOS, complemented by a number of global and regional agreements, States are to cooperate in the conservation and management of High Seas living resources, including through determining allowable catches.[234] While determining allowable catches may be inappropriate with regard to genetic material, setting sample quotas may be an option. Establishing High Seas MPAs on the basis of Article 119 on the conservation of High Seas living resources has been proposed as a possible conservation measure.[235] While MPAs were identified as one of the tools for the conservation of biodiversity beyond national jurisdiction by the Conference of the Parties to the CBD in Decision VII/5, and by the General Assembly in Resolution 59/24, their establishment is still discussed among States. MPAs in the High Seas could encompass varied levels of protection and regulation, and may involve regulating activities taking place therein, including through setting conditions for access and/or regulation of methods for undertaking samplings. However, unless States cooperate or harmonize their conservation measures, the approach will remain fragmented and may entail very different levels of regulation.

5.1.3. Bioprospecting in the Area: Part XI and the role of the International Seabed Authority

The Area is subject to a special regime set out under Part XI of UNCLOS, as modified by the 1994 Agreement on the Implementation of Part XI of UNCLOS.[236]

The Area and its resources are the common heritage of humankind, the exploration and exploitation of which shall be carried out for the benefit of humankind as a whole, irrespective of the geographical location of States.[237] States cannot claim or exercise sovereignty over the Area nor its resources, nor appropriate any part of the Area. No State or natural or juridical person may claim, acquire or exercise rights with respect to the minerals recovered from the Area except in accordance with the provisions of UNCLOS.[238]

The regime of the Area only applies to "activities of exploration for, and exploitation of, the resources of the Area," which are defined as "solid, liquid or gaseous mineral resources *in situ* in the Area[239] at or beneath the seabed, including polymetallic nodules."[240] It is noteworthy that because biological and mineral resources are intrinsically linked in deep-sea ecosystems, sampling of biological resources may occur in the course of expeditions aimed at exploring the Area for mineral deposits. While there is no specific measure addressing exploration for, and exploitation of, biological resources in the Area under Part XI, several features of the regime set forth under Part XI may be extended to, or be the basis for developing a specific regime related to bioprospecting in the Area.

Activities in the Area are organized and controlled by the ISA.[241] The Authority is composed of a decision-making Assembly, the Executive Council, a Secretariat, and the Enterprise, which is the organ charged with carrying out activities in the Area as well as transporting, processing and marketing minerals recovered from the Area.[242] The Authority's responsibilities include:

- organizing, carrying out and controlling exploration and exploitation activities in the Area;[243]
- providing for the equitable sharing of financial and other economic benefits derived from activities in the Area;[244]
- carrying out and promoting MSR in the Area, as well as coordinating and disseminating the results of such research and analysis when available;[245]
- taking measures to acquire technology and scientific knowledge relating to activities in the Area as well as promoting transfer of such technology and scientific knowledge;[246]
- adopting measures for the protection of the marine environment against the harmful effects of activities carried out in the Area, including for the protection and conservation of the natural resources of the Area and the prevention of damage to marine flora and fauna;[247] and
- establishing a system of inspection of activities undertaken in the Area to ensure compliance with UNCLOS and ISA rules and regulations.[248]

Part XI requires prospective miners to submit a plan of work for approval to the Council,[249] which shall indicate two sites proposed for exploration[250] and/or exploitation, and be accompanied by an assessment of the potential environmental impacts of the proposed activities.[251] Upon approval of the work plan, the Authority's Enterprise has the right to decide which of the two sites it wishes to mine.[252] This so-called 'parallel system,' which ensures a reserved area for the Enterprise, is designed at ensuring an equitable sharing of the Area's mineral resources.

ISA's role regarding biodiversity in the Area was on the agenda of the Legal and Technical Commission at the

ISA's ninth (28 July – 8 August 2003) and tenth (24 May – 4 June 2004) sessions.[253] Members of the Legal and Technical Commission (LTC) emphasized the need to work within the ISA's mandate under UNCLOS and the 1994 Part XI Agreement. A seminar was proposed to consider seabed and deep ocean biodiversity to enable drawing up regulations for the protection and preservation of the marine environment during prospecting and exploration for mineral resources.[254] At the ISA's tenth session in 2004, the LTC considered a study on the legal implications of the management of seabed living resources in the international seabed area within the framework of UNCLOS. The study stressed the need for the ISA to cooperate with other competent bodies to establish a regime for the management and protection of the living resources of the Area, within the law of the sea framework. Some members recommended addressing the legal gap existing in the current regime with regard to bioprospecting. ISA's Secretary-General stressed the need to encourage scientists to enter into good practices regarding their research in deep-sea areas.[255]

Outside the context of the ISA itself, it has been proposed to expand ISA's mandate to include activities related to genetic resources of the Area.[256] While this would require amending UNCLOS and entail a time-consuming and complex process, the advantage of such an option would be to build on an existing institutional framework and regulations addressing benefit-sharing, sustainable use as well as conservation needs.

To fulfill its mandate regarding the protection of the deep seabed marine environment, ISA has adopted regulations and undertaken cooperative scientific projects, which address the harmful effects of mining activities on the Area's biodiversity.[257] In September 2004, a workshop was held on the establishment of environmental baselines at deep seafloor cobalt-rich crusts and deep seabed polymetallic sulphide mine sites in the Area. The workshop aimed to evaluate the likely effects of exploration and exploitation of these resources on the marine environment.[258]

5.1.4. The Regulations of the International Seabed Authority

The regulations developed by the ISA to address the impact of mining on the Area's marine environment could be used as a model to develop regulations addressing the impacts of bioprospecting activities in the Area.

At its sixth session in 2000, the ISA adopted Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area.[259] The Regulations state that they "shall not in any way affect the freedom of scientific research (...) or the right to conduct marine scientific research in the Area" or the exercise by States of the freedom of the High Seas.[260]

Under Regulation 2, prospecting is not to be undertaken if substantial evidence indicates a risk of serious harm to the marine environment.[261] Regulation 2 also states that prospecting does not confer rights on the prospector with respect to resources, but that the prospector may "recover a reasonable quantity of minerals, being the quantity necessary for testing and not for commercial use."[262]

In contrast, entering into contracts to explore for polymetallic nodules confers the exclusive right to explore an area specified in a plan of work for a period of 15 years.[263] This right is balanced by the contractor's responsibility regarding damage arising out of wrongful acts in the conduct of its operations, in particular damage to the marine environment.[264]

Each contractor is required to, *inter alia*, take necessary measures to prevent, reduce and control pollution and other hazards to the marine environment arising from his activities in the Area, as well as monitor the likely effects of these activities.[265] Regulation 31(2) requires applying a precautionary approach. Of particular interest is the requirement for a contractor applying for exploitation rights to set aside "impact reference zones" and "preservation reference zones." Impact reference zones are areas to be used for assessing the effect of each contractor's activities on the Area's marine environment and which are representative of the environmental characteristics of the Area. Preservation reference zones are "areas in which no mining shall occur to ensure representative and stable biota of the seabed in order to assess any changes in the flora and fauna of the marine environment."[266]

Confidentiality of data and information gathered in the course of commercially-oriented activities is also to be considered. In this respect, with the exception of a few cases, data and information obtained from prospection, exploration or exploitation, designated by the contractor in consultation with the ISA's Secretary-General as confidential, shall be treated as such. Whether such data and information should remain confidential is reviewed periodically, and requires establishing that there would be a substantial risk of serious and unfair economic prejudice resulting from their release.[267]

It is noteworthy that under Regulation 40, if a prospector or contractor finds resources in the Area other than polymetallic nodules, the prospecting and exploration for, and exploitation of, such resources shall be subject to the rules, regulations and procedures of the ISA relating to such resources in accordance with UNCLOS and the 1994 Agreement. Such rules would only apply to mineral resources, leaving open the question of biological material collected during activities aimed at exploring and exploiting polymetallic nodules.

At the ISA's tenth session in 2004, the LTC developed "Draft regulations on prospecting and exploration for polymetallic sulphides and cobalt-rich ferromanganese crusts in the Area."[268] The Council will review these draft regulations at the ISA's eleventh session in 2005. The draft is modeled on the basis of the Regulations for Polymetallic Nodules, and adopts essentially the same rules and principles, with some additions.

Of particular relevance are additional provisions relating to addressing threats to, and harmful effects on, the marine environment. Under Regulation 5, each prospector shall

take necessary measures to prevent, reduce and control pollution and other hazards to the marine environment arising from prospecting. Cooperation with the Authority is also required to establish and implement monitoring and evaluation programmes regarding the potential impacts of exploration and exploitation activities. Regulation 7 states that data and information relating exclusively to environmental monitoring programmes shall not be considered confidential.

Moreover, applicants for exploration shall either: contribute a reserved area; offer an equity interest to the Enterprise, enter into a joint-venture arrangement with the Enterprise; or enter into a production-sharing contract with the Enterprise.[269] These provisions aim to ensure sharing of benefits arising out of the utilization of the Area's resources.

Regarding confidentiality, under Regulation 38(2), data and information necessary for the formulation by the ISA of rules, regulations and procedures concerning protection of the marine environment and safety, other than equipment design data, shall not be deemed proprietary.

Thus ISA's Regulations integrate various concerns with respect to exploration of the Area's resources that address some of the aspects embedded in the concept of common heritage of humankind principle, including conservation, sustainable use, and sharing of benefits in the form of non-monetary benefits, such as public availability and dissemination of data.

5.1.5. Part XIII: Marine scientific research

As shown in section 3.1.2 of this report, there is a fine line between marine scientific research and bioprospecting. It is therefore necessary to consider the provisions of Part XIII of UNCLOS related to MSR. It should be noted, at the outset, that UNCLOS provisions regarding MSR are not confined to mineral resources.

Article 241 states that MSR activities shall not constitute the legal basis for any claim to any part of the marine environment or its resources. In theory, MSR is therefore different from other investigative marine activities including a commercial component, such as prospecting and exploration, which may entail confidentiality or proprietary rights. Under UNCLOS, MSR is primarily aimed at furthering humankind's knowledge of the marine environment, its resources and various phenomena, and shall not be used to search for natural resources for commercial purposes.[270] As noted in section 3.1.2. of this report, with regard to coastal States' right to withhold consent to MSR, a distinction is made between research carried out for "peaceful purposes and in order to increase scientific knowledge of the marine environment for the benefit of all humankind" and research "having a direct significance for the exploration and exploitation of natural resources." While UNCLOS does not explicitly elaborate on the distinction, nor use it in any other context than that of coastal States' rights, one could assume that the latter refers to prospecting and that the difference of regime lies in the treatment of research results, as well as authorization procedures to carry out these activities.

Under Article 238, all States and competent international organizations have the right to conduct MSR, including in the Area and the High Seas[271] subject to the rights and duties of other States. MSR is to be conducted for peaceful purposes exclusively, shall not interfere unjustifiably with other legitimate uses of the sea, and shall be conducted in compliance with all relevant regulations, including those for the protection and preservation of the marine environment.[272] The latter provisions are particularly important considering the threats that marine scientific research pose to marine fauna and flora.

Within their territorial sea, their EEZ and continental shelf, coastal States have the right to regulate, authorize and conduct MSR.[273] MSR undertaken under the consent regime set out in Article 246, must comply with certain conditions, including: the provision of information on the nature and objectives of the project; the right for the coastal State to participate in the project and have access to all data and samples derived from the project as well as to assessment and interpretation of such data and results; and making available internationally the research results.[274]

MSR activities within the Area are to be carried out for the benefit of humankind as a whole.[275] The ISA has the mandate to promote and encourage the conduct of MSR in the Area and to coordinate and disseminate the results of such research and analysis. It may also engage in MSR itself.[276] When conducting MSR in the Area, States are required to, *inter alia*, promote international cooperation, develop programmes for the benefit of developing States and technologically less-developed States to strengthen their research capabilities among others, and to effectively disseminate the results of their research and analysis.[277] The sharing of the results of MSR undertaken in the Area is therefore ensured in the form of non-monetary benefits.

Because MSR is to benefit humankind as a whole, Part XIII contains elaborate rules regarding publication and dissemination of information and knowledge gathered from MSR. Such provisions are particularly important with regard to deep sea organisms, considering their potential applications and the difficulties in accessing them. However, such publication and dissemination of data may not be appropriate when the information is acquired in the course of commercially-oriented activities such as bioprospecting.

The publication and dissemination of information and knowledge gathered from MSR is addressed under Article 244, which states that information on proposed programmes, their objectives and resulting knowledge are to be made available. States and competent international organizations are required to promote data and information flow and the transfer of knowledge actively, in particular to developing States. Under Article 242, States shall provide other States, as appropriate, "with a reasonable opportunity to obtain from [them], or with [their] co-operation, information necessary to prevent and control damage to (...) the marine environment." Finally, Article 250 notes that communications on MSR projects are to be made through appropriate official channels, unless otherwise agreed.

Considering the non-commercial purpose of MSR

under UNCLOS and the very fine line between activities undertaken in the deep seabed, one could assume that if the results of MSR be used at any stage for commercial gains, the regime for MSR would cease to apply. In such a case, the research would then be deemed to have been a commercially-oriented activity.[278] It can also be assumed that if the results of marine scientific research are not made available as per Article 244, the activity does not qualify as MSR, and should be subject to another regime. Considering the consequences in terms of dissemination of information among others, it is therefore crucial to identify suitable definitions for MSR and bioprospecting, and determine the relationship between them. Moreover, it has been suggested that intellectual property claims over resources collected in the course of MSR may run counter to UNCLOS Article 241, in that they would constitute a "claim to any part of the marine environment or its resources."[279] Another issue to consider is whether, and if so how, the patenting process affects the public availability of the results of MSR.

5.1.6. Part XIV: Development and transfer of marine technology

The provisions of UNCLOS addressing development and transfer of marine technology under Part XIV are of particular relevance to deep seabed activities, which require sophisticated and expensive technological equipment and skills. These provisions, which act as a means for benefit-sharing, are all the more relevant in a context where resources of such an extreme and still largely inaccessible environment are exploited for economic benefits.

Under Article 266, States shall cooperate in accordance with their capabilities to actively promote the development and transfer of marine science and marine technology on fair and reasonable terms and conditions. They are to "promote the development of marine scientific and technological capacity of States which may need and request technical assistance in this field, particularly developing States (...) with regard to the exploration, exploitation, conservation and management of marine resources, the protection and preservation of the marine environment, marine scientific research and other activities in the marine environment." States are to foster favorable economic and legal conditions for technology transfer on an equitable basis. Notwithstanding these provisions, Article 267 binds States to have due regard to all legitimate interests, including the rights and duties of holders, suppliers and recipients of marine technology. It is conceivable that the protection of confidential data regarding such technology may fall under legitimate interests and rights of holder and suppliers of the technology.

In order to achieve the objectives of Part XIV, a number of measures are outlined, including the establishment of programmes of technical cooperation for the effective transfer of marine technology, promotion of the exchange of scientists and technological and other experts, and promotion of favorable conditions for concluding agreements and contracts under equitable and reasonable conditions.[280]

With regard to activities undertaken in the Area, and in line with the principle of common heritage of humankind, the transfer of skills and marine technology to developing States, their nationals and the Enterprise shall be facilitated.[281] Article 274, which outlines the responsibilities of the ISA in this regard, provides that the ISA shall ensure, among others, that: technical documentation is made available to all States, in particular developing States; and adequate provision is made to facilitate technical assistance and the acquisition of necessary equipment and technical know-how in the field of marine technology for States which may need and request it, in particular developing States.

Under the 1994 Part XI Agreement, seabed mining technology shall be acquired on "fair and reasonable commercial terms and conditions, on the open market or through joint-venture arrangements" and "consistent with the effective protection of intellectual property rights." States are also required to promote international technical and scientific cooperation with regard to activities in the Area.[282]

Similar provisions for the transfer of technologies are to be found in the CBD as outlined in section 5.3 of this report.

5.1.7. Part XII: Protection and preservation of the marine environment

Part XII of UNCLOS sets out general obligations on the protection and preservation of the marine environment. These may have consequences on the ability to undertake bioprospecting activities in the deep seabed.

Under Article 192, States have the general obligation to protect and preserve the marine environment. Article 194 elaborates on this general obligation by requiring States to, *inter alia*, take measures to ensure that activities under their jurisdiction or control are conducted in such a way as not to cause damage by pollution to other States and their environment. UNCLOS defines pollution of the marine environment as "the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities."[283]

Measures include those designed to minimize pollution from installations and devices used in exploration or exploitation of the natural resources of the seabed and subsoil.[284] These measures include those necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life. These measures shall not interfere unjustifiably with activities carried out by other States in the exercise of their rights and pursuance of their duties under UNCLOS.[285]

With regard to seabed activities, Article 208 requires coastal States to adopt laws and regulations to prevent, reduce and control pollution of the marine environment arising from,

or in connection with, seabed activities subject to their jurisdiction, as well as establish global and regional rules, standards and recommended practices and procedures through competent international organizations. This could provide a basis for adopting common/international regulations aimed at harmonizing rules related to bioprospecting activities taking place in the seabed under national jurisdiction, when these activities are thought, or proven to create pollution.

Article 209 specifically addresses pollution from activities in the Area. Pursuant to the definition of "activities in the Area," measures adopted under Article 209 would only relate to activities for exploration for, and exploitation of, the resources of the Area, i.e. non-living resources. Regulating bioprospecting on this basis is therefore excluded.

5.2 The UN General Assembly and the UN Informal Consultative Process on Oceans and the Law of the Sea

5.2.1. UN General Assembly resolutions and reports of the Secretary-General

The regime embedded in UNCLOS governing activities in the Area stems from UN General Assembly Resolution 2749 (XXV) of 17 December 1970. Recognizing that the regime governing the High Seas did not provide substantive rules for the exploration and exploitation of the resources of the seabed and ocean floor and the subsoil thereof beyond national jurisdiction,[286] Resolution 2749 required the establishment of an international regime applying to the area "to, *inter alia*, provide for the orderly and safe development and rational management of the area and its resources and for expanding opportunities in the use thereof, and ensure the equitable sharing by states in the benefits derived therefrom, taking into particular consideration the interests and needs of developing countries."[287] The Resolution sets out the consequences attached to the concept of common heritage of humankind, now embedded in Part XI of UNCLOS.

It is noteworthy that following the adoption of Resolution 2749, the UN General Assembly adopted Resolution 2750 (XXV) addressing the reservation exclusively for peaceful purposes of the Area and use of its resources in the interests of humankind. It requested the Secretary-General to cooperate with the UN Conference on Environment and Development and other competent organizations of the UN system to identify issues related to the production of certain minerals from the Area and examine the impacts on the economic well-being of developing countries.[288] This shows that addressing the issue of exploitation of non-living resources of the Area was proving delicate in a context of limited relevant information, as is now the case regarding the exploitation of the Area's living resources. A similar study could be undertaken within the UN system to assess various aspects of bioprospecting, including its ethical, economic, scientific and environmental aspects. The present report could be used as a contribution to such a study.

In spite of the UN Secretary-General's repeated expressions of concern regarding the issue of exploitation of deep seabed genetic resources,[289] the UN General Assembly did not adopt any resolution of relevance to the issue until 2002, when it requested the UN Informal Consultative Process on the Law of the Sea (UNICPOLOS or ICP) to address the protection of vulnerable marine ecosystems at its fourth meeting.[290] Relevant measures recommended by the UN General Assembly after this date will be considered in conjunction with the ICP's recommendations, below.

In his annual report to the 57th session of the UN General Assembly in 2002, the UN Secretary-General noted the need to clarify aspects of the regime for MSR, including the lack of distinction between pure and applied research, and how to address newly discovered marine genetic resources. Possible conflicting uses of the deep seabed were also highlighted between pure MSR, mineral prospecting, and bioprospecting as well as with the conservation and management of the deep ocean environment.[291]

The issue of conflicting uses was underscored again in the UN Secretary-General's annual report to the 58th session of the UN General Assembly in 2003.[292] Marine scientific research was identified as a specific threat to hydrothermal vents,[293] and the need to address the legal lacuna with respect to commercially-oriented activities relating to marine genetic resources in the Area was noted.[294]

In his report to the 59th session of the UN General Assembly in 2004, the Secretary-General noted that "although the conservation and management of the biodiversity of the seabed beyond national jurisdiction is not directly addressed in UNCLOS (...) [t]he provisions for the protection of the marine environment, for the conservation of marine living resources and other forms of marine life, as well as for the protection of rare and fragile ecosystems provide a basis for the conservation and sustainable use of the biodiversity of the deep seabed. Other relevant provisions include the rules for the exploration and exploitation of mineral resources on the seabed beyond the limits of national jurisdiction, including those elaborated by the International Seabed Authority, and for marine scientific research."[295] The report also noted that because the biological resources of the deep seabed are intermingled with its mineral resources, their conservation and management is inevitably related to the regulation of deep seabed mining. It was further noted that no specific legally binding regulations have been adopted regarding the protection of seabed biodiversity from marine scientific research.[296]

With regard to bioprospecting in particular, the report recognized the link between marine scientific research activities, especially those related to biological and geological sampling, and onshore commercial activities. The importance of distinguishing between pure academic research and research carried out for commercial purposes, which may involve confidentiality or proprietary rights, was reiterated. Because of its exploitative purpose and profit-making goals, it was suggested that bioprospecting may be compared to prospecting for mineral resources, which is

an investigative activity undertaken for the discovery and estimation of the economic value of a resource, prior to its future commercial exploitation.[297] The report recommended clarifying the legal lacuna regarding commercially-oriented activities targeting the Area's biodiversity.[298]

5.2.2. Further activities of the General Assembly, including the UN Informal Consultative Process on the Law of the Sea

With Resolution 54/33 of 24 November 1999, the UN General Assembly established an open-ended informal consultative process to undertake annual reviews of developments in oceans affairs. It was decided that the Consultative Process would consider the Secretary-General's annual reports on oceans and the law of the sea, and suggest particular issues for consideration by the General Assembly, with an emphasis on identifying areas where intergovernmental and inter-agency coordination and cooperation should be enhanced.[299] To date, the ICP has held five meetings.

At its third meeting in 2002, the ICP proposed that the General Assembly invite various organizations, including the Food and Agriculture Organization (FAO), the Intergovernmental Oceanographic Commission (IOC), the ISA, the Secretariat of the CBD, UNDOALOS and the United Nations Environment Programme (UNEP), to consider urgently how to integrate and improve, on a scientific basis, the management of risks to the fauna and flora of seamounts and certain other underwater features under threat within the framework of UNCLOS.[300]

The ICP recommended that the General Assembly reiterate the importance of the ongoing elaboration by the ISA of recommendations to ensure the effective protection of the marine environment from harmful effects that may arise from activities in the Area. It was further proposed that the General Assembly invite various organizations, including those mentioned above, to consider what action, consistent with UNCLOS, should be suggested to address priority problems in the marine environment, in particular any that may be highlighted by future global marine assessments.[301]

The ICP also identified some issues that could benefit from future work by the General Assembly that are of relevance to deep seabed bioprospecting, including: marine protected areas; potential and new uses of the oceans; development and transfer of marine technology; impact of activities in the international seabed area as a source of contamination of the marine environment; competing uses of the continental shelf; and the protection of biodiversity of the seabed.[302] The UN General Assembly adopted these recommendations in Resolution 57/141, and requested the ICP to consider the protection of vulnerable marine ecosystems as one of its areas of focus at its next meeting.[303]

At its fourth meeting in June 2003, the ICP discussed the protection of vulnerable marine ecosystems, including seamounts, hydrothermal vents, deep-sea trenches, deep-sea coral reefs, cold seeps and pockmarks. During the debate, seabed activities, including exploration and exploitation of non-living resources, marine scientific research and bioprospecting, were identified as having potential adverse impacts on those ecosystems.[304] Among the tools proposed to protect those ecosystems, delegations noted, *inter alia*, marine protected areas, the ecosystem approach and the precautionary principle.[305]

The ICP proposed that the General Assembly reiterate its call for urgent consideration of ways to integrate and improve, on a scientific basis, the management of risks to marine biodiversity of seamounts, cold water coral reefs and certain other underwater features, and note relevant scientific and technical work under the CBD. It was also proposed to invite relevant international bodies at all levels to: consider urgently how to better address, on a scientific and precautionary basis, the threats and risks to vulnerable and threatened marine ecosystems and biodiversity beyond national jurisdiction; examine how existing treaties and other relevant instruments can be used in this process, consistent with UNCLOS in particular; and explore a range of potential approaches and tools for protection and management.[306]

The ICP further proposed that the General Assembly reaffirm the efforts of States to develop and facilitate the use of diverse approaches and tools for conserving and managing vulnerable marine ecosystems, including the establishment of marine protected areas, consistent with international law and based on the best scientific information available, and the development of representative networks of such MPAs by 2012.[307]

The 58th session of the UN General Assembly adopted these recommendations,[308] further requesting the Secretary-General to submit an addendum to his annual report to the fifty-ninth session of the General Assembly, describing the threats and risks to vulnerable marine ecosystems and biodiversity in areas beyond national jurisdiction as well as details on any conservation and management measures in place at the global, regional, subregional or national levels regarding these issues. It also recommended that the fifth meeting of the ICP discuss new sustainable uses of the oceans, including the conservation and management of the biodiversity of the seabed in areas beyond national jurisdiction.[309]

At its fifth meeting in June 2004, the ICP heard a presentation on the types of uses of deep seabed biological resources and bioprospecting undertaken in the deep seabed. In the ensuing discussions, delegates expressed conflicting views regarding the legal status and the regime for bioprospecting in the deep seabed beyond national jurisdiction.[310]

Delegates in favor of policies regulating bioprospecting in the Area, argued that, on the basis of the symbiotic relationship of deep seabed biodiversity with its environment, all deep seabed resources beyond national jurisdiction, including biological resources, are the common heritage of humankind and should be dealt with under the regime established for the Area under Part XI of UNCLOS. Complementarities were noted between UNCLOS and the CBD regarding the fair and equitable distribution of benefits arising from utilizing the resources. Some delegations said commercially-oriented activities regarding

biodiversity in the Area should be subject to these legal frameworks, and access to the biodiversity and genetic resources of the Area should be subject to the regime of MSR. It was noted that the results of such research should be subject to benefit-sharing on a non-discriminatory basis. The role of IPRs was also noted, with some delegations expressing concerns over the fact that improper use of IPRs may deprive countries that do not possess yet the necessary technology of the benefits derived from deep seabed bioprospecting.

Delegates who expressed reservations about policies addressing bioprospecting pointed out that UNCLOS only contains general principles for the conduct of MSR and does not provide for restrictions to the freedom to conduct MSR and undertake bioprospecting activities on the High Seas. They noted that UNCLOS excludes marine living resources from the regime of the Area and the common heritage of humankind principle. Some delegations were opposed to regulating MSR on the High Seas, and pointed out that UNCLOS did not provide a definition of MSR nor did it mention bioprospecting. It was also noted that the distinction between pure and applied MSR had never been accepted universally, since there was no perceivable difference in activities or methods.

Some delegations expressed the view that there is a legal lacuna in respect of deep seabed biodiversity. Delegates discussed the appropriate forum to address deep seabed bioprospecting, including the ICP and the ISA. Other delegations recommended undertaking further work, particularly on the nature of the resources and their potential use, before considering any legal regime.[311]

There was agreement that bioprospecting should be further discussed at the ICP's sixth meeting. It was recommended that the General Assembly welcome Decision VII/5 of the seventh meeting of the Conference of the Parties (COP) to the CBD on the use of deep seabed genetic resources, as well as Decision VII/28, which requires exploring options for cooperation to promote the establishment of MPAs beyond national jurisdiction, consistent with international law, including UNCLOS, and based on scientific information.[312] The meeting further proposed that the General Assembly encourage the ISA's work regarding the regulations for prospecting and exploration for polymetallic sulphides and cobalt-rich crusts in the Area and procedures to ensure the effective protection of the Area's marine environment and natural resources. It was also suggested to encourage States to improve their understanding and knowledge of the deep sea in areas beyond national jurisdiction by increasing their MSR activities in accordance with UNCLOS.[313] The ICP also identified genetic resources as an issue that may benefit from further work by the General Assembly.[314]

During the debate on oceans and the law of the sea of the 59th session of the General Assembly, some States stressed that bioprospecting required regulation in such a way as to ensure the sustainable use of biological resources, including the equitable sharing of benefits with humankind as a whole. One delegation expressed concerns regarding the debate over whether all resources found in the seabed were for the benefit of humankind or whether they fell outside the provisions of UNCLOS, noting that there was no need to draw any such distinction.[315] The role of UN-Oceans, a new inter-agency mechanism for coordination and cooperation on issues relating to oceans and coastal issues, regarding marine biodiversity beyond national jurisdiction was also recognized.[316]

The General Assembly adopted most of the recommendations from ICP-5, and further reaffirmed the need for States and competent international organizations to urgently consider ways to integrate and improve, on a scientific basis and in accordance with UNCLOS and related agreements and instruments, the management of risks to the marine biodiversity of seamounts, cold water corals, hydrothermal vents and certain other underwater features. States and international organizations were called upon to urgently take action to address, in accordance with international law, destructive practices that have adverse impacts on marine biodiversity and ecosystems, including seamounts, hydrothermal vents and cold water corals. The General Assembly also reaffirmed the need for States to continue their efforts to develop and facilitate the use of diverse approaches and tools for conserving and managing vulnerable marine ecosystems, including the possible establishment of MPAs and networks of such areas, consistent with international law and based on the best scientific information available, as well as the development of representative networks of any such areas by 2012.[317]

Significantly, the General Assembly decided to establish an *Ad hoc* Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction, through: surveying relevant past and present activities of the UN and other relevant international organizations; examining the scientific, technical, economic, legal, environmental, socioeconomic and other aspects of these issues; identifying key issues and questions where more detailed background studies are needed; and indicating possible options and approaches to promote international cooperation and coordination. The Working Group is expected to convene in 2006, following the release of the Secretary-General's report to the 60th session of the General Assembly, which should address these issues.[318]

Additionally, the General Assembly recognized the urgent need to initiate a start-up phase, the "Assessment of Assessments," as a preparatory stage towards the establishment of a regular process for global reporting and assessment of the state of the marine environment, including socioeconomic aspects, as called for under the Johannesburg Plan of Implementation, and General Assembly Resolutions 57/141 and 58/240.[319] Presumably, this assessment would include an assessment of the state of deep seabed biodiversity.

These activities are likely to help assess the impacts of bioprospecting in the deep seabed and understand the extent to which an international legal framework is required. As has been evidenced by discussions on the topic within the ICP, agreement on need and modalities of a regulatory framework is far from being reached.

5.3 The Convention on Biological Diversity

The CBD was adopted in June 1992, and entered into force on 29 December 1993. The CBD aims at the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the utilization of genetic resources, including by appropriate access to genetic resources and transfer of relevant technologies.[320] It adopts a holistic, ecosystem-based approach to the conservation and sustainable use of biological diversity, and recognizes States' sovereignty over their natural resources.[321] Measures for the conservation and sustainable use of biodiversity are contained in Articles 6 to 14, which address respectively: general measures for conservation and sustainable use; identification and monitoring; *in situ* conservation; *ex situ* conservation; sustainable use of components of biological diversity; incentive measures; research and training; public education and awareness; and impact assessment. Access to genetic resources and benefit-sharing are addressed in Articles 15 to 21, which deal respectively with: access to genetic resources; access to and transfer of technology; exchange of information; technical and scientific co-operation; handling of biotechnology and distribution of benefits; financial resources; and the financial mechanism.

The CBD is a framework instrument setting out goals, key objectives and general principles which are to be implemented through national-level measures on the basis, *inter alia*, of guidance provided by the COP. It is noteworthy that, although the CBD addresses the use of genetic resources, the term bioprospecting is neither used nor defined in the CBD or any COP decision.[322]

5.3.1. Deep seabed genetic resources under the Convention on Biological Diversity

Under Article 4, the jurisdictional scope of the CBD is limited to components of biodiversity found in areas within the limits of national jurisdiction. *Per se*, deep seabed genetic resources beyond national jurisdiction are therefore excluded from the CBD's scope. However, the CBD applies to processes and activities, regardless of where their effects occur, carried out under the jurisdiction or control of States within or beyond areas subject to national jurisdiction.[323] It follows that activities undertaken in the High Seas or the Area, including navigation, scientific research, bioprospecting, exploration, exploitation, dumping and tourism, fall within the scope of the CBD if they are carried out under the control or jurisdiction of a CBD Party. In these areas, flag State Parties are required to cooperate directly, or through competent international organizations for the conservation and sustainable use of biodiversity. It is assumed that these processes and activities should only be regulated to the extent that they have, or are likely to have, a significant adverse impact on the conservation and sustainable use of biodiversity.[324] This raises the question of the level of impact required for it to be considered as significant, a level that is all the more difficult to establish with regard to deep seabed environments, for which gaps in knowledge still need to be filled.

To date, some States have adopted regulations related to marine scientific research carried out within waters subject to their jurisdiction, but no measures specifically addressing bioprospecting undertaken by their nationals outside the limits of national jurisdiction have been adopted.

Under Article 22, the CBD does not affect the rights and obligations of Parties deriving from existing international agreements, except where the exercise of those rights and obligations would cause a serious damage or threat to biodiversity. More specifically, with respect to the marine environment, Parties are required to implement the CBD consistently with the rights and obligations of States under the law of the sea.[325]

Since the exploitation of deep seabed genetic resources implies a succession of value-adding activities, from exploration through laboratory analysis to the eventual commercialization, several articles of the CBD could provide a basis for States to regulate bioprospecting activities related to deep seabed genetic resources, including Articles:

- 8(d) on the protection of ecosystems and species *in situ*;
- 9(d) on the regulation and management of collection of resources;
- 7(c) on the identification and monitoring of processes and activities which have or are likely to have a significant adverse impact;
- 8(l) on the management and regulation of processes and activities having a significant adverse impact; and
- 14(a) and (c) on environmental impacts assessments and exchange of information regarding activities having a significant adverse impact.

These provisions provide a basis for measures such as technical standards for equipment, maximum amounts of material that can be collected, planning expeditions, monitoring of activities and processes impacting on deep seabed ecosystems, and the conduct of environmental impact assessments.

Articles 10(b) (regulation of uses to minimize impacts) and 8(i) (compatibility between present uses and conservation and sustainable use) can help ensure that uses that are made of genetic resources, following *in situ* collection, are sustainable, including through incentives such as the granting of exclusive rights over the resources.[326]

Following discussions at the first meeting of the Subsidiary Body on Scientific Technical and Technological Advice (SBSTTA),[327] the COP adopted Decision II/10, which contains the so-called Jakarta Mandate on Marine and Coastal Biological Diversity providing a basis for a programme of work to implement the CBD in respect of marine and coastal biodiversity.[328] The COP also requested the Secretariat of the CBD,

> "in consultation with the UN Office for Oceans Affairs and the Law of the Sea, to undertake a study of the relationship between the CBD and the UN Convention on the Law of the Sea with regard to the conservation

and sustainable use of genetic resources on the deep seabed, with a view to enabling the SBSTTA to address at future meetings, as appropriate, the scientific, technical and technological issues relating to bioprospecting of genetic resources on the deep seabed."[329]

It is worth noting that the programme of work on marine and coastal biodiversity, as adopted by the fourth meeting of the COP, included among its operational objectives the provision of information on marine and coastal genetic resources, including bioprospecting.[330]

The study, called for in Decision II/10, was presented at the 8th meeting of the SBSTTA in March 2003. It outlined relevant provisions of the CBD and UNCLOS, and concluded that "neither the United Nations Convention on the Law of the Sea nor the Convention on Biological Diversity provides a specific legal regime for commercially-oriented activities relating to marine genetic resources on the High Seas and in the Area," and stressed the need to develop a legal regime to regulate them.[331] A similarity between the objectives pursued by the international community both under UNCLOS and the CBD was noted, since both instruments aim at the conservation of marine biodiversity and attempt to ensure a sustainable use of its components. The study stressed that while the CBD further aims at a fair and equitable sharing of the benefits arising out of the use of genetic resources, UNCLOS aims at an equitable sharing of benefits arising out of mineral resources from the Area.[332] The following options to address bioprospecting for deep seabed genetic resources were weighed: maintaining the *status quo* and leaving the exploitation of deep seabed genetic resources unregulated; applying the regime of the Area and its resources to deep seabed genetic resources, which would entail the application of the common heritage of humankind principle to deep seabed genetic resources as well as their management by an international body for the benefit of all; and amending the CBD to bring deep seabed genetic resources within its framework. The study further noted that while "individual Parties may impose certain strictures on their nationals regarding the exploitation of genetic resources in (...) areas [beyond national jurisdiction], (...) such interventions would not represent a coordinated approach to the issue and do not constitute an effective response to the vast array of issues that need to be dealt with."[333]

Discussions on the issue at SBSTTA-8 proved rather divisive. Some delegates from developing countries stressed that genetic resources beyond national jurisdiction fall outside the CBD mandate, and opposed expanding CBD's scope. Many delegates supported further studies on the issue. The need to address benefit-sharing was stressed, as were strengthening the relationship with the ISA, discussing the issue within the UN General Assembly, and exploring options for a code of conduct.[334] In substance, delegates agreed on information-gathering activities regarding deep seabed genetic resources within and beyond national jurisdiction.[335]

Delegates also discussed the establishment of MPAs and agreed, *inter alia*, that "there is an urgent need to establish in areas beyond national jurisdiction further marine and coastal protected areas consistent with international law, and based on scientific information, including in relation to areas of seamounts, hydrothermal vents, cold-water corals and open ocean."[336]

On the basis of the SBSTTA recommendations, the seventh meeting of the COP (February 2004) further discussed the issue of deep seabed genetic resources and MPAs beyond national jurisdiction. Some delegates opposed addressing bioprospecting within the programme of work on marine and coastal biodiversity.[337] Regarding MPAs, some delegates opposed creating MPAs in areas beyond national jurisdiction, while others stressed the need to act within the framework of UNCLOS when doing so.[338]

COP Decision VII/5 on marine and coastal biodiversity contains a specific section on deep seabed genetic resources beyond national jurisdiction, which calls for information-gathering activities including on: methods to identify, assess and monitor seabed genetic resources in areas beyond the limits of national jurisdiction; the status and trends of, and threats to, these resources; technical options for their protection; and activities and processes under Parties' jurisdiction or control which may have significant adverse impacts on deep seabed ecosystems and species beyond the limits of national jurisdiction. The UN General Assembly is also called upon to further coordinate work relating to the conservation and sustainable use of genetic resources of the deep seabed beyond the limits of national jurisdiction.[339]

Decision VII/5 also stresses the need for rapid action to address threats to marine biodiversity in areas beyond the limits of national jurisdiction, in particular areas with seamounts, hydrothermal vents, and cold-water corals, other vulnerable ecosystems and certain other underwater features, on the basis of the precautionary approach and the ecosystem approach. The General Assembly and other relevant international and regional organizations are also called upon, within their mandate, to urgently take the necessary short-term, medium-term and long-term measures to eliminate/avoid destructive practices, consistent with international law, on a scientific basis, including the application of precaution and consideration of interim prohibition of destructive practices adversely impacting marine biodiversity associated with these areas.[340]

With regard to MPAs beyond national jurisdiction, the COP recognized the urgent need for international cooperation and action including the establishment of further MPAs, consistent with international law and based on scientific information, for seamounts, hydrothermal vents, coldwater corals and other vulnerable ecosystems. The COP specifically recognized that the law of the sea provides the legal framework to regulate activities in those areas.[341] It was also stated that integrated networks of marine and coastal protected areas consist of: areas where threats are managed and extractive uses may be allowed; and areas where extractive uses are excluded and other significant human pressures are removed or minimized.[342]

On the basis of this Decision, the programme element on

marine and coastal living resources, within the revised programme of work on marine and coastal biodiversity, includes a specific operational objective on information-gathering activities regarding marine genetic resources in areas under and beyond national jurisdiction. The programme element on marine and costal protected areas includes a specific operational objective on MPAs beyond national jurisdiction.

5.3.2. Bioprospecting under the Convention on Biological Diversity

Besides provisions related to the conservation and sustainable use of biodiversity, the CBD sets forth measures addressing access to genetic resources, transfer of technologies, technical and scientific cooperation, funding and handling of biotechnology.[343] According to the jurisdictional scope of the CBD, these provisions are limited to genetic resources falling within the limits of national jurisdiction. However, some of the measures could be adapted, within an appropriate institutional and regulatory framework, to access to, and use of, genetic resources found beyond the limits of national jurisdiction.

With respect to access to genetic resources, Article 15(1) provides that the authority to determine access to genetic resources rests with the national governments and is subject to national legislation.[344] It is further stated that each State shall facilitate access to genetic resources for environmentally-sound uses by other Parties, and that access shall be provided on mutually agreed terms.[345] Parties shall moreover undertake scientific research related to resources provided by other Parties with these Parties' full participation, and take measures to share, in a fair and equitable way, the results of research and benefits arising from a commercial and other utilization of genetic resources with Parties providing the resources.[346] The parallel between Article 15 and Part XIII of UNCLOS on MSR has been noted in this respect.[347]

Regarding access to, and transfer of, technology, which includes biotechnology,[348] Parties are to provide and/or facilitate access to, and transfer of, technologies that are relevant to the conservation and sustainable use of biodiversity or make use of genetic resources.[349] Such access and transfer to developing countries shall be provided under fair and most favorable terms and, in the case of technologies subject to patents and other IPRs, on terms which recognize and are consistent with the adequate and effective protection of IPRs.[350] States are further required to adopt measures to ensure that the private sector facilitates access to, and joint development and transfer of, technology for the benefit of governmental institutions and the private sector of developing countries.[351] The CBD further recognizes that patents and other IPRs may have an influence on the implementation of the CBD, and requires Parties to co-operate to ensure that IPRs are supportive of its objectives.[352] The issue of technology transfer is particularly relevant in the context of deep sea activities, which require extremely sophisticated equipment, the development of which is particularly costly. As has been pointed out above, this has meant that so far, scientific research and exploitation of deep seabed genetic resources has remained the privilege of a very few. The provisions of the CBD, in conjunction with relevant UNCLOS provisions, could be used, in an appropriate framework, as a basis to further developing countries' capacities in this respect.

Article 19, which addresses the handling of biotechnology and distribution of its benefits, provides that measures shall be adopted to provide for the effective participation in biotechnology research by countries providing the genetic resources, and that they be given priority access, on a fair and equitable basis, to results and benefits arising from biotechnologies based upon such genetic resources.[353]

On the basis of Articles 8(j), 10(c), 15, 16 and 19, Parties to the CBD have developed Guidelines aimed at regulating access to, and sharing of benefits arising out of the utilization of, genetic resources. Adopted by COP-6 in 2002,[354] the Guidelines, known as the Bonn Guidelines on Access and Benefit-Sharing, provide guidance for policy makers and persons using and providing genetic resources.

The Guidelines apply to all genetic resources covered by the CBD, as well as to benefits arising from the commercial and other utilization of such resources, with the exception of human genetic resources. On the basis of the CBD's jurisdictional scope, it follows that the Guidelines are only applicable to marine genetic resources found in areas under national jurisdiction. However, the Guidelines provide a framework on the basis of which a regime for access to deep seabed genetic resources beyond the limits of national jurisdiction and sharing of benefits can be organized.

The Guidelines, which are voluntary,[355] are to be applied in a manner that is mutually supportive of the work undertaken by other fora, including the FAO and the World Intellectual Property Organization (WIPO).[356] It is specifically stated that nothing in the Guidelines, including the terms "provider", "user" and "stakeholder" should be interpreted to assign any rights over genetic resources beyond those provided in accordance with the CBD.[357] While it is not clear what the rights referred to may be, one can think that this provision excludes proprietary rights other than IPRs.

Section II of the Guidelines lays out roles and responsibilities of National Focal Points, Competent National Authorities and Providers and Users with respect to access and benefit-sharing pursuant to Article 15 of the CBD. Section III addresses the participation of stakeholders when developing and implementing access and benefit-sharing arrangements. Section IV identifies steps in the access and benefit-sharing process.

Accordingly, access to genetic resources is to be subject to prior informed consent (PIC) of the Party providing the resources, unless otherwise determined by that Party.[358] Paragraph 27 details possible elements of a PIC system, including specification of use of the resources. The second step proposed to form part of the access and benefit-sharing process is the adoption of mutually agreed terms (MATs) to ensure the fair and equitable sharing of research results and benefits arising from commercial and other utilization of genetic resources.[359] Such MATs may include regulation of the use of the resources in order to take

into account ethical concerns, the use of IPRs and joint ownership of IPRs.[360] An indicative list of typical MATs is provided, which includes the type and quantity of genetic resources, the geographical area of activity, limitations on the possible use of the material, capacity building, transferability of genetic resources, and treatment of confidential information.[361] The Guidelines further state that the MATs can cover, *inter alia*, the types of benefits, i.e. monetary and non-monetary, timing, and the persons/entities sharing the benefits. It is stated that these will vary depending on what is regarded as fair and equitable in light of the circumstances.[362]

The Bonn Guidelines also provide guidance on incentives, accountability in implementing access and benefit-sharing arrangements, national monitoring and reporting, means for verification of compliance, dispute settlement, and remedies.[363] Finally, Appendix I outlines suggested elements for Material Transfer Agreements, and Appendix II addresses monetary and non-monetary benefits.

COP Decision VI/24 also recognizes the role of IPRs in the implementation of benefit-sharing arrangements, and encourages the disclosure of origin of the resources in applications for IPRs.[364] The relationship between the provisions of the CBD and those of the TRIPS are also noted.[365]

Interestingly, at its most recent meeting in 2004, the COP noted that a number of relevant terms not defined in the CBD may need to be examined, and requested information regarding national definitions of such terms as "access to genetic resources," "benefit-sharing," "commercialization," "derivatives," "provider," "user," "stakeholder," and "*ex situ* collection."[366] All these are particularly relevant in the case of activities related to deep seabed genetic resources found in areas beyond national jurisdiction, for which questions of ownership arise and which may be subject to several transformation stages as well as transfers from one industry to the other. Difficulties and associated costs of collecting those resources *in situ* also make *ex situ* collections particularly relevant. COP-7 also stressed the need to further examine other approaches to access to resources and benefit-sharing, such as interregional and bilateral arrangements as well as an international certificate of legal provenance/origin/source.[367]

Furthermore, on the basis of calls from the World Summit on Sustainable Development (WSSD) and the UN General Assembly,[368] COP-7 mandated the CBD *Ad hoc* Open-ended Working Group on Access and Benefit-sharing (ABS Working Group) to elaborate and negotiate an international regime on access to genetic resources and benefit-sharing with the aim of adopting an instrument/instruments to effectively implement relevant provisions of the CBD.[369] Further recognizing the need for transparency in the international exchange of genetic resources, Decision VII/19 requests the ABS Working Group to identify issues related to the disclosure of origin of genetic resources and associated traditional knowledge in applications for IPRs, including those raised by a proposed international certificate of origin/source/legal provenance.[370]

These requests for further information on issues of relevance to access to, and benefit-sharing of, genetic resources show that the issue of bioprospecting is still contentious and needs further policy clarification. This is even more so in respect of seabed genetic resources in areas beyond national jurisdiction, the status of which remains uncertain and the potential economic value of which is considerable.

While the provisions of the CBD and the Bonn Guidelines may not be applicable to deep seabed genetic resources as a result of the CBD's bilateral approach to the issue of access and benefit-sharing, all the provisions outlined above can be used as a starting point to develop a regime for access to deep seabed genetic resources and sharing of the benefits arising out of their utilization. If a regime similar to that of the Area's mineral resources is contemplated, a body such as the ISA could be mandated to negotiate access and benefit-sharing arrangements, keeping in mind the requirements stemming from the principle of common heritage of humankind. Delaying negotiations on benefit-sharing until a compound reaches patent protection and the commercial phase is launched has been proposed as a possible option, considering the odds of success. It has been suggested to replace benefit-sharing negotiations at the time of granting access by an agreement to negotiate should a compound originating from an organism collected under the access permit proceed to commercial research.[371] Such requirements as specification of use, disclosure of origin, and certificates of provenance could also be used to ensure that the benefits arising out of the commercialization or other use of deep seabed genetic resources benefit all.

The CBD-UNDOALOS study noted the particular relevance of benefit-sharing regarding deep seabed genetic resources, which are not easily accessible due to scientific and technological constraints but have great potential scientific and economic value. The need to ensure that rules related to IPRs take into account and abide by the principles regarding MSR in the Area was noted, especially in light of the close links between MSR and commercially-oriented activities.[372] In order to do so, it may be worth considering a *sui generis* system of IPRs for deep seabed genetic resources in areas beyond national jurisdiction. The CBD-UNDOALOS study concluded that benefit-sharing arising from the exploitation of resources beyond the limits of national jurisdiction can only be effected if such resources are brought under a regime similar to that governing the mineral resources of the Area under UNCLOS.[373]

5.4 Intellectual property rights instruments

As shown in section 3 of this report, patents have already been granted to inventions using deep seabed organisms. Because commercial applications of deep seabed organisms are likely to increase in the future, it is necessary to consider how international instruments related to intellectual property address genetic resources.

5.4.1 Intellectual property rights and genetic resources

Patenting life forms, including genetic resources, has ethical aspects which cannot be overlooked. Concerns have been expressed that patenting of a source material, e.g. genetic resources or organisms, may lead to compromising a growing proportion of biodiversity, discovered or yet-to-be found, from unconditional use over time. It is essential to ensure that the resources or organisms have been legitimately accessed and that benefits arising out of the utilization of the source genetic resources are shared between owners of the resources and users. This is especially true for deep seabed genetic resources, the status of which as open-access or common heritage of humankind is still disputed, but the potential commercial applications of which are numerous. Noting the emergence of a consensus regarding the better suitability of *sui generis* systems of IPR to biological material and traditional knowledge, Oldham concludes that some resources are too important, in terms of the present and future public benefit, to be subject to strong intellectual property protection.[374]

It appears that the extension of patentability to biological and genetic material has not been based on sufficient economic analysis and that the positive benefits expected from patent protection with regard to trade, foreign direct investment and technology transfer have not been evidenced.[375] Nevertheless, granting IPRs over inventions derived from novel resources has some benefits. Patents can be part of the legal and commercial framework used to generate benefits from the use of genetic resources and agreements concerning patent ownership, while licensing exploitation can help define how access is granted and benefits are shared.

5.4.2. Activities of the World Intellectual Property Organization[376]

WIPO promotes the protection of intellectual property throughout the world through cooperation among its 180 Member States and in collaboration with other international organizations. WIPO implements this mandate by, *inter alia*, administering various multilateral treaties dealing with the legal and administrative aspects of intellectual property.

In 1998, WIPO established a programme on global intellectual property issues to explore, among others, the intellectual property aspects of biodiversity and biotechnology, and the protection of traditional knowledge. The WIPO General Assembly established, in 2001, an Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC). This Committee provides the main forum within WIPO for discussions on intellectual property aspects of access to genetic resources and benefit-sharing and the protection of traditional knowledge. It is worth noting that WIPO uses the term "genetic resources" as defined by Article 2 of the CBD as "genetic material of actual or potential value."

At its fourth session in 2002, the IGC agreed to develop a pilot database of contractual practices and clauses relating to intellectual property and access to genetic resources and benefit-sharing. A document prepared by the Secretariat for the IGC's fifth session in July 2003 provides an overview of intellectual property aspects of contracts relating to biological materials and associated traditional knowledge.[377] The document notes that due to the central role of confidentiality in the patent system, its maintenance is crucial until appropriate protection is in place. This is frequently done by entering into stand alone confidentiality agreements, which generate legal certainty by stipulating that the party providing the material considers it to be confidential, supplied for an express purpose, not to be used for other purposes, and not to be disclosed to third parties.[378] Other elements proposed for inclusion in such contractual arrangements include a description of the information covered by the agreement, the nature of the protection required, the scope of the permitted disclosure and use, ownership and management of further IPRs, and monitoring and reporting on the use of confidential information.[379]

Responding to an invitation from the sixth COP to the CBD (April 2002), WIPO prepared a technical study on patent disclosure requirements related to genetic resources and traditional knowledge,[380] which was subsequently adopted by WIPO's General Assembly and presented at the seventh meeting of the CBD COP in February 2004. Disclosure of origin is particularly relevant to deep seabed genetic resources, the status of which as common heritage of humankind or resources open-access is still largely disputed. The study aims to analyze methods, consistent with international patent-related obligations, to disclose within patent applications, among other things, genetic resources used in the development of the invention, the country of origin of the resources and evidence of PIC as well as associated traditional knowledge, innovations and practices used in the development of the claimed inventions.

WIPO's study proposes various scenarios for disclosure, which revolve around the following requirements: disclosure of origin or source of genetic resources used in an invention (or in some way connected with the development of the invention); and disclosure of the legal context in which relevant genetic resources were accessed (this may include providing evidence that the access complied with a certain procedure or legal standard).[381] The study notes the need to clarify the link between input, i.e. the source genetic material, and invention and whether this link is sufficient to trigger any particular disclosure requirement. This raises the issue of whether the requirement would also apply when the invention for which the application is filed concerns synthesized substances that were isolated or derived from active compounds of an accessed genetic resource and, if so, what the definition of "derived" is. The study stresses the need for further work on the nature of disclosure requirements, noting that a requirement can concern disclosure *per se*, or be used as an effective mechanism to prevent securing a patent if certain preconditions are not met.[382] The study identifies several possible legal bases for disclosure requirements, some of which are particularly interesting considering the status of deep seabed genetic resources. Those are:

- compliance with laws governing access to genetic resources;

- compliance with morality and ordre public considerations relating to genetic resources applied within the jurisdiction of the country where the patent is filed, as well as considerations based on concerns about genetic resources collected inconsistently with foreign laws or international law; and
- possible invocation of equitable principles to limit the enforceability of patent rights when required information is withheld or when access to, or use of, genetic resources is considered to violate equity.[383]

A distinctive disclosure mechanism of particular relevance to deep seabed genetic resources (because of the extreme difficulty to access the resources *in situ*) is the system of deposit of microorganisms or biological materials with a recognized culture collection. Such a mechanism can be part of the obligation to give a full description of the invention in order to enable a person skilled in the art to carry out or to repeat the invention. In some cases, it is impossible to describe the strain and its selection sufficiently to ensure that another person can obtain the same strain from soil himself because the organism may have been improved by mutation and further selection. In such a case, the microorganism itself might be considered to be an essential part of the disclosure. Moreover, if the microorganism is not generally available to the public, as is the case regarding deep seabed genetic resources, the written disclosure of the invention might be considered insufficient.[384]

In this regard, it is worth referring to the 1977 Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure, which entered into force in August 1980.[385] According to the Budapest Treaty, Contracting Parties recognize a deposit made in specified culture collections, or International Depositary Authorities (IDA), as adequate for the purposes of their patent procedure.[386] The IDA must make its collection available to depositors on equal terms, accept and store deposited microorganisms for the period specified in the Treaty, and provide samples only to those entitled to them.[387] The Treaty contains procedures governing the behavior of depositors and IDAs, the duration of storage of microorganisms and the mechanism for providing samples.[388] Between 1980 and 2000, a total of 43,533 microorganisms were deposited with IDAs under the Budapest Treaty. While data on the origin and conditions of collection of such microorganisms has been limited to date, the establishment of online databases, including the online sequence listing of WIPO, may facilitate tracking such origin and conditions.[389] The system established under the Budapest Treaty provides a practical example of how benefit-sharing could be organized with respect to genetic resources from the deep seabed, if such arrangements were to be considered.

5.4.3. The Agreement on Trade-Related Aspects of Intellectual Property Rights of the World Trade Organization

Under the TRIPS, WTO Member States have to raise their national standards on the protection of intellectual property to a uniform level, and provide protection for subject matters not covered at the national level in most developing countries.

Under Article 27 of the TRIPS, "patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application." Patents shall be available and patent rights enjoyable without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced.[390]

Pursuant to Article 27(3), high taxonomic levels of plants or animals are excluded from patentability, but microorganisms and microbiological and non-biological processes can be subject to patents.[391] It follows that under the TRIPS, deep seabed genetic resources are patentable.

Under Article 28, a patent confers on its owner the exclusive rights to prevent third parties who do not have the owner's consent from:
- making, using, offering for sale, selling, or importing for these purposes the product that is the subject-matter of the patent;
- using the process that is the subject-matter of the patent; and
- using, offering for sale, selling, or importing for these purposes the product obtained directly by the process, which is the subject-matter of a patent.

Patent owners have the right to assign, or transfer by succession, the patent and to conclude licensing contracts. Applicants for a patent have to disclose the invention in a manner sufficiently clear and complete for the invention to be carried out by a person skilled in the art, and may be required to indicate the best mode for carrying out the invention known to the inventor at the filing date or, where priority is claimed, at the priority date of the application.[392]

The 2001 Doha Declaration requires that in its review of Article 27(3), the TRIPS Council consider the relationship between the TRIPS Agreement and the CBD, among others. Work on these topics is to be guided by the objectives of the TRIPS Agreement set out in Article 7 [393] and its principles embedded in Article 8,[394] and should take development issues into account.[395]

With respect to patentability of genetic material and biological resources, issues raised during TRIPS Council's discussions include: ways of applying TRIPS provisions on patenting biotechnological inventions, including the extent to which life forms should be patentable; ways to implement the TRIPS Agreement and the CBD together and whether the TRIPS Agreement should be amended to avoid potential conflicts; whether patents should disclose the source of the genetic material; and the type of approval necessary prior to using genetic material.[396] Discussions are ongoing in the TRIPS Council regarding disclosure requirements.[397]

The TRIPS Agreement also contains provisions regarding technology transfer. Article 7 includes the transfer and

dissemination of technology as one of the basic objectives of the protection of IPRs.

5.5 Other relevant international instruments and activities

5.5.1. Regional marine environment-related instruments

In consistency with UNCLOS and the CBD, a number of regional instruments provide a basis for assessing the status of the marine environment and organizing cooperation to regulate potentially harmful activities, including in areas beyond national jurisdiction. In this respect, the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (Noumea Convention), the legal framework of the Mediterranean Action Plan (MAP), and the Antarctic Treaty System (ATS) are relevant.

5.5.1.1. Convention for the Protection of the Marine Environment of the North-East Atlantic

OSPAR, which entered into force on 25 March 1998, is the instrument providing for international cooperation for the protection of the marine environment of the North-East Atlantic.[398] The Convention applies to the area situated not only within the internal waters, territorial seas and EEZ of its Contracting Parties,[399] but also to a significant proportion of the High Seas and the underlying seabed and subsoil in the North East Atlantic and Arctic Oceans as delineated by the Convention.[400] In fact, more than 50% of the OSPAR area is beyond national jurisdiction. There are at least four known hydrothermal vent fields in the OSPAR maritime area, including the Menez Gwen, Lucky Strike, Saldanha and Rainbow vent fields.

Annex V of OSPAR and the accompanying Sintra Ministerial Statement (22-23 July 1998), provide a strategy for the protection and conservation of the ecosystems and biodiversity of the area covered by OSPAR. The strategy includes the establishment of a network of MPAs, as well as an assessment of species and habitats requiring protection, as well as human activities that are likely to have an adverse effect on such species and habitats. The network of MPAs is likely to include hydrothermal vents and other deep seabed ecosystems found in the High Seas. Appendix 3 to Annex V sets out a non-exhaustive list of criteria to identify human activities covered by Annex V, including: the extent, intensity and duration of the activity; its actual and potential adverse effects on specific species, communities and habitats; actual and potential adverse effects on specific ecological processes; and irreversibility or durability of these effects.

The revised Strategy (June 2003, Bremen) includes provisions regarding the development of programmes and measures for the protection of species and habitats threatened or in decline, as well as to safeguard against the harm caused by human activities, which may have an adverse effect.[401] The Bremen Ministerial meeting also agreed that the assessment of the impact of specific activities and identification of the necessary programmes and measures should be completed by 2010. Among these activities, exploration for oil, gas and solid minerals was mentioned. Presumably, investigative activities undertaken in regard of biological resources could be assessed.

Several deep sea habitats within OSPAR waters, including sponge aggregations, seamounts and oceanic ridges with hydrothermal vents/fields, have been included on the OSPAR List of Threatened and/or Declining Species and Habitats.[402] Some hydrothermal vents, including Lucky Strike and the Menez Gwen fields, were proposed as possible candidates for the MPA network.[403] Bioprospecting activities at hydrothermal vents in the North East Atlantic could therefore be regulated on the basis of OSPAR. However, it is likely that such activities could only be regulated in so far as they may have an adverse impact on their surroundings, like in the CBD context. Moreover, measures adopted in this context would only be applicable to nationals of OSPAR Contracting Parties. This is likely to raise difficulties considering that bioprospecting activities are often carried out in the context of multinational joint ventures and consortia, as noted above.

5.5.1.2. Noumea Convention

The Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, which entered into force on 22 August 1990, aims to contribute to the care and responsible management of the special hydrological, geological and ecological characteristics of the South Pacific Region.[404] The Convention Area excludes the internal waters or archipelagic waters of its Parties, but includes their EEZ and the areas of the High Seas which are enclosed from all sides by the Parties' EEZ.[405] To date, several hydrothermal vents/fields have been identified in the South Pacific Region, including the Vienna Woods, PACMANUS, Su Su Knolls, Willaumez and Conical Seamount fields in the Manus Basin, and the Franklin Seamount in the Woodlark Basin.

While it is not explicitly stated that the Convention also applies to the seabed underlying these areas, some provisions address pollution from seabed activities. It is therefore reasonable to assume that activities such as bioprospecting would be covered when carried out at hydrothermal vents and around other deep seabed features.

Under Article 4, each Party shall ensure that activities within its jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of its national jurisdiction. Under Article 5, Parties are required to take all appropriate measures to prevent, reduce and control pollution of the Convention Area from any source, and to ensure sound environmental management and development of its natural resources. Seabed activities are specifically addressed under Articles 8 and 13, which require Parties to take appropriate measures to prevent, reduce and control pollution and environmental damage in the Convention Area, resulting directly or indirectly from exploration and exploitation of the seabed and its subsoil.

The Noumea Convention also provides for the establishment of specially protected areas under Article 14 to protect and preserve rare or fragile ecosystems, depleted, threatened or endangered flora and fauna as well as their habitat, including through the establishment of protected areas and the prohibition or regulation of any activity likely to have adverse effects. Finally, Article 17 provides for scientific and technical cooperation, requiring Parties to cooperate in scientific research, environmental monitoring, and the exchange of data and other scientific and technical information. Research and monitoring programmes should also be developed.

5.5.1.3. The Mediterranean Action Plan

The legal framework that constitutes the Mediterranean Action Plan (MAP) includes maritime areas in the High Seas, beyond the national jurisdiction of the 22 Parties to the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention). The MAP draws on the Barcelona Convention and its six protocols, which address specific environmental issues.

Under the Convention, Parties are to apply the precautionary principle and the polluter-pays principle, as well as undertake environmental impact assessment for activities that are likely to have a significant adverse effect on the marine environment.[406]

Article 7 of the Convention specifically requires Parties to take all appropriate measures to prevent and eliminate pollution resulting from exploration and exploitation of the continental shelf and the seabed and its subsoil.

Under Article 10, Parties shall take measures to protect and preserve biological diversity and rare or fragile ecosystems, as well as species of wild fauna and flora which are rare, depleted, threatened or endangered and their habitats.

Parties shall endeavor to establish a pollution monitoring system,[407] and undertake to cooperate in the adoption of rules and procedures on liability and compensation for damage resulting from pollution.[408]

Among the Protocols to the Barcelona Convention, it is worth noting the 1995 Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean, which provides for the establishment of "specially protected areas of Mediterranean importance" beyond Parties' jurisdictional waters.[409] The Protocol applies to the seabed and its subsoil.[410]

Under the Protocol, Parties shall identify and compile inventories of the components of biodiversity, as well as monitor these components. Parties are also required to identify processes and categories of activities which have or are likely to have a significant adverse impact on the conservation and sustainable use of biodiversity and monitor their effects.[411] Article 17 provides for environmental impact assessments of projects or activities that could significantly affect protected areas and species and their habitats.

The 1995 Protocol includes a list of possible protection measures, including: the regulation of the passage, stopping and anchoring of ships; the regulation or prohibition of any activity involving the exploration or modification of the soil or the exploitation of the subsoil of the land part, the seabed or its subsoil; the regulation of any scientific research activity; and the regulation or prohibition of taking of animals and harvesting of plants or their destruction, as well as trade in animals and plants or parts thereof, which originate in specially protected areas.[412] Measures adopted on this basis could provide a basis to regulate bioprospecting.

Article 20 of the Protocol requires Parties to encourage and develop scientific and technical research.

5.5.1.4. The Antarctic Treaty System

Some hydrothermal vents have been identified in Antarctica waters, including at the Bransfield Strait.[413] Relevant instruments of the Antarctic Treaty System (ATS) to regulate access and activities related to hydrothermal vents include the Antarctic Treaty, the 1980 Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), the 1991 Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol), and the 1988 Convention on the Regulation of Antarctic Mineral Resources Activities (CRAMRA). It is noteworthy that most of the States involved in deep seabed research and bioprospecting are Parties to CCAMLR, including France, Australia, Japan, the US and New Zealand. Discussions on bioprospecting in Antarctica are ongoing within ATS institutions.[414] Considering similarities in terms of uncertainty of legal status and potential for scientific research and exploitation of extremophiles, several provisions of the ATS can provide a model for developing a regime for deep seabed bioprospecting.

Antarctic Treaty
The Antarctic Treaty, which entered into force on 23 June 1961, provides for the freedom of scientific investigations and the promotion of international co-operation in Antarctica.[415] Under Article III(a) to (c), Contracting Parties agree to, *inter alia*, exchange information regarding plans for scientific programmes, and exchange and make freely available scientific observations and results. Parties are also required to give prior notice to other Parties of all expeditions to, and within, Antarctica, on the part of their ships or nationals, and all expeditions to Antarctica organized in, or proceeding from, their territory.[416]

CCAMLR
CCAMLR, which entered into force on 7 April 1992, aims at the conservation of Antarctic marine living resources, including their "rational use."[417] The Convention applies to the area south of 60° South latitude and to the Antarctic marine living resources of the area between that latitude and the Antarctic Convergence, which form part of the Antarctic marine ecosystem.[418]

Article II(2) defines Antarctic marine living resources as "the population of fin fish, molluscs, crustaceans and all other species of living organisms." Presumably, species of molluscs

and crustaceans associated with hydrothermal vents would fall within this definition, as would Bacteria and Archaea found at hydrothermal vents.

Harvesting of marine living resources and any associated activities must be conducted in accordance with a number of principles of conservation set out in Article II (3) of CCAMLR, including: the prevention of decrease in the size of harvested population to levels below those which ensure its stable recruitment; and the prevention of changes or minimization of the risk of changes in the marine ecosystem, which are not potentially reversible over two or three decades.

The Commission for the Conservation of Antarctic Marine Living Resources, established under Article VII, is mandated to, *inter alia*: facilitate research into Antarctic marine living resources; compile and disseminate data on those resources; and formulate, adopt and revise conservation measures on the basis of the best scientific evidence available.[419] Conservation measures of relevance to bioprospecting include: designation of quantities for harvested species; quantities that may be harvested in specific regions and sub-regions; designation of protected species; designation of opened and closed areas for the purposes of scientific study or conservation, including special areas for protection and scientific study; and regulation of the methods of harvesting.

A Scientific Committee is established to provide a forum for consultation and cooperation regarding the collection, study and exchange of information with respect to marine living resources covered by the Convention.[420]

Madrid Protocol
The Madrid Protocol, which entered into force on 14 January 1998, promotes the comprehensive protection of the Antarctic environment and dependent and associated ecosystems. It designates Antarctica as a natural reserve, devoted to peace and science.[421]

Antarctica's value as an area for the conduct of scientific research, in particular research essential to understanding the global environment, is one of the fundamental considerations to take into account when planning and conducting activities in the Antarctic Treaty area. Priority over any other planned activity is accorded to scientific research, and any activity relating to mineral resources, other than scientific research, is prohibited.[422]

To achieve the Protocol's objective, a series of principles are set out which require, *inter alia*, planning and conducting activities in such a way as to limit adverse impacts, avoid significant changes in the marine environment and detrimental changes in the distribution, abundance or productivity of species or populations of species of fauna and flora, and avoid degradation of, or substantial risk to, areas of biological and scientific significance among others.[423]

The Protocol includes provisions on environmental impact assessment (EIA), outlined in Annex I. Under Article 8, activities subject to EIA are activities carried out pursuant to scientific research programmes, tourism and all other governmental activities. Decisions regarding whether an activity may proceed or not rest with the Antarctic Treaty Consultative Meetings following advice by the Committee on Environmental Protection, established under Article 11. Bioprospecting would therefore be subject to prior EIA to assess whether collection of genetic material would affect specific species or habitats among others.

The Protocol also provides for cooperation among Parties when planning and conducting activities in the Treaty Area, including with regard to the development of scientific and technical programmes, the choice of sites for prospective stations, and the undertaking of joint expeditions and sharing of information.[424]

In order to ensure compliance with the Protocol, a system of inspections by observers is set forth under Article 14. Considering the difficulties associated with monitoring activities in the deep seabed, a similar system could be contemplated with regard to bioprospecting in deep seabed areas falling outside the scope of the Antarctic Treaty System.

Annex V to the Protocol provides for the establishment and management of protected areas, including marine areas. Activities in those areas shall be prohibited, restricted or managed in accordance with management plans.[425] The provisions set forth would likely require regulating access to and activities carried out in hydrothermal vents located in such areas.

It is noteworthy that the question of whether the Protocol applies to the deep seabed is unresolved to date. While CRAMRA explicitly excluded the application of the Convention to the deep seabed, the Protocol remains silent in this respect. Possible inconsistencies have been noted between the Protocol's provisions, including its ban on mining, and UNCLOS' provisions related to the Area, which authorize mining activities.[426]

CRAMRA
CRAMRA's measures on mineral activities in Antarctica, although not related to biological resources, could be considered in the context of a regime for bioprospecting. The Convention provides for a system of authorization by Sponsoring States for prospecting activities, and authorization by the Convention's bodies for exploration and exploitation.[427]

CRAMRA's provisions on data and information that have potential commercial value are particularly interesting as a possible model for regulating deep seabed bioprospecting. Article 16 provides that data and information shall be made freely available to the greatest extent feasible, whereas data and information of commercial value gained through prospecting may be retained by the operator in accordance with Article 37. Finally, Article 16(b) notes that regarding data and information deriving from exploration or development, the Commission shall 'adopt measures relating, as appropriate, to their release and to ensure the confidentiality of data and information of commercial value'. Under Article 37, Sponsoring States may, at any time,

release part of or all data and information of commercial value generated by prospecting on conditions which they shall establish, for scientific or environmental purposes. Such data and information shall be made readily available when not, or no longer, of commercial value and, in any event, no later than 10 years after the year the data and information were collected, unless the data and information continue to have commercial value.

5.5.2. The World Summit on Sustainable Development

Several paragraphs of the Plan of Implementation adopted in 2002 at the WSSD are of relevance to the issue of bioprospecting in the deep seabed.

Paragraph 44 of the Plan of Implementation calls upon States to negotiate an international regime promoting and safeguarding the fair and equitable sharing of benefits arising out of the utilization of genetic resources, within the framework of the CBD and bearing in mind the Bonn Guidelines.[428] Such a regime could have a broader scope than the Bonn Guidelines and address genetic resources found in areas beyond national jurisdiction, including the deep seabed, subject to amendments to the CBD to broaden its scope.

The provisions of the Plan of Implementation related to the sustainable development of oceans are also of relevance to activities undertaken in the deep seabed. In particular, Paragraph 32(a) calls upon States to maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, including in areas beyond national jurisdiction. An element in maintaining productivity of those areas is to effectively manage the threats to, and impacts on, those ecosystems. This may include adopting regulations for marine scientific research and bioprospecting. Under the Plan, States are also encouraged to develop and facilitate the use of diverse approaches and tools, including the ecosystem approach and the establishment of representative networks of MPAs consistent with international law and on the basis of scientific information by 2012.[429]

5.5.3. Intergovernmental Oceanographic Commission of UNESCO

The purpose of the IOC is to promote international cooperation and coordinate programmes in research, services and capacity building related to the oceans.[430]

At its 19th Session in 1997, the Assembly of the Intergovernmental Oceanographic Commission established the Advisory Body of Experts on the Law of the Sea (ABE-LOS) to assist in carrying out its tasks. In 2001, the IOC Secretariat prepared a questionnaire to obtain information in order to: assess the problems encountered in the implementation of Part XIII of UNCLOS on MSR; assist States in establishing generally-accepted guidelines, criteria and standards for the transfer of marine technology; and inform the international community about the status of MSR and the transfer of marine technology and on the practical issues raised in implementing Parts XIII and XIV of UNCLOS. At the time of writing, the questionnaires were still being analyzed.

It is noteworthy that ABE-LOS considered criteria and guidelines on the transfer of marine technology. Interestingly, the guidelines define marine technology as instruments, equipment, vessels, processes and methodologies required to produce and use knowledge to improve the study and understanding of the nature and resources of the ocean and coastal areas. Considering the definition of marine technology, it would be the technology used to carry out pure marine scientific research. Hence, marine technology used to carry out commercially-oriented activities would be excluded from the term and possibly from the guidelines' scope. Such exclusion would seem unrealistic considering that the equipment to carry out marine scientific research and bioprospecting is the same. The guidelines further state that marine technology includes: information and data on marine sciences and related marine operations and services; sampling and methodology equipment; equipment for *in situ* and laboratory observations, analysis and experimentation; and expertise, knowledge, skills, technical/scientific/legal know-how and analytical methods related to marine scientific research and observation.[431]

Activities undertaken within the IOC should be considered when assessing the need for, and eventually designing, an international regime on deep seabed bioprospecting, particularly with regard to the relation between bioprospecting and marine scientific research.

5.6. Non-governmental initiatives

5.6.1. Codes of conduct

Codes of conduct to address the impacts of marine scientific research in the deep seabed are being developed by the scientific community. Considering the current lack of regulatory framework for deep seabed bioprospecting activities, codes of conduct could be developed and used as an interim measure while awaiting the development of regulations or management plans. [432]

As noted in section 3 of this report, InterRidge is an initiative by scientists to facilitate international and multi-disciplinary research associated with mid-ocean ridges through project coordination and information exchange and dissemination. It is developing a Code of Conduct for the Scientific Study of Marine Hydrothermal Vent Sites. The Code aims to minimize the impacts and maximize the efficiency of necessary research. It would apply to organizations and affiliated individuals undertaking marine scientific research and submarine-based tourism activities at hydrothermal vents located within and beyond the limits of national jurisdiction. These actors would commit to: identifying and complying with international, national and sub-national laws and policies; minimizing or eliminating adverse environmental impacts through all stages of an activity; minimizing or eliminating actual or potential conflicts or interference with existing or planned marine scientific research activities; and monitoring, evaluating and

reporting on the Code's application. The Code also notes the need to reduce the impact of sampling at heavy use sites by encouraging the development of micro-analytical procedures, and alternatives to sampling.[433] Such codes, besides emanating from the primary users of deep seabed ecosystems, thereby enhancing their efficiency, can allow pre-cruise planning and post-cruise assessment, provide for personal responsibility, and coordinate site visits.[434]

A code of conduct was also among the measures proposed by the Horta Workshop on the Management of Deep Sea Hydrothermal Vents at the Azores Triple Junction. The proposed code of conduct addresses scientific research, tourism, fisheries and commercial exploitation. Under the proposed code, scientific research should be undertaken in accordance with the approved MPA Management Plan and any other local and international regulations and follow prior clearance. A list of samples, preservation methods, numbers, destination, and person/lab responsible should be communicated to the MPA Management Committee following expeditions. Collection of non-target samples should be reported, and voucher specimens deposited in national collections. Proponents of the research should also indicate possible environmental impacts in their research proposals. The proposed code forbids all commercial exploitation inside the boundaries of the MPA. Exploitation outside the MPA, which might affect the area, should be subject to strict independent environmental assessment and may be prohibited.[435]

Although related to resources found within national jurisdiction, codes of conduct have also been developed to support implementation of the CBD provisions on access and benefit-sharing. An example is the Micro-Organisms Sustainable Use and Access Regulation International Code of Conduct (MOSAICC), addressing access to and benefit-sharing regarding microbial resources.[436] The Code, which is the result of a consensus between public and private sector representatives, recognizes that monitoring the transfer of microbial genetic resources is necessary to identify the individuals or groups that are entitled to be scientifically or financially rewarded for their contribution to the conservation and sustainable use of the resources. The Code includes provisions on access to *in situ* resources and, more interestingly in the context of deep seabed resources, on access to *ex situ* resources. There are also provisions on monitoring the distribution and utilization of microbial genetic resources, and terms of agreement on benefit-sharing, access to technology, scientific and technical cooperation as well as technology transfer. The role of IPRs is also addressed. Such a code could be considered for access to, and sharing of benefits stemming from, deep seabed genetic resources.

5.6.2. Other initiatives

Draft Rules and Regulations on Protecting Biodiversity in International Waters have been proposed.[437] The Regulations essentially address bioprospecting in the Area. While these Regulations are based on the assumption of an expanded mandate of the ISA, similar measures could be considered within any other institutional framework. Under the proposed Regulations, bioprospecting may be multi-purpose and carried out in conjunction with prospecting for mineral resources and marine geological research. A notification process, similar to an authorization process, is provided for, as well as the need for access agreements prior to commencement of activities. Access agreements shall contain provisions on EIA, benefit-sharing, IPRs and confidentiality of data and information of a commercially sensitive nature. Benefit-sharing measures include participation of the ISA in bioprospecting activities, as well as deposition of samples to the ISA.

5.7 Reporting requirements under international instruments

Reporting not only provides information on the status of deep seabed ecosystems, but also allows identifying gaps in policies and legislation in place, as well as necessary technical and financial resources to fill these gaps. This section aims to assess the extent to which reporting requirements under the international instruments considered above provide a basis for information gathering regarding deep seabed bioprospecting. At the outset, it is worth noting that States have raised concerns within various fora, about the burden of increased reporting requirements for governments, in particular developing countries. A reporting mechanism with regard to deep seabed bioprospecting should therefore aim to consolidate information gathered through the requirements outlined below.

5.7.1. Reporting requirements under the UN Convention on the Law of the Sea

Part XII of UNCLOS on the protection and preservation of the marine environment contains a specific section on monitoring and environmental assessment. Under Section 4, States are required to publish or provide reports at appropriate intervals to the competent international organizations on the results of their observations, measures and analysis of the risks or effects of pollution of the marine environment. More particularly, when they have reasonable grounds to believe that planned activities under their jurisdiction or control may cause substantial pollution of, or significant and harmful changes to, the marine environment, States shall assess the potential effects of such activities on the marine environment and communicate the results of such assessments. This provision provides a basis for States to assess bioprospecting undertaken by vessels flying their flags in the Area.[438]

With regard to MSR undertaken in the Area, States are requested to disseminate the results of research and analysis when available, through the Authority or other international channels, under Article 143.

Under Article 160, the ISA's Assembly is mandated to examine periodic reports from the Council and from the Enterprise and special reports requested from the Council or any other organ of the Authority on activities undertaken in the Area. This would include activities undertaken by the Enterprise in the Area. Presumably, such reports could

include information on the impacts of mining activities. Such reports could also be applied to bioprospecting activities, though a framework similar to that of the Area would be needed. Under Article 165, the ISA's LTC supervises, upon the Council's request, activities in the Area and reports to the Council. Although under the current regime this relates to mining activities, bioprospecting activities could be also included in such reports.

Under the Regulations on Polymetallic Nodules of the ISA, prospectors shall submit annual reports to the Authority on the status of prospecting. These reports shall contain: a general description of the status of prospecting and of the results obtained; and information on compliance with UNCLOS and relevant rules, regulations and procedures adopted by the ISA regarding cooperation in training programmes for MSR and technology transfer, and protection and preservation of the marine environment.[439] Under Annex 4 on Standard Clauses for Exploration Contracts, contractors could be requested to submit annual reports containing information on: exploration work and its results; the equipment used; the implementation of training programmes; results obtained from environmental monitoring programmes; and the quantity of polymetallic nodules recovered as samples or for the purpose of testing.[440] Moreover, under Regulation 31, each contractor undertaking exploration or exploitation is required to gather environmental baseline data and establish environmental baselines against which to assess the likely effects of its activities, as well as establish a programme to monitor and report on such effects. Regulation 32 requires the ISA's Secretary-General to immediately report on any incident resulting from, or caused by, a contractor's activities which has caused, or is likely to cause, serious harm to the marine environment. These measures could be considered for bioprospecting activities, within an appropriate institutional framework.

5.7.2. Reporting requirements under the Convention on Biological Diversity

Article 26 of the CBD requires Contracting Parties to submit reports, at intervals to be determined by the COP, on measures adopted to implement the Convention, as well as on the effectiveness of these measures to meet the objectives of the Convention. Presumably, this includes measures adopted by States to regulate activities and processes under their jurisdiction or control carried out beyond the limits of national jurisdiction, including deep seabed bioprospecting.

To date, two sets of national reports have been submitted by Parties to the CBD Secretariat, in 1998 and 2001 respectively. National reports are now to be submitted every four years, with the third set of reports to be submitted in 2005. Following adoption of a reporting format, Parties are requested to answer specific questions regarding their implementation of all the Convention's articles as well as thematic programmes, including the programme of work on marine and coastal biodiversity and related COP decisions. As it stands, the format, as revised following COP Decision VI/25, falls short of addressing specifically deep sea ecosystems as well as marine genetic resources beyond areas of national jurisdiction. However, revisions should take into account the revised programme of work on marine and coastal biodiversity at COP-7 and the inclusion of specific operational objectives on information-gathering activities regarding marine genetic resources in areas under and beyond national jurisdiction and on MPAs beyond the limits of national jurisdiction. In respect of genetic resources, at this stage, such information would presumably only provide information on information-gathering activities undertaken at the domestic level, not on the measures adopted to address activities undertaken with respect to those resources.

Parties are also invited to submit thematic reports on issues for in-depth consideration at COP meetings. Examples of such reports include thematic reports on: technology transfer; protected areas; and on access to, and benefit-sharing arising from, genetic resources. Under the multi-year programme of work of the COP adopted at COP-7 (Decision VII/31), implementation of the programme of work on marine and coastal biodiversity will be subject to in-depth review at COP-10 in 2010. A thematic report on related issues, including items addressing deep sea ecosystems and related activities, could be considered.

5.7.3. Reporting requirements under other instruments

Article 22 of the OSPAR Convention requires Contracting Parties to report to the Commission at regular intervals on their legal, regulatory, and other measures for the implementation of OSPAR as well as the effectiveness of these measures. On the basis of Recommendation 2003/3 on a network of MPAs, Parties must report to the OSPAR Commission the areas that they have selected as components of the OSPAR Network, including information on the ecological and practical criteria for selection of the area as an MPA, the proposed management and protection status, and the management plan and measures adopted. Following this recommendation, Portugal will be required to report annually, after 2005, on implementation of the measures adopted for the management of the Lucky Strike and Menez Gwen MPAs. Presumably, such protected areas set up in the High Seas covered by the Convention Area on the basis of cooperation between Contracting Parties would also need to be subject to this reporting obligation.

The Noumea Convention is rather flexible regarding reporting. It only requires Parties to transmit to the Organization information on the measures adopted to implement the Convention "in such form and at such intervals as the Parties may determine." This would include reporting on measures adopted to address pollution resulting from exploration and exploitation of the seabed and its subsoil, such as bioprospecting.

Within the context of the Mediterranean Action Plan, under Article 23 of the 1995 Protocol to the Barcelona Convention, Parties are required to submit to the ordinary meetings of the Parties a report on their implementation of the Protocol, in particular on the status and the state of the areas included in the list of specially protected areas of Mediterranean importance.

As noted above, Article III of the Antarctic Treaty requires Parties to, *inter alia*, exchange information regarding plans for scientific programmes, and exchange and make freely available scientific observations and results. Under Article 10 of Annex V to the Madrid Protocol, Parties have to collect and exchange records, including records of permits and reports of visits to Antarctic Specially Protected Areas and reports of inspection visits to Antarctic Specially Managed Areas, as well as on any significant change or damage to these areas. Parties also have to inform annually other Parties and the Committee of the number and nature of permits issued, and provide summary descriptions of the activities conducted by persons subject to their jurisdiction in the above mentioned areas. Observers designated under the system of observations and inspection set forth under CCAMLR must report on their inspections and observations.[441] Information regarding bioprospecting activities could be gathered on this basis.

6 Outline of domestic measures of selected countries

As outlined above, under UNCLOS and the CBD, flag States have the jurisdiction to adopt measures to regulate activities under their jurisdiction or control carried out beyond the limits of national jurisdiction, including for the purposes of ensuring that such activities do not cause damage to the marine environment. At the time of writing, no State had adopted any regulation addressing specifically bioprospecting or marine scientific research activities carried out by their nationals outside the limits of national jurisdiction. However, some States have adopted, or are in the process of adopting, regulations for marine scientific research or bioprospecting carried out within their jurisdiction. Moreover, Canada and Portugal, within the jurisdiction of which some hydrothermal vents have been discovered, have established MPAs around those sites.[442]

6.1 Domestic measures on marine scientific research and bioprospecting

Hydrothermal vents have been discovered in the South Pacific in the Manus Basin (including the Vienna Woods, PACMANUS, Su Su Knolls, Willaumez and Conical Seamount fields) and in the Woodlark Basin (including the Franklin Seamount). Some of these sites fall under the jurisdiction of Papua New Guinea (PNG), New Zealand, Fiji, the Solomon Islands, and Tonga, among others. Some of these States are considering granting, or have granted, permits for exploration and exploitation of mineral resources associated with hydrothermal vents within their territorial sea and/or EEZ.[443] Some expeditions have sampled microbes from the Manus Basin and other locations such as Lihir Island and Rabaul, within PNG's territorial waters.[444]

There is currently no legislation addressing marine scientific research or access to PNG's genetic resources so far. However, PNG would be currently developing a policy on marine scientific research within its waters, as well as considering options for regulating bioprospecting.[445] For the time being, individual requests for access to PNG's waters for pure marine scientific research and/or bioprospecting are dealt with on a case-by-case basis. In some cases, individual access and benefit-sharing agreements have been entered into with individual research organizations.[446] Because PNG is also a Party to the Noumea Convention, it could also consider regulating access to these sites on this basis.

At least five hydrothermal vents are found under Fiji's jurisdiction.[447] Fiji is currently drafting its bioprospecting legislation. Under the draft legislation, persons wishing to conduct biodiversity research would need to be granted access by the Conservation and Natural Parks Authority. Bioprospecting would be prohibited in any marine or terrestrial area without prior approval. Application forms for access would detail: area(s) of collection; organisms to be collected; and benefits for the resource owners. A statement on the nature of any IPRs that may be affected would also be required. Access would be granted by the Authority following advice, especially from the Fisheries Department when marine collections are proposed.[448]

Also in the South Pacific Region, New Zealand is host to several hydrothermal vents, including Brothers Arc Caldera, Kermadec-Havre and Backarc System in the Lau Basin. New Zealand is currently developing an integrated bioprospecting policy as well as an oceans policy, which would address bioprospecting.[449]

Norway's waters host a hydrothermal vent, the Knipovich located in the Arctic Ocean. Norway has adopted regulations on marine scientific research undertaken within its waters and EEZ. Until adoption of a specific legislation on access to genetic resources, application for research related to marine genetic material is addressed under regulations in place for marine scientific research. Consent to marine scientific research projects is granted by the Directorate of Fisheries and research activities are controlled and surveyed by the Coast Guard, who may request to inspect a vessel or installation.[450]

6.2 Indirect regulation of bioprospecting: marine protected areas

6.2.1. Canada: the Endeavour Marine Protected Area

On the basis of the 1996 Oceans Act,[451] and following concerns over increasing pressure resulting from scientific interest for the area,[452] Canada established the Endeavour Hydrothermal Vent Marine Protected Area in 2003. The Area lays in Canadian waters, on the Juan de Fuca Ridge, southwest of Vancouver Island at depths of 2250 meters, covers 100 square kilometers of seabed and overlying water column, and is composed of four fields of large black smoker structures, namely the Main Endeavour Field, the Mothra Field, the High Rise Field and the Sawlty Dawg Field.[453]

The Area is to be managed in accordance with the provisions of the 2003 Endeavour Hydrothermal Vent Marine Protected Area Regulations and the Endeavour Hydrothermal Vents Marine Protected Area Management Plan. The Management Plan aims at conserving Endeavour's ecological integrity as well as monitoring and coordinating activities through an access authorization process.[454]

Section 2 of the Regulations states that no person shall disturb, damage, destroy or remove from the MPA, any part of the seabed, including a venting structure, of the subsoil, or any living marine organism or part of its habitat. Activities, which are likely to result in the disturbance, damage, destruction or removal of these things, are also prohibited.

However, under Section 3, no person contravenes this prohibition if the disturbance, damage, destruction or removal is for scientific research for the conservation, protection and understanding of the area, and obeys certain conditions. It follows that pure marine scientific research is allowed within the MPA, subject to submission of a research plan to Fisheries and Oceans Canada no later than 90 days before the start of the expedition.[455] The research plan must include: information regarding the ships and scientists involved in the research; commencement date, duration and itinerary of the research; a summary of the research to be carried out, including the data to be collected,

sampling protocols to be used, and techniques to be used; and equipment to be moored, as well as the method of mooring.[456] All licenses, authorizations or consents required under the Oceans Act, the Coastal Fisheries Protection Act, the Coasting Trade Act or the Fisheries Act in respect of scientific research have to be obtained prior to the expedition.[457]

Permission to undertake activities in the area are to be obtained through existing procedures. Foreign vessels must obtain permission through the Department of Foreign Affairs and International Trade under the 1992 Coasting Trade Act. Domestic vessels are subject to the provisions of the 1985 Fisheries Act regarding issuance of scientific permits. Requests for access authorization are reviewed by the Endeavour Management Committee,[458] which advises Fisheries and Oceans Canada on whether to grant access or not.

The MPA has been divided into four zoned management areas centered on each of the four main hydrothermal fields. Different types of activity are permitted within each zone.[459]

The Management Plan also provides for the establishment of an information center to consolidate access to various data and information related to Endeavour, and facilitate information sharing.[460] Monitoring of marine environmental quality on the basis of protocols and indicators is provided for under Management Objective 7. An education and outreach strategy is also set out in the Plan.[461]

While scientific research is authorized and regulated within the MPA, the Management Plan and the Regulations remain silent regarding activities undertaken with a commercial purpose, such as bioprospecting, which seem to fall under the prohibition of Section 2 of the Regulations. The issue of sharing of scientific research results is taken into account, to a small extent, through the establishment of the information center. Implications of the Regulations and the Management Plan for expeditions involving both scientific research and bioprospecting remain unclear. Section 4 of the Regulations provides that no person contravenes section 2 by carrying out an activity in the Area by means or under conditions that are authorized under the Fisheries Act, the Coasting Trade Act, the Oceans Act, and the Coastal Fisheries Protection Act. To some extent, this may cover activities undertaken for commercial purposes such as bioprospecting.

6.2.2. Portugal: the Lucky Strike and Menez Gwen Marine Protected Areas

Four hydrothermal vent fields are found at the Azores Triple Junction in the Northeast Atlantic, stretching along the Mid-Atlantic Ridge to the Southwest of the Azores. Menez Gwen, Lucky Strike, Saldanha and Rainbow lie at depths between 850 and 2800 meters. Of these four sites, only Menez Gwen and Lucky Strike fall under Portugal's jurisdiction.[462]

Within the framework of the OSPAR Convention, the Azores Regional Government decided to establish an MPA around the Menez Gwen and Lucky Strike vent fields to "prevent degradation of and damage to species, habitats and ecological processes on the basis of the precautionary approach." Elements of a management plan for the MPA were identified by a workshop sponsored by the Government of the Azores.[463]

Both sites include the superjacent water column, the subsoil and sub-surface. The Workshop proposed that the Lucky Strike MPA comprise three areas: an integral reserve for observation only; a reserve for observation and monitoring; and an area for regulated sampling. The Menez Gwen MPA would comprise two areas: a conservation area for non-intrusive observation and non-destructive sampling; and an area for regulated sampling. Within both areas, only regulated scientific activities would be allowed.[464]

Access to the fields would be regulated, and a specific institution vested with the authority to grant access. Requests for access should include: information regarding the principal investigator or programme operator, the vessel, and participants; funding sources; the rationale for the expedition; the types of activities planned, including the anticipated number and type of samples to be collected; location of activities to be carried out; schedule and dates of the expedition; planned dissemination of research results; and an agreement to abide by the proposed code of conduct.[465]

Fisheries, tourism[466] and all commercial activities, including mining and bioprospecting would be prohibited within the MPAs. Pure marine scientific research would be the only activity allowed, and subject to different regulation depending on the vent fields within which it would be carried out. It was proposed that, on the basis of a code of conduct, a list of sample species be made available to the MPA Management Committee after each expedition. The MPA Management Committee would encourage the publication of the research results, and publish an annual summary of research carried out in the area. The need for interdisciplinary research teams was noted, as was the need to report collection of non-target samples. It was proposed that sample specimens and reference collections be deposited in a natural history museum, as well as an MPA data bank.[467]

The administration of the MPA would be entrusted to a general assembly composed of government representatives and relevant stakeholders. An executive managers group would consider requests for vessel clearance, and be assisted by an advisory body.[468]

While non-target samples would have to be declared, the implications attached to such declaration are unclear. Moreover, apart from communication of research results to the MPA management authorities, no specific provisions are made regarding benefit-sharing and what would happen should economic gains ensue from the transfer of samples collected during pure marine scientific research expeditions to biotechnology companies.

7 Conclusions and possible approaches to bioprospecting in the deep seabed

This section takes stock of the main findings of the report, identifies areas for further study, and presents possible options to address deep seabed bioprospecting.

7.1 Main findings of the report

7.1.1. Status of, and threats to, deep seabed ecosystems

Oceans are an extremely rich ecosystem, home to many species and a huge biomass. 32 out of the existing 34 phyla are found in the oceans. Data indicate that the trends in discovery of new oceanic species, including deep sea species, are positive. This means that many more species of scientific and commercial interest are bound to be discovered.

Hydrothermal vents, which are of an ephemeral nature, are found almost ubiquitously along the world's mid-ocean ridges. Cold seeps, brine pools and other types of soft-bottom deep sea ecosystems exist in many ocean margins and continental shelves. The biodiversity of ocean floor sediments is extremely high.

Some deep seabed ecosystems and species are particularly sensitive to disturbances, including cold seeps and seamounts. The richness, extremely high sensitivity and poor resilience of seamount species, associated with their direct exposure to intensive deep sea fishing activities, call for a precautionary approach to their management. Specific studies are required on the impacts of oil drilling on cold seep ecosystems and species. Hydrothermal vents have various characteristics, depending on the intensity of local volcanic activity on the seafloor and hydrological conditions. A common feature is that hydrothermal vents act as center of irradiation of species towards virgin seabed areas. Specific management measures taking into account the dynamic nature of these ecosystems should be adopted.

Concern has grown over the impacts of both pure and applied scientific research in deep seabed areas. While it is impossible to quantify the damage caused by such research on the deep seabed environment, threats include the destruction of habitats, unsustainable collection, alteration of local hydrological and environmental conditions, and pollution of various nature. Similar activities can have very different impacts in various deep seabed ecosystems. Cumulative impacts over time, such as those associated with deep sea trawling, have already resulted in the extinction of species.

Technology is a key driver in deep sea research and monitoring. As technology evolves and becomes more accessible, including through the establishment of partnerships between governments and industry, scientific research in these areas is likely to increase.

This is likely to result in additional adverse impacts on the deep sea environment.

Aware of the potential impacts of marine scientific research on deep seabed ecosystems, many scientists have proposed establishing special scientific areas in the deep seabed. These areas are aimed to prevent or mitigate interference during the conduct of scientific expeditions, as well as avoid potential conflicting uses. Voluntary codes of conduct have also been developed to remedy the current lack of intergovernmentally-agreed measures.

Activities have recently been initiated at governmental level within the United Nations (UN) system by the General Assembly, including the Global Marine Assessment and the establishment 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, as well as within the framework of the Convention on Biological Diversity (CBD). These initiatives will help further assess the status of, and threats to, deep seabed ecosystems and resources both within and beyond national jurisdiction, and help identify suitable management measures.

7.1.2. The value of deep seabed ecosystems and resources

There is a clear consensus among the scientific community that deep sea ecosystems perform important ecological functions, in spite of our limited knowledge about these ecosystems.

Deep seabed areas, especially hydrothermal vents, appear to be one of the nurseries of life on Earth. The peculiar characteristics of life in these extreme environments have offered hints about the evolution of life on Earth and how it could be shaped on other planets. Areas where methane hydrates are found play an important role in the maintenance of the global climate balance, as a result of their role as a greenhouse buffer. The role of hydrothermal plumes in supporting upper zooplankton communities demonstrates the importance of these ecosystems in the maintenance of the global carbon cycle. Ecological interlinkages have been observed between different deep seabed ecosystems, as well as between the ecosystems of different ocean realms. Moreover, some of the discovered deep seabed sites possess unique aesthetical features.

It is also widely recognized that deep seabed genetic resources, as a result of their particular biological characteristics that allow them to thrive in extreme conditions, hold great potential for various applications, including in the health sector, for industrial processes and bioremediation. Marine species have proven to be efficient in treating diseases such as carcinogenic tumors, and many experts concur in asserting that the potential of marine genes only commences to be unveiled. Once disclosed, the genome of many yet-to-be discovered deep seabed organisms will provide information that may be of crucial importance to various applications and sectors.

The features and potential of deep seabed ecosystems and resources should be taken into account when designing an appropriate management framework, which requires adopting a precautionary approach as well as the ecosystem approach. In designing a regime addressing the exploitation of deep seabed resources, consideration might

also be given to the fact that private appropriation of these ecosystems and resources may not be appropriate with regard to their contributions to humankind, in terms of advancement of scientific knowledge and human welfare.

7.1.3. Trends in deep seabed research

Exploration of the deep seabed started as early as the 1870s, but it was not until 1977 that the first hydrothermal vents, one of the main features of the deep seabed, were discovered. Since then, deep seabed research activities have been conducted extensively.

Deep seabed expeditions are being undertaken at an increasing pace. It is estimated that at least 432 cruises to deep seabed sites have taken place in eleven years and that expeditions to deep seabed sites take place on a regular basis. These expeditions are carried out by scientists from a few nations, including the US, France, Japan, Germany and Canada. The most visited sites are vents located in the North-East Pacific, followed by those along the northern segment of the Mid-Atlantic Ridge, where one site alone, the Juan de Fuca Ridge, concentrates 72 cruises. Uncertainties remain regarding the jurisdiction within which vents are located. However, on the basis of the InterRidge Vent Database, it can be estimated that an even number of sites fall either within or beyond national jurisdiction.

The focus of ocean science is much more diversified than at the time of conventional oceanographic expeditions. Technological innovations, including satellite-based observations and the effective coupling of *in situ* and *ex situ* observations, have allowed the identification of new subject-areas for research, including the identification, development and commercialization of new products based on natural compounds. Section 4 showed the importance of marine resources in providing new sources of drugs, products and industries, and how this trend is likely to increase in the future, within the context of the global and regional biotechnology industry contexts.

Similarly, the focus of deep sea expeditions seems to be shifting from geological/geophysical purposes to ecological, biological, physiological and bioprospecting ones. Data indicate that deep seabed research activities are still mainly of a pure scientific research nature. However, promises of discoveries of novel organisms and products are likely to lead to an increase in commercially oriented research. This is all the more so since ocean expeditions and scientific programmes are increasingly designed and implemented on the basis of partnerships and joint ventures between public and private research institutions, governments and industry. As a result, modern oceanography is likely to become more interdisciplinary. This implies that distinguishing, in practice, between marine scientific research undertaken to advance knowledge of marine ecosystems, also called "pure scientific research," and marine scientific research undertaken for commercial purposes, also called "applied scientific research" – to which marine bioprospecting could be equated – is increasingly difficult.

Industry is not systematically involved in deep seabed exploration, but it is very interested in, and supportive of, deep seabed research. Industry still largely depends on public research institutions which own the necessary technology and expertise to conduct deep seabed exploration. This reliance on public research institutions has allowed limiting multiple, potentially conflicting, uses of deep seabed resources and ecosystems. However, conflicting uses still exist, including between marine scientific research and fisheries activities, particularly deep sea trawling, and ocean drilling for the purposes of oil exploration and exploitation. Designing a comprehensive management regime for deep seabed ecosystems and resources will require taking into account these conflicts.

Following the general increase in the use of biodiversity for commercial purposes and the related growth in bioprospecting activities, bioprospecting for marine resources, including marine extremophiles, is likely to increase in the future. The advent of genomics and bioinformatics has paved the way for novel approaches to the identification of useful compounds and the development of new drugs, products and processes. This will also facilitate research on, and commercial development of, deep seabed genetic resources.

Section 3 showed that, following sampling and recovery from the deep seabed, various compounds from deep seabed organisms have been isolated, patented and developed for commercial application. Some products containing or developed on the basis of deep seabed genetic resources are already available on the market, and others may soon be commercialized. There are, however, difficulties in assessing the type of application and level of activity related to deep seabed genetic resources since information on origin and applications of the resources is not always readily available to the public or included in patent descriptions.

While public availability of research results of potential value for commercial applications remains limited, there seems to be an open exchange of information regarding research cruises, location of sites, and species discovered and identified. The scientific information thus disclosed is easily accessible through public, Internet-based databases, as well as relevant scientific publications. Such information has helped increase our knowledge of geological, biological, ecological, physiological and evolutionary processes related to the deep sea. It can also contribute to the development of new drugs, products and processes, and support the establishment of well-informed management and conservation measures. More particularly, the information gathered on deep seabed ecosystems and resources can support the work of various international organizations and institutions, such as the International Seabed Authority (ISA), the CBD, the Intergovernmental Oceanographic Commission of UNESCO (UNESCO-IOC), and regional marine-related bodies.

An increase in deep seabed bioprospecting remains subject to addressing the various technological and legal impediments that prevent a balanced development of activities related to deep seabed organisms, fruitful for all and respectful of the environment. Such impediments include ethical issues regarding patenting of inventions

based on genetic resources, the high cost of necessary equipment and research expeditions, as well as the lack of a clear legal and institutional framework for access to these resources and sharing of the benefits arising out of their utilization. It is noteworthy that uncertainty over access procedures may act as major deterrent to investment in research, as may overly stringent conditions on access.

7.1.4. Current legal and policy framework

While science and technology evolve at a fast pace, the international legal and policy framework lags behind. Governments are still divided on whether, and if so, how to regulate deep seabed bioprospecting. This division is largely the result of knowledge gaps regarding the environmental impacts and economic potential of deep seabed bioprospecting, as well as questions regarding the relationship between marine scientific research – a High Seas freedom – and bioprospecting in areas beyond national jurisdiction, the legal status of genetic resources found in the Area as open-access or common heritage of humankind, and whether and how benefits should be shared from their recovery and use. To a large extent, the debate is reminiscent of that relating to deep seabed mineral resources several decades ago.

This section provides a brief summary of the international instruments relevant to deep seabed bioprospecting. By way of comparison, a brief overview is given of the framework for marine bioprospecting in areas within national jurisdiction.

7.1.4.1. Bioprospecting within national jurisdiction

Bioprospecting undertaken in the seabed within the limits of national jurisdiction is currently regulated by a set of measures found in the UN Convention on the Law of the Sea (UNCLOS), which determines States' jurisdiction, and rights and obligations in the oceans, as well as in the CBD, which provides for a specific set of measures on access to genetic resources and benefit-sharing.

On the basis of these instruments, bioprospectors intending to undertake research in a State's seabed are required to comply with this State's domestic legislation on marine scientific research, as well as its bioprospecting legislation, if such legislation has been adopted. While most States have adopted measures to regulate marine scientific research undertaken in their waters and seabed, only a handful of States have adopted legislation regulating access to, and exploitation of, their genetic resources, including their marine resources. Depending on the specific scope of legislation related to marine scientific research – i.e. addressing only pure scientific research or also dealing with applied research – bioprospecting could be regulated through this legislation in the absence of specific bioprospecting laws.

Some States have put in place measures, which, without specifically addressing bioprospecting, are aimed at ensuring the conservation and sustainable use of various deep seabed ecosystems, mainly hydrothermal vents. Canada established a marine protected area (MPA), within its waters, at the Endeavour site, Portugal, within the context of the Convention on the Protection of the Marine Environment of the North East Atlantic (OSPAR), proposed to establish an MPA for the Lucky Strike and Menez Gwen sites. Access to, as well as the type of research that can be undertaken within, these MPAs are strictly regulated on the basis of management plans and authorization procedures. To some extent, sharing of the results of pure research undertaken in those areas is provided for through the deposit of samples within a national collection and/or public dissemination of data and information. However, provisions for environmental impact assessment are absent.

Domestic measures susceptible to impact on the ability to undertake bioprospecting remain territorially based. As far as information available has allowed concluding, no State has adopted any legislation regulating pure marine scientific research or bioprospecting undertaken by their nationals or vessels under their control in international areas or under foreign jurisdiction.

7.1.4.2. Bioprospecting beyond national jurisdiction

There is currently no specific international regime addressing seabed bioprospecting carried out beyond national jurisdiction. Relevant measures are found in a number of international instruments, including UNCLOS, the CBD, various intellectual property rights (IPRs) instruments.

On the basis of the law of the sea framework set out in UNCLOS, the regulation of bioprospecting undertaken in marine areas beyond national jurisdiction falls within the jurisdiction of flag States. To date, no State has adopted any measure addressing bioprospecting undertaken by their nationals outside the limits of national jurisdiction. Moreover, legislation addressing marine scientific research tends to be territorially based.

What follows is a summary of the key issues and gaps that need to be addressed within relevant instruments.

The UN Convention on the Law of the Sea

- UNCLOS provides the legal framework to organize activities undertaken in the oceans in order to ensure, *inter alia*, the "equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment."
- The regime of the Area, defined as the seabed and ocean floor and subsoil thereof beyond the limits of national jurisdiction, is set out under Part XI of UNCLOS and the 1994 Implementation Agreement. The Area and its resources are recognized with the status of common heritage of humankind. However, the regime flowing from this principle and set out under Part XI does not apply to all resources of the Area, but only to mineral resources. The main features of the regime are those of: non-appropriation over the Area or its resources; international management through an international institution; peaceful use of the Area and its resources;

and sharing with humankind of the benefits resulting from activities related to the Area or its resources.

- Does the exclusion of living resources from the regime set out under Part XI on the Area imply that genetic resources located in the Area fall under the regime governing the High Seas, as organized under Part VII? The answer is not a clear-cut case. The language of UNCLOS regarding living resources, including such terms as "harvestable stage" or "sedentary" is applicable to macrofauna such as fisheries. However, this language is not appropriate with regard to microorganisms such as genetic resources, which are collected or sampled, but not "harvested." Moreover, these microorganisms can be either sedentary or not depending on their biological/physiological characteristics.
- The question arises whether the distinction made in Article 77 between living species that are sedentary and those that are not, is also applicable to living resources found in the Area. If it is, a fragmented regime ensues between genetic resources which then would fall under the regime of the High Seas (because belonging to the water column) and those that should be regulated by the regime of the Area (because belonging to the seabed and its subsoil).
- Distinguishing, in practice, between pure marine scientific research and research undertaken for commercial purposes is difficult. The lack of clear definition, within the context of UNCLOS, of marine scientific research as well as of prospecting, to which bioprospecting could be compared, contributes to this difficulty.
- Currently, deep seabed bioprospecting falls under flag States' legislation. It is not addressed *per se* under UNCLOS.
- The distinction between bioprospecting and marine scientific research, if any and appropriate, should be clearly articulated in order to define the regime that ensues with regard to treatment of information and data acquired during research. Marine scientific research undertaken in the Area should be carried out for the benefit of humankind as a whole, and research results made public and disseminated. This has to be reconciled with the need for confidentiality of data gathered for commercial purposes, such as in the case of bioprospecting. There are provisions for data confidentiality in the case of prospection for mineral resources in the Area, but there is no counterpart regarding confidentiality of data and exclusive rights in the case of prospection for biological resources in the Area.
- The provisions of UNCLOS related to the protection of the marine environment, as well as those related to technology transfer apply, presumably, to bioprospecting activities and technology.

The Convention on Biological Diversity

- The CBD provides a framework for the conservation and sustainable use of biological resources, including marine resources, as well as for the equitable sharing of the benefits arising from their utilization. With regard to marine areas, the CBD is to be implemented consistently with States' rights and obligations under the framework of the law of the sea.
- Under the CBD, genetic resources located in areas beyond national jurisdiction are only dealt with to the extent that processes and activities carried out under the control or jurisdiction of a State, within or beyond national jurisdiction, have or are likely to have a significant adverse impact on such resources or areas. With regard to deep seabed genetic resources, this implies that flag States are under the obligation to regulate bioprospecting or marine scientific research undertaken by their nationals or vessels flying their flag, within the framework of the law of the sea, only when such activities present a risk of significant adverse impact on the marine environment.
- With regard to conservation and sustainable use measures, this raises the issue of the threshold required for action: what is considered to be an adverse impact? What is a "significant" adverse impact? The level of what can be deemed significant clearly differs depending on factors such as the ecosystem to which it applies, since what may cause irreversible damage in the deep seabed may only cause moderate damage in the water column, for example. Would repeated collection and sampling at hydrothermal vent sites be considered as a significant adverse impact? The answer depends on the type and level of impacts that such activities bear on the resources themselves, as much as on the surrounding environment.
- With regard to access to, and sharing of the benefits arising from, deep seabed genetic resources, the CBD and the Bonn Guidelines on Access and Benefit-Sharing provide a useful model, including such procedures as prior informed consent of the owner of the resources, and arrangements for sharing of ensuing benefits. However, such a model, which remains of a bilateral nature and based on the assumption of national sovereignty over resources, would require being adapted to the multilateral framework of deep seabed activities and open-access resources. Section 7.3. further elaborates on how access and benefit-sharing measures under the CBD could be adapted to deep seabed genetic resources.

Intellectual property rights instruments

- Instruments on IPRs, including the Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure, and the Agreement on Trade-Related Aspects of Intellectual Property Rights of the World Trade Organization, have a role in regulating the use of information, data, and inventions ensuing from biological material, including deep seabed genetic resources.
- These instruments lack a clear definition of what can be considered as microorganisms or resources suitable for patentability.
- As they are currently designed, patent classification systems and databases do not permit clearly tracking and identification of marine microorganisms.
- There is a need to define precisely what is covered by an invention, and whether describing the sequence of a genome can be considered an invention, for example.
- IPRs instruments and traditional systems of protection of intellectual property may be inadequate with regard

to inventions stemming from biological resources, which are of common public interest.
- By way of benefit-sharing mechanisms, disclosure requirements, within patent applications, may be considered with regard to genetic resources considered as open-access or common heritage of humankind. Such disclosure could be implemented through deposit of samples within designated public collections, as in the case of the Budapest Treaty.
- There is a need for further economic analysis of the benefits and disadvantages of patentability of life forms, including its effects on promoting research and innovation.

7.2. Issues to be addressed and areas requiring further study

This report has brought to light a number of issues that need clarification and/or further work. The following are some of the main questions to be addressed:

1) There is a need to further research the content and nature of, and trends in, patent claims with regard to deep seabed genetic resources, in order to better assess and monitor trends in the use of such organisms. This requires greater responsiveness from patent classification systems and databases, including through the adoption of classifiers relating to marine organisms.

2) Further study regarding public-private partnerships for deep seabed bioprospecting is also necessary. Such study could explore the role of publicly-funded and private research institutions in the discovery and development of deep seabed valuable compounds, the types of partnerships established, and issues related to IPRs and benefit-sharing.

3) There is a need to clearly identify and define what bioprospecting covers, as well as develop criteria and guidelines to assist States in ascertaining the nature and implications of marine scientific research, as called for under Article 251 of UNCLOS. Should marine scientific research and bioprospecting be treated differently, considering practical difficulties in establishing the difference? Should researchers/academia and private companies be treated differently in terms of access to deep seabed genetic resources? Clarifying these issues is particularly important considering that, while marine scientific research is among the most direct threats to deep seabed ecosystems, it is also necessary to increase our knowledge of these ecosystems.

4) Parties to UNCLOS need to make the political decision whether living resources associated with the seabed beyond national jurisdiction fall within the regime of the High Seas, and are therefore openly accessible, or within the regime of the Area, and are therefore a common heritage of humankind.

5) Additional uncertainty regarding the regime applicable to deep seabed genetic resources and related activities carried out in the deep seabed results from the fact that claims to an extended continental shelf, beyond the 200 nautical miles, are still being filed. This implies that the precise delineation of the Area is not yet defined, and that uncertainty exists as to whether specific deep seabed bioprospecting activities fall under the regulation of national legislation or remain currently unregulated.

6) Because conservation measures are necessary, as a precaution, and are likely to impact on deep seabed bioprospecting and vice-versa, it is important to see how such measures, including possibly the establishment of MPAs, can accommodate the needs of pure and applied science, as well as States' rights within international areas.

7) In order to adequately assess the type and level of conservation measures required, further international scientific programmes, including monitoring activities, should be designed, implemented and adequately funded. Authoritative scientific assessments of deep seabed ecosystems and deep seabed genetic resources should be produced regularly. In addition to independent scientific assessments, reporting requirements, within the UNCLOS and CBD frameworks, as well as within regional frameworks, provide a basis upon which deep seabed bioprospecting activities can be assessed and monitored.

8) The benefits and role of voluntary initiatives in implementing conservation and sustainable use measures, including voluntary codes of conduct, should be taken into account. These could be used as temporary measures while regulations are being developed.

9) Issues related to technology transfer, including "clean technology," need to be considered. These issues relate, among others, to the modalities of the transfer, as well as to the desirability of such transfer with regard to conservation needs. If transfer of technology related to deep seabed bioprospecting is deemed undesirable, sharing of benefits should be ensured through the widest possible dissemination of research results.

10) Several aspects of the role of IPRs with regard to deep seabed genetic resources, including their socioeconomic and ethical aspects, need to be further studied. The role of IPRs in stimulating research, contributing to a sustainable use of resources and ensuring sharing of benefits resulting from the use of deep seabed genetic resources, cannot be taken for granted but cannot be overlooked. The need for a *sui generis* system of IPRs should be explored, should it be decided that these resources are the common heritage of humankind.

11) Adequately defining what genetic resources are and what the scope of intellectual property instruments covers (e.g. broad or restricted definition of microorganisms) is also required.

12) There is a need to ensure consistency between the rules related to IPRs and those related to sharing of information resulting from marine scientific research in the Area. This is intimately linked to clarifying the

distinction between marine scientific research and bioprospecting.

13) The question of how sharing of benefits can be organized should be further studied. Monetary as well as non-monetary benefits, including technology transfer and capacity building need to be explored. Issues to consider regarding benefit-sharing include the modalities to ensure that the sharing is fair and equitable, as well as whom the beneficiaries should be. A requirement of disclosure of origin, within patent applications, may ensure that benefits are shared equitably. These questions are intimately linked to the status of deep seabed genetic resources.

7.3. Feasible approaches to designing a regime for bioprospecting in the deep seabed

The international community will be able to determine the desirability and modalities of an international regime for deep seabed bioprospecting, on the basis of the clarifications obtained on the above-mentioned issues. These clarifications can be obtained through further work and cooperation within such fora as the UN Informal Consultative Process on Oceans and the Law of the Sea (ICP), the UN *Ad hoc* Working Group on biodiversity beyond national jurisdiction, the CBD and UN-Oceans. The UN General Assembly, due to its large participation and broad mandate under the UN Charter, seems to be the most appropriate forum to determine ways forward regarding discussions on possible options for a regime. Some available options are exposed below.

It should be noted, at the outset, that a wide range of actors have a key interest in the way deep seabed resources and ecosystems are managed and used. While the most obvious of these remain academia and industry, including the chemical, health, energy, food, and pharmaceutical sectors, governments also have various interests in the issues related to deep seabed ecosystems, ranging from compliance with treaty obligations (e.g. UNCLOS, environmental agreements, IPRs instruments, etc.) to a share in the benefits ensuing from the development and use of deep seabed resources. For a successful regime to be designed and implemented, it is therefore necessary to involve all relevant actors in the process, i.e. governments, academia, industry, indigenous representatives, and civil society.

7.3.1. Retaining the status quo

Retaining the *status quo* would entail that access to, and use of, deep seabed genetic resources remain unregulated and open. As it stands, the responsibility to adopt measures to regulate activities carried out in the Area or in the High Seas lays with flag States.

Advantages

- The CBD-UNDOALOS Study pointed to the stimulation of research and investment.

Disadvantages

- Risks of over-exploitation and destruction of habitats are not negligible if no conservation and sustainable use measures are put in place.
- Provided that flag States adopt relevant measures, such an approach may entail the adoption of uncoordinated, if not contradictory, measures. This would be inappropriate with respect to conservation needs related to deep seabed ecosystems.
- It appears that lack of a clear regulatory framework and procedures act as a deterrent to investment in research.
- The *status quo* favors the minority of those that have the technology and financial resources to access deep seabed ecosystems. While provisions for technology transfer and capacity building are provided for under UNCLOS with regard to marine scientific research, practical steps in this regard have been limited.
- There is currently no organized framework for an equitable sharing of the benefits resulting from the exploitation of genetic resources which are, to a large extent, deemed of public interest. This approach would therefore be inappropriate with regard to benefit-sharing needs, should States agree that deep seabed genetic resources are the common heritage of humankind.
- Issues associated with the patenting of deep seabed organisms would also remain unresolved.

If the *status quo* is maintained, it would be worth considering expanding the mandate of the ISA with respect to the Area's biodiversity in order to allow it to regulate activities related to living resources of the Area, in addition to those related to mineral resources only.

7.3.2. Using regional frameworks

As a first step towards an integrated regime, the use of regional instruments for the protection of the marine environment could be contemplated. Such instruments provide a framework to organize cooperation and harmonize management measures within their respective geographical area.

Advantages

- Using regional instruments would ensure that measures adopted to regulate activities undertaken within deep seabed ecosystems, including the establishment of MPAs, are in conformity with the law of the sea framework.
- Regional instruments often include requirements for prior environmental impacts assessments, as well as monitoring activities regarding the status of, and threats to, the marine environment.

Disadvantages

- Regional instruments cover a relatively small part of areas beyond national jurisdiction.
- Not all regional frameworks presented in this report cover all relevant aspects associated with deep seabed bioprospecting. Particularly, the issue of sharing of information and data, as well as benefits ensuing

from the use of such resources, if such use is allowed, may not be adequately covered.
- The institutional framework of some instruments may be weak, e.g. lack of periodicity in meetings of the Parties, lack of a permanent structure mandated with operational and organizational responsibilities, lack of adequate scientific input...

Among the various regional instruments that could be used as models *per se* to regulate deep seabed bioprospecting, it is worth highlighting the framework of the Antarctic Treaty System (ATS), the key aspects of which include:
- planning and notification of research activities undertaken in the area covered by the Antarctic Treaty;
- information sharing;
- a set of conservation principles and measures, including the establishment of MPAs;
- an institutional framework, under the Convention for the Conservation of Antarctic Marine Living Resources, made up of: a Commission mandated to, *inter alia*, facilitate research, disseminate information, and revise conservation measures; and a Scientific Committee for consultation and information exchange purposes;
- priority accorded to scientific research over any other activity;
- detailed provisions for environmental impact assessments under the Madrid Protocol on Environmental Protection;
- a system of inspections;
- a system of authorization regarding prospecting, exploration and exploitation of mineral resources under the Convention on the Regulation of Antarctic Mineral Resources Activities; and
- the confidential treatment of data and information that have potential commercial value.

While the ATS may be used as a model to address bioprospecting in the deep seabed, it should be stressed that its provisions are based on conflicting claims to sovereignty over parts of the Antarctic and its waters. Any regime on bioprospecting, modeled on the ATS, would have to take into account the fact that the Area is common heritage of humankind, over which no sovereignty claims can be exercised. Such a regime should also be adapted to the legal status of deep seabed genetic resources – i.e. open-access, common heritage of humankind, or of a *sui generis* status. Moreover, it should be borne in mind that the issue remains open as to whether some of the provisions of the system (i.e. those of the Madrid Protocol) are applicable to the deep seabed.

7.3.3. Adoption of guidelines by the General Assembly

Among the options available, the UN General Assembly could adopt a resolution containing guidelines or principles on deep seabed bioprospecting. Such guidelines or principles, which could be prepared by the ICP or the UN *Ad hoc* Working Group on biodiversity beyond national jurisdiction, could be used as a temporary framework until a binding regime is developed, if such a regime was deemed desirable.

Advantages
- This approach would accommodate the urgency to take action, since it would facilitate the conciliation of diverging views within a relatively shorter timeframe than if a convention or treaty were considered.
- The adoption of guidelines or principles by the UN General Assembly would reflect broad governmental support to addressing deep seabed bioprospecting.

Disadvantages
- The guidelines or principles would remain non-legally binding.
- Guidelines or principles do not allow for a great level of details. Such guidelines should therefore be complemented by a code of conduct setting out ways to operationalize the guidelines or principles.

Based on the current patchwork framework, guidelines or principles could focus on organizing cooperation and coordination between flag States and, drawing upon existing global and regional instruments, including measures on conservation, sustainable use, cooperation in marine scientific research, information sharing and capacity building, monitoring, as well as certain principles regarding sharing of ensuing benefits, and the use of voluntary codes of conduct. The guidelines should clearly address the distinction between pure marine scientific research and bioprospecting. The resolution should consider an appropriate institutional framework to coordinate implementation of the guidelines. The regulations of the ISA relating to prospecting could be used as a valuable input in the elaboration of the guidelines.

With regard to conservation measures, the guidelines may address: MPAs; procedures of notification or authorization to regulate access to deep seabed ecosystems; collection/sample quotas and regulation of equipment; and environmental impact assessments.

With regard to benefit-sharing, several aspects would need to be addressed, including:
- the treatment of information and data collected during marine scientific research, as well as the procedure for maintaining confidentiality or disseminating information;
- the possible use of a disclosure mechanism similar to that set out in the Budapest Treaty;
- the modalities for technology transfer and capacity building; and
- with regard to monetary benefits, the possible establishment of a common fund financed by a share in the profits ensuing from the development and commercialization of deep seabed genetic resources.

7.3.4. Using the framework of the Convention on Biological Diversity

The CBD provides a framework within which the ethical, socioeconomic and environmental aspects of deep seabed activities can be reconciled, through a balanced implementation of the three objectives of the Convention.

Advantages

- The CBD provides a framework to coordinate flag States activities for the conservation and sustainable use of deep seabed genetic resources.
- A substantial amount of work and activities undertaken within CBD fora are of relevance to deep seabed bioprospecting, including work on: conservation measures, including MPAs; access and benefit-sharing, including the Bonn Guidelines on Access and Benefit-Sharing; the role of IPRs with regard to biological resources; technology transfer; and exchange of information, through the Clearing-House Mechanism. Such work provides a good starting point to elaborate a specific regime for bioprospecting in the deep seabed.

Disadvantages

- Activities related to deep seabed genetic resources are only regulated under the CBD in so far as they have or are likely to have a significant adverse impact on the marine environment. In order to ensure that deep seabed bioprospecting is regulated, regardless of its impacts, notably with regard to the issue of benefit-sharing, amendments would be required.
- The institutional framework of the CBD is not appropriate to address issues of access to, and sharing of the benefits arising from, deep seabed genetic resources, which fall beyond national jurisdiction. If a system of prior notification is envisioned, the Secretariat could receive such notifications. However, if a system of authorization is favored, a structure with the political authority to grant such access would be needed. While the Conference of the Parties (COP) has such authority, the frequency of its meetings does not seem appropriate to consider access applications. The Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) could be such a structure, considering its mandate regarding scientific, technical and technological matters. Amending Article 25, which sets out the responsibilities of the SBSTTA, would be necessary. With regard to benefit-sharing, a smaller permanent structure may be more desirable in order to negotiate arrangements with bioprospectors and act as a mechanism for the distribution of such benefits. Such a structure could be a new subsidiary body.
- Amending the CBD or adopting a Protocol is likely to be a lengthy endeavor considering States' reluctance to address the issue of deep seabed bioprospecting. Moreover, consensus is far from being achieved on the legitimacy, for the CBD, to address issues related to resources found in areas beyond national jurisdiction, particularly with regard to marine areas.
- As for UNCLOS, the US, one of the major actors in marine scientific research, is not a Party to the CBD.

If amendments were considered by Parties, the following articles merit attention:
- Article 2 to include a definition of bioprospecting;
- Article 8(l) to remove the threshold required for conservation action;
- Article 15, on access to genetic resources, to specify that access to resources found in international areas may require prior notification to/authorization from the national government of the applicants or from a designated institutional structure within the CBD framework (e.g. the Secretariat, the SBSTTA or a new subsidiary body);
- Article 19, on handling of biotechnology and distribution of its benefits, to ensure that benefits arising out of the utilization of genetic resources from international areas are shared with all other Parties;
- Article 24 to expand the mandate of the Secretariat; and
- Article 25 to expand the mandate of the SBSTTA.

Other amendments may be required, as appropriate, depending on the level and type of regulation desired. Such amendments would need to be proposed by any Party to the Convention, and adopted by the COP by consensus, or failing which, by a two-third majority (Article 29). The adoption of a Protocol (Article 28) is also a possibility, particularly if a specific institutional framework to grant access authorization and negotiate benefit-sharing arrangements is envisioned.

7.3.5. Applying the regime of the Area

The regime of the Area could be used as a model or be applied *per se* to the bioprospecting following appropriate amendments to UNCLOS, since this regime only applies to non-living resources as it stands.

Under the regime of common heritage of humankind, deep seabed genetic resources would not be subject to private appropriation, should only be used for peaceful purposes, and would be managed by an international institution. The benefits ensuing from the utilization of these resources should also be shared with humankind as a whole.

Advantages

- Through the concept of common heritage of humankind, this regime covers all the issues associated with deep seabed activities, i.e. ethical, socioeconomic and environmental ones.
- The regime includes provisions for organizing and controlling exploration and exploitation activities, as well as measures for the sharing of benefits, through technology transfer and knowledge and information sharing.
- An institutional framework, the International Seabed Authority (ISA), is already in place and is operational.
- Management of deep seabed genetic resources by the ISA would respond to the needs of the ecosystem approach to conservation and sustainable use.

Disadvantages

- Bringing living resources within the scope of the Area's regime and the International Seabed Authority's (ISA) mandate, would require either: amending UNCLOS; adopting a Protocol; developing an implementing agreement; or adopting an agreed interpretation of UNCLOS by States Parties, stating that genetic resources found in the Area fall under the regime of either Part XI or Part VII, and clarifying

the relation between MSR and (bio)prospecting.
- These options to bring living resources within the scope of the Area's regime are likely to prove time consuming and difficult to negotiate since States are still divided on whether the regime of the Area and ISA should deal with living resources.
- It is also noteworthy that the US, one of the major States involved in deep seabed activities, is not a Party to UNCLOS.

In amending UNCLOS, the following articles should be considered:
- Article 1 (Part I) to include definitions for: MSR, prospecting, exploration and exploitation, as well as bioprospecting; and living resources, to include genetic resources;
- Article 77 (Part VI) to remove the distinction between sedentary and non-sedentary living resources; and
- Article 133 (Part XI) to include living resources within the scope of the resources covered by the regime of the Area.

Depending on the extent to which Parties intend to regulate bioprospecting and the desired institutional framework, other amendments would be required regarding, among others, provisions addressing publication and dissemination of information, as well as the responsibilities of the ISA.

It is noteworthy that pursuant to Article 312 of UNCLOS, amendments, other than those related to activities in the Area, should be proposed by a Party. A conference, mandated with considering such amendments, would be convened if not less than half of the Parties replied favorably to the proposals within a year. A simplified procedure is also provided for (Article 313). The voting procedure shall be that used during the Third UN Conference on the Law of the Sea.

With regard to amendments of the provisions relating exclusively to activities in the Area (Article 314), a Party makes proposals for amendments, which are subject to approval by the ISA. Under the 1994 Implementation Agreement (Section 4), the Assembly of the ISA may undertake a review of the provisions of Part XI and relevant Annexes at any time. The voting procedure shall be that used during the Third UN Conference on the Law of the Sea.

Considering the difficulties associated with bringing living resources within the scope of the Area's regime, this regime could be used as a model to develop a standalone regime for activities carried out with respect to living resources of the Area, in conformity with UNCLOS. Similarly, the regulations developed by the ISA can be used as models to address the impacts of bioprospecting activities. However, as for the previous options, negotiating such a framework is likely to prove time consuming.

A new institution, possibly modeled on the ISA, could be set up with the mandate to adopt conservation measures, authorize or receive notification of access to deep seabed genetic resources, act as a focal point for the transfer of technology and information exchange, as well as the designated authority to receive samples of resources collected, negotiate benefit-sharing arrangements, and supervise a system of inspections. The framework within which such institution would be established remains to be determined, but options include a subsidiary body of the UN General Assembly and a standalone organization outside the UN system.

Whether and how the various options set out above should be explored shall be decided by the UN General Assembly on the basis of solid, comprehensive information about all the aspects of the issue. Further studies should be undertaken cooperatively within the UN system in order to address the various ethical, socioeconomic, environmental, scientific and legal aspects of the issue. It is hoped that this report provided a useful starting point for these studies.

Endnotes

1 A metasearch of the databases of relevant authoritative scientific journals, including Nature, Nature Biotechnology, Science and Deep-Sea Research, using various keywords (e.g. bioprospecting, cold seeps, deep sea bioprospecting, deep sea ecosystems, deep sea genetic resources, deep seabed bioprospecting, deep seabed ecosystems, deep seabed genetic resources, extremophiles, gas hydrates, hot vents, hydrothermal vents, marine extremophiles, methane hydrates, seamounts, seeps), has led to the identification of more than 400 scientific articles. These articles contained references to other relevant studies. It is therefore possible to conclude that a large body of scientific literature on deep seabed ecosystems, generally supported by a very high degree of evidence, is available.

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4 The technology requirements associated with the exploration and exploitation of deep seabed organisms, including those necessary for their isolation and culture, are described in section 3 of this report.

5 Hydrothermal vents are also located in unstable systems, as these are areas that are geologically very active.

6 Continental slopes belong to the same oceanic realm as the sediments of the abyssal plain. The two together constitute the realm of hidden boundaries (source: Baseline Report of the Census of Marine Life).

7 Art.76, United Nations Convention on the Law of the Sea, hereafter referred to as "UNCLOS."

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54 Bergquist, D.C., Williams, F.M. & Fisher, C.R., "Longevity Record for Deep-sea Invertebrate" (2000) Nature 403, 499-500. In this case, the Johnson Sea Link manned submersible was utilized. It is further described in section 3 of this report.

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65 A fact sheet of the JAMSTEC-XBR Marine Biology and Ecology Research Program.
66 Nisbet, E.G., "The Realms of Archean Life" (2000) Nature 405, 625-626.
67 InterRidge is an international initiative by scientists, which aims at promoting coordination for all aspects of mid-ocean ridges (scientific activities, operations, information exchange, etc.). See: <http://interridge.org/>.
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69 ISA's Hydrothermal Vent Systems and Sulphide Database is available at <http://www.cdr.isa.org.jm/servlet/page?_pageid=326,328&_dad=portal30&_schema=PORTAL30> (last visited on 15 December 2004). Polymetallic massive sulfide deposits are typically associated with high-temperature (ca. 350°C) black smoker vents that occur in areas of active or recently active volcanism (e.g. deep sea mid-ocean ridges, sedimented ridges, mid-plate seamounts, arc volcanoes, back-arc rift environments). Low temperature hydrothermal vents and associated mineral deposits are typically found at the margins of high temperature vent fields or in shallow water settings adjacent to volcanically active landmass.
70 See <http://www.interridge.org>.
71 Glowka, L., "Bioprospecting, Alien Invasive Species, and Hydrothermal Vents: Three Emerging Legal Issues in the Conservation and Sustainable Use of Biodiversity" (2000) Tulane Environmental Law Journal 13(2), 329-360.
72 Korn, H., Friedrich, S., *et al*., "Deep Sea Genetic Resources in the Context of the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea", 2003, German Federal Agency for Nature Conservation, 83 pp. Also Leary, D.K., "Emerging Legal Regimes Regulating Bioprospecting for Thermophiles and Hyperthermophiles of Hydrothermal Vents" (2003) Journal of Marine Biotechnology (forthcoming) .
73 Art.12(b), Convention on Biological Diversity, hereafter referred to as "CBD."
74 "Progress Report on the Implementation of the Programmes of Work on the Biological Diversity of Inland Water Ecosystems, Marine and Coastal Biological Diversity, and Forest Biological Diversity - Information on Marine and Coastal Genetic Resources, Including Bioprospecting" (UNEP/CBD/COP/5/INF/7). The Encyclopedia of Biodiversity defines bioprospecting as the "systematic search for genes, natural compounds, designs, and whole organisms in wild life with a potential for product development by biological observation and biophysical, biochemical, and genetic methods, without disruption to nature." (Academic Press, 2001, p.471).
75 Glossary, New Zealand Biodiversity Strategy, 2000.
76 Glossary of the European Community Clearing-House Mechanism <http://biodiversity-chm.eea.eu.int/CHMIndexTerms/Glossary/B/bioprospecting> (visited on 16 November 2004).
77 Art.1, Act No.10 of 2004: National Environmental Management: Biodiversity Act.
78 Section 5(a), Wildlife Resources Conservation and Protection Act, Republic Act No.9147 of 19 March 2001.
79 It has been proposed to distinguish between "biodiscovery" and "bioprospecting." Biodiscovery would cover the first phase of scientific research, and be equivalent, in this regard, to prospecting for mineral resources. Bioprospecting would cover the subsequent phases of re-collection of the resources for purposes of further investigation and eventual commercial application, and be closer, in this respect, to exploration and exploitation of mineral resources. It is assumed that the regime for authorizing access in both sets of circumstances would differ as well as the regime for, and modalities of, benefit-sharing. See Workshop on Bioprospecting in the High Seas (28 – 29 November 2003, Dunedin, New Zealand), report available at <http://www.fish.govt.nz/current/deepsea/workshop-report-bioprospecting-in-the-high-seas.doc>, hereafter referred to as "Dunedin Workshop Report." Queensland's 2004 Biodiscovery Act seems to use the term biodiscovery as a synonym of bioprospecting, defining biodiscovery as "a) research or b) the commercialization of native biological material or a product of biodiscovery research." Biodiscovery research is "the analysis of molecular, biochemical or genetic information about native biological material for the purpose of commercializing the material" (Schedule, Biodiscovery Act 2004 (No.19)).
80 Art.246(5), UNCLOS.
81 Art.251, UNCLOS.
82 "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" (UNEP/CBD/SBSTTA/8/INF/3/Rev.1), hereafter referred to as "CBD-UNDOALOS Study."
83 Regulation 1(3)(e), Regulations on Prospecting and Exploration for Polymetallic Nodules, hereafter referred to as "Polymetallic Nodules Regulations."
84 Regulations 6 and 35, Polymetallic Nodules Regulations.
85 Art.2(2), Annex III, UNCLOS; Regulation 2(a), Polymetallic Nodules Regulations.
86 Para 420 and 422, "Oceans and the law of the sea. Report by the Secretary-General" (A/57/57).
87 A Dictionary of Biology, Oxford University Press, 2000.
88 Nee, S., "More than Meets the Eye" (2004) Nature 429, 804-805.
89 Oldham, P., Global Status and Trends in Intellectual Property Claims: Microorganisms, 2004, Centre for Economic and Social Aspects of Genomics, 42 pp.
90 Many of these research programmes are reported in the InterRidge MOR & BAB Cruise Database, available at <http://www.interridge.org>.
91 See <http://www.mpch-mainz.mpg.de/~geo/Arctic/Cruise2001/> (last visited on 22 December 2004).
92 See <http://www.challengerexpedition.com/> (visited on 7 March 2005).
93 Using DNA technology, the Census will retrieve gene sequences from old preserved samples of formaldehyde obtained during the Continuous Plankton Recorder campaigns dating back 70 years.
94 The Census of Marine Life reports that 11 seamount research programmes are currently being carried out.
95 The European Commission-funded project HERMES will form the nucleus of the Continental Margins activities.
96 Two other categories of activities complete current efforts under the Census of Marine Life: the Drifters activities, including the Census of Marine Zooplankton (CMarZ, coordinated by the US, Japan and Germany); and the Swimmers activities, including on Tagging of Pacific Pelagics (TOPP, coordinated by the US).
97 See <http://www.esf.org/esf_article.php?language=0&article=127&domain=3&activity=7> (visited on 22 December 2004).
98 Ifremer, Annual Report 2003, 80 pp. See also <http://www.ifremer.fr/droep>.
99 See <http://www.pmel.noaa.gov/vents/> (last visited on 22 December 2004).
100 See: <http://www.sorcerer2expedition.org/version1/HTML/main.htm>, visited on 12 May 2005.
101 See: http://www.venterinstitute.org/press/news/news_

2005_02_24.php, visited on 12 May 2005.
102 See <http://www.marbec.org/index.asp> (last visited on 16 December 2004).
103 See <http://www.amnh.org/nationalcenter/expeditions/blacksmokers/> (visited on 16 December 2004).
104 See <http://www.ocean.washington.edu/outreach/revel> (last visited on 6 March 2005).
105 In addition to conducting Internet-based research, the authors of this report sought information from the main private and public entities identified as either holding relevant patents or having commercialized products based on deep seabed genetic resources. A questionnaire was sent out to clarify the nature, level and modalities of public-private partnerships. Out of the dozen entities contacted, only one responded.
106 Rappuoli, R., "Reverse Vaccinology, a Genome-based Approach to Vaccine Development" (2001) Vaccine 19, 2688-2691. Also, Rappuoli, R. & Covacci, A., "Reverse Vaccinology and Genomics" (2003) Science 302, 602.
107 Oldham, P., Global Status and Trends in Intellectual Property Claims: Microorganisms, 2004, Centre for Economic and Social Aspects of Genomics, 42 pp.
108 A summary of views, prepared by the WTO Secretariat in 2002, regarding the relationship between the WTO TRIPS Agreement and the CBD offers an account of the debate regarding patentability of genetic material ("The Relationship Between the TRIPS Agreement and the Convention on Biological Diversity – Summary of Issues Raised and Points Made. Note by the Secretariat" (IP/C/W/368)). One view is that allowing patents to be granted in respect of genetic material would limit access to such genetic material and may conflict with countries' sovereign rights over their genetic resources. It has also been noted that failure to fulfill closely the criteria for patentability, namely those of novelty, inventive step (or non-obviousness) and industrial applicability (or usefulness) may lead to: granting patents covering genetic material in their natural state, considering that some countries define inventions to include discovery of naturally-occurring matter; and granting patents for genetic material that has been merely isolated from nature without having undergone any genetic modification from man's hands. In response, the summary notes that holding a patent on isolated or modified genetic materials does not amount to ownership of the genetic materials themselves, nor does it provide property rights with regard to the source from which the original material was obtained. It also notes that life forms in their natural state would not satisfy the criteria for patentability in the TRIPS Agreement, unless the subject-matter of a patent has involved sufficient human intervention, such as production by means of a technical process or isolation or purification, and if the isolated or purified subject is not of a previously recognized existence (Para 14-19).
109 See <http://www.newscientist.com/news/print.jsp?id=ns99991503> (last visited on 12 December 2004).
110 See <http://www.sederma.fr>, 'Patent corner' (visited on 10 November 2004). Also: Mas-Chamberlin, C., Mondon, P., Lamy, F., Scocci, S., De Givry, L., Vissac, F. & Lintner, K., "Heat- and UV-stable Cosmetic Enzymes from Deep Sea Bacteria" (2002) Cosmetics & Toiletries 117(4), 22-30. Lintner, K., Lamy, F., Mas-Chamberlin, C., Mondon, P., Scocci, S., Buche, P. & Girard P., "Heat-Stable Enzymes from Deep Sea Bacteria: A Key Tool for Skin Protection Against UV-A Induced Free Radicals" (2002) IFSCC Magazine 5(3), 195-200.
111 The name of the specific product derived from *T. thermophilus* was not specified in information retrieved from <http://www.californiatan.com/> (visited on 12 December 2004).
112 See <http://www.roche-diagnostics.com/ba_rmd/patent_list.html> (last visited on 14 December 2004).
113 See <http://www.diversa.com/inteprop/issupate.asp> (visited on 10 November 2004).
114 See <http://www.diversa.com/corpinfo/corpalli.asp> (last visited on 22 December 2004).
115 See <http://www.diversa.com/presrele/2004/view_release.asp?id=20041122> (visited on 13 December 2004).
116 See <http://www.diversa.com/markprod/prod/pyro.asp> (last visited on 14 December 2004).
117 See <http://www.invitrogen.com/content.cfm?pageid=3450> (visited on 14 December 2004).
118 See <http://www.neb.com/nebecomm/products/productM0258.asp> (visited on 15 December 2004). Also, Wirsen, C.O., Molyneaux, S.J. & Langworthy, T.A., "Comparative Physiological Studies on Hyperthermophilic Archaea Isolated from Deep-Sea Hot Vents with Emphasis on Pyrococcus Strain GB-D" (1992) Applied and Environmental Microbiology 58, 3472-3481.
119 See <http://www.neb.com/nebecomm/products/productM0261.asp> (visited on 15 December 2004).
120 See <http://www.aquaartis.com> (visited on 19 January 2005).
121 See <http://oceanexplorer.noaa.gov/explorations/03bio/background/medicines/medicines.html> (visited on 19 January 2005). The Harbor Branch Oceanographic Institution holds the following patents related to the discovery of discodermolide compounds and methods for their use: AT0486565 (Austria); BE0486565 (Belgium); 3,008,985 (Canada); DK0486565 (Denmark); FR0486565 (France); P69018991.5 (Germany); GB0486565 (Great Britain); IT0486565 (Italy); 2,056,412 (Japan); LU0486565 (Luxembourg); NL0486565 (The Netherlands); ES0486565 (Spain); SE0486565 (Sweden); P0486565 (Switzerland); and 5,681,847, 5,840,750, 4,939,168, 5,010,099 (United States).
122 See <http://www.hytest.fi/tuotteet388.php> (last visited on 14 December 2004).
123 See <http://www.promega.com/catalog/CatalogProducts.asp?catalog%5Fname=Promega%5FProducts&category%5Fname=Tth+DNA+Polymerase&description%5Ftext=%3Ci%3ETth%3C%2Fi%3E+DNA+Polymerase> (visited on 14 December 2004).
124 See <http://v3.espacenet.com/textdoc?CY=ep&LG=en&F=4&IDX=WO03093434&DB=EPODOC> (visited on 7 December 2004).
125 See <http://v3.espacenet.com/textdoc?CY=ep&LG=en&F=4&IDX=US2003235902&DB=EPODOC> (visited on 7 December 2004).
126 Japanese Unexamined Patent Publication 2001-288103, Japanese Unexamined Patent Publication 2001-520027, and Japanese Unexamined Patent Publication 2000-103743.
127 See <http://v3.espacenet.com/textdoc?CY=ep&LG=en&F=4&IDX=US2003129734&DB=EPODOC> (visited on 1 November 2004).
128 See <http://v3.espacenet.com/textdoc?CY=ep&LG=en&F=4&IDX=US5989587&DB=EPODOC> (visited on 12 December 2004).
129 See <http://appft1.uspto.gov/netacgi/nph-Parser?Sect1=PTO1&Sect2=HITOFF&d=PG01&p=1&u=/netahtml/PTO/srchnum.html&r=1&f=G&l=50&s1='20020106660'.PGNR.&OS=DN/20020106660&RS=DN/20020106660> (last visited on 14 December 2004).
130 See <http://ep.espacenet.com/search97cgi/s97_cgi.exe?Action=FormGen&Template=ep/en/advanced.hts> (visited on 3 November 2004).
131 See <http://www.hboi.edu/dbmr/dbmr_patents.html> (visited on 5 November 2004). The list is limited to issued and allowed patents as of 6 February 2002.
132 Leary, D.K., "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?" (2004) Macquarie Journal of International and Comparative Environmental Law 1, 137-178.
133 The Resolution also "calls upon States and international financial institutions, including through bilateral, regional and global cooperation programmes and technical partnerships, to continue to strengthen capacity-building activities, in particular in developing countries, in the field of marine scientific research by, *inter alia*, training the necessary skilled personnel, providing the necessary equipment, facilities and vessels and transferring environmentally sound technologies." It is assumed that these provisions also apply to deep sea MSR.

134 Baseline Report of the Census of Marine Life. Also, Broad, W.J., The Universe Below, 1997, Simon & Schuster, 415 pp.
135 Baseline Report of the Census of Marine Life.
136 This estimation is based on anticipated scientific efforts regarding phyla (phyla are the first hierarchical subdivisions of life domains) and to sampling intensity in this realm, knowing that most of the marine species are contained in a few phyla and that practically all phyla are represented in the marine environment.
137 For a legal definition of acoustic pollution in the oceans, see Dotinga, H.M. & Oude Elferink, A.G., "Acoustic Pollution in the Oceans: The Search for Legal Standards" (2000) Ocean Development and International Law 31, 151-182. Regarding light in the deep sea bed, see Jinks, R.N., Markley, T.L., Taylor, E.E., Perovich, G., Dittel, A.I., Epifanio, C.E. & Cronin, T.W., "Adaptive Visual Metamorphosis in a Deep-sea Hydrothermal Vent Crab" (2002) Nature 420, 68-70. It has been discovered that species inhabiting vent sites such as the crab *Bythograea thermydron*, which has a planktonic larval stage, undergo adaptive visual metamorphosis while settling down in the vent environment. These adaptations demonstrate not only that light exists in the deep seabed but also that it plays a role as a factor orientating post-larval settlement.
138 In addition to MSR, the other main threats to deep seabed ecosystems are mining and tourism. The impacts of mining result from drilling, excavation and disposal of associated waste, as well as construction, operation and maintenance of the necessary infrastructure. Tourism in the deep sea is still at very early stages but is a potentially growing activity. As an example, the Russian Academy of Sciences, which operates the MIR submersible vehicles, has partnered with the tour operator Deep Ocean Expeditions in providing tourists with the opportunity to visit deep seabed sites in the Azores in the context of official scientific missions. A cruise took place in June 2002, and costed participating tourists US$ 55,000 per head. See Glowka, L., "Putting Marine Scientific Research on a Sustainable Footing at Hydrothermal Vents" (2003) Marine Policy 27(4), 303-312.
139 Glowka, L., "Putting Marine Scientific Research on a Sustainable Footing at Hydrothermal Vents" (2003) Marine Policy 27(4), 303-312.
140 Mullineaux, L., Desbruyeres, D. & Juniper, K.S., "Deep-sea Hydrothermal Vents Sanctuaries: A Position Paper" (2001) InterRidge News 7, 15-16.
141 See <http://earthobservations.org/docs/DRAFT%20GEOSS%20Plan%20Reference%20Document%20203-1.pdf> (last visited on 16 December 2004).
142 See <http://beaufix.ipgp.jussieu.fr/rech/lgm/MOMAR/> (last visited on 16 December 2004).
143 Copley, J., "Oceanography: All Wired Up" (2004) Nature 427, 10-12.
144 See <http://www.pmel.noaa.gov/vents/nemo/index.html> (last visited on 16 December 2004).
145 See <http://195.37.14.189/public_html/reser-db.htmto> (last visited on 22 December 2004).
146 See <http://195.37.14.189/public_html/res-epr.htm> (last visited on 22 December 2004).
147 See <http://195.37.14.189/public_html/res-mar.htm> (last visited on 22 December 2004).
148 Correspondence from Dr. Alex Rogers, British Antarctic Survey.
149 An example of such difficulties lays in the fact that deep sea organisms change in shape once brought to the surface.
150 A few countries operate manned or unmanned vehicles needed for deep sea exploration, including France (Nautile, Victor 6000, Aster), Russia (Mir I and II), and the US (Alvin, ABE and others). For an comprehensive review of the main deep sea manned or unmanned vehicles see <http://www.oceanexplorer.noaa.gov/technology/subs/subs.html>.
151 In some cases, the technology is owned by the military but operated by a research institution. Such is the case for the Deep Submersible Vehicle Alvin, owned by the US Navy, and operated as a national oceanographic facility by the Woods Hole Oceanographic Institution in the US. Alvin reaches the depth of 4,500 meters . Further details are available online at <http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/alvinspecs.html> (visited on 6 November 2004).
152 Stoeckle, M., "Taxonomy, DNA and the Bar Code of Life" (2003) Bioscience 53(9), 2-3.
153 In their 2000 review of search and discovery strategies for biotechnology, Bull, Ward and Goodfellow state that "[b]iotechnology in a great many and probably most instances has a requirement for real, not virtual organisms, and thus research on ways and means of bringing as yet uncultured organisms into culture should be given much greater prominence." in Bull, A., Ward, A.C. & Goodfellow, M., "Search and Discovery Strategies for Biotechnology: the Paradigm Shift" (2000) Microbiology and Molecular Biology Reviews 64(3), 575-606.
154 For example, the Harbor Branch Oceanographic Institution, a not-for-profit oceanographic research and education organization based in Florida, US, owns and operates the Johnson Sea Link I and II manned submersibles, which can reach depths of about 1,000 meters. For further details, see <http://www.hboi.edu/marineops/jsl1.html#> (visited on 5 November 2004). Some of the Harbor Branch Oceanographic Institution's deep sea missions, which include benthic and/or mid-water observations, photo/video documentation, and collection of organisms, are funded or co-funded by the US National Science Foundation and the National Oceanic and Atmospheric Administration.
155 This section is based on a visit to the headquarters of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokosuka, Japan on 8 November 2004.
156 Pamphlet on the Extremobiosphere Research Center, 2004. Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan, 14 pp.
157 For specifications, see <http://www.jamstec.go.jp/jamstec-e/ships/shinkai3.html> (visited on 6 November 2004). JAMSTEC also used to operate the SHINKAI 2000 (maximum depth of operation: 2,000 meters), which is now retired from service for financial reasons (personal communication with the Deputy-Manager of the JAMSTEC-XBR Center). For specifications on SHINKAI 2000, see <http://www.jamstec.go.jp/jamstec-e/ships/shinkai1.html> (visited on 6 November 2004).
158 For specifications, see <http://www.jamstec.go.jp/jamstec-e/rov/3k.html and http://www.jamstec.go.jp/jamstec-e/rov/hyper.html> (visited on 9 November 2004).
159 Another ROV, called KAIKO, was able to sample sediments from the Mariana Trench – the deepest point in the world ocean at the depth of 10,898 meters. KAIKO was lost during one of its missions.
160 For specifications, see <http://www.jamstec.go.jp/jamstec-e/rov/auv_ex1.html> (visited on 9 November 2004).
161 For specifications, see <http://www.jamstec.go.jp/jamstec-e/odinfo/sdsreport.html> (visited on 9 November 2004).
162 See <http://www.jamstec.go.jp/jamstec-e/bio/exbase.html> (visited on 9 November 2004).
163 The UK has a deep-sea research programme and ROV technology capable to reach 6,500m (correspondence from Dr. Alex Rogers, British Antarctic Survey).
164 See <http://www.ifremer.fr and www.whoi.edu>.
165 "Scientific Information on Biodiversity in Marine Areas Beyond the Limits of National Jurisdiction," Information document presented at the first meeting of the *Ad hoc* Open-ended Working Group on Protected Areas of the Convention on Biological Diversity (UNEP/CBD/WG-PA/1/2/INF/1).
166 Resilience is the capacity of an ecosystem to resist changes and includes the pace at which an ecosystem may be able to recover following changes.
167 "Management of Risks to the Biodiversity of Seamounts and Cold-water Coral Communities Beyond National Jurisdiction," Information document presented at the seventh meeting of the Conference of the Parties to the Convention on Biological Diversity (UNEP/CBD/COP/7/INF/25).
168 "Scientific Information on Biodiversity in Marine Areas

Beyond the Limits of National Jurisdiction," Information document presented at the first meeting of the *Ad hoc* Open-ended Working Group on Protected Areas of the Convention on Biological Diversity (UNEP/CBD/WG-PA/1/2/INF/1).

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227 States can regulate activities taking place within their internal waters, including prohibiting passage of foreign vessels (Art.2(1) and Art.3, UNCLOS). In the territorial sea, States exercise their sovereignty, subject to the right of innocent passage for foreign ships (Art.17, UNCLOS). In their Exclusive Economic Zone (EEZ), coastal States have sovereign rights to explore for, exploit, conserve and manage living and non-living natural resources, and regulate other activities for the economic exploitation and exploration of the EEZ (Art.56(1)(a), UNCLOS). Within the EEZ, States also have jurisdiction over the establishment and use of artificial islands, installations and structures, marine scientific research (MSR) and the protection and preservation of the marine environment (Art.56(1)(b), UNCLOS). On the continental shelf, coastal States have sovereign rights to explore and exploit non-living resources as well as living organisms belonging to sedentary species. These sovereign rights are subject to the rights of other States, including the right of navigation and to lay submarine cables and pipelines (Art.77, Art.78(2) and Art.79, UNCLOS).
228 Art.4, Annex II, UNCLOS. To date, claims have been deposited by the Russian Federation, Brazil and Australia.
229 "Oceans and the law of the sea. Report of the Secretary-General to the 59th session of the UN General Assembly" (A/59/62), Para 47. In relation to deposit of charts and coordinates, the Secretary-General notes that "the international community and the users of the seas and oceans need to know the limits of the maritime zones in which a coastal State exercises its sovereignty or sovereign rights and jurisdiction, in view of the different legal regimes applicable. Ultimately, through the delineation of the outer limits of the continental shelf and, where appropriate, the [EEZ], the international community should be able to determine the boundaries of the international seabed area (the Area), which is subject to the regime of the common heritage of humankind."
230 According to Art.31 of the 1966 Vienna Convention on the Law of Treaty, a treaty shall be interpreted in light of its object and purpose.
231 Art.77(4), UNCLOS.
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233 Art.86 and 87, UNCLOS.
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235 The Status of Natural Resources on the High Seas, WWF/IUCN, Gland, Switzerland, 2001, 93 pp.
236 Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (A/RES/48/263), hereafter referred to as "1994 Part XI Agreement."
237 Preamble, UNCLOS.
238 Art.136 and 137, UNCLOS.
239 Art.1(3), UNCLOS.
240 Art.133, UNCLOS.
241 Art.156 and 157, UNCLOS.
242 Art.156-170, UNCLOS and Section II, 1994 Part XI Agreement.
243 Art.153(1), UNCLOS.
244 Art.140(2), UNCLOS.
245 Art.143(2), UNCLOS.
246 Art.144(1), UNCLOS.
247 Art.145, UNCLOS.
248 Art.162(2)(z), UNCLOS.
249 Art.153(3), UNCLOS.
250 Art.8, Annex III, UNCLOS.
251 Point 7, Section I, 1994 Part XI Agreement.
252 Section II, 1994 Part XI Agreement.
253 Reports of the Chairmen of the Legal and Technical Commission to the Council (ISBA/9/C/4 and ISBA/10/C/4).
254 Para 15-17, Report of the Chairman of the Legal and Technical Commission (ISBA/9/C/4).
255 "Seabed Authority's Legal and Technical Commission, in First Open Meeting, Discusses Biodiversity in Deep Seabed Area," Press Release (SB/10/8).
256 This is also one of the options presented in the CBD-UNDOALOS Study.
257 The ISA is currently associated with the Kaplan Project, designed to measure biodiversity, species range, and gene flow in the Clarion-Clipperton Zone in the Northeast Pacific. The information gained will be used to determine the potential risks resulting from mining of manganese nodules for marine life. The first set of results and analyses should be available in 2005. The outputs will include the establishment of a database of some of the important species found in the Clarion-Clipperton Zone, including their genetic sequences. The Authority will also promote work undertaken by the Chemosynthetic Ecosystems Group (known as ChEss) and the Seamounts Group (known as CenSeam) within the Census of Marine Life. Both cover the environments where polymetallic sulphides and cobalt-rich crusts are found, namely hydrothermal vents and seamounts. See Statement by the ISA's Secretary-General at the 59th session of the UN General Assembly, 17 November 2004.
258 The workshop's presentations are available at <http://www.isa.org.jm/en/default.htm>.
259 Decision of the Assembly of the International Seabed Authority relating to the Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area (ISBA/6/A/18), hereafter referred to as "Polymetallic Nodules Regulations."
260 Regulation 1(4), Polymetallic Nodules Regulations.
261 Regulation 2(2), Polymetallic Nodules Regulations.
262 Regulation 2(4), Polymetallic Nodules Regulations.
263 Regulations 24(1) and 26(1), Polymetallic Nodules Regulations.
264 Regulation 30, Polymetallic Nodules Regulations.
265 Regulation 31(3) and (4), Polymetallic Nodules Regulations.
266 Regulation 31(7), Polymetallic Nodules Regulations.
267 Regulation 35(3), Polymetallic Nodules Regulations.
268 "Draft regulations on prospecting and exploration for polymetallic sulphides and cobalt-rich ferromanganese crusts in the Area. Proposed by the Legal and Technical Commission" (ISBA/10/C/WP1), hereafter referred to as " Draft Polymetallic Sulphides Regulations."
269 Regulations 16-19, Draft Polymetallic Sulphides Regulations.

270 Para.39, CBD-UNDOALOS Study.
271 Art.256 and 257, UNCLOS.
272 Art.240, UNCLOS.
273 Art.245 and 246(1), UNCLOS.
274 Art.248, Art.249(1)(a) and (c), and Art.249(2), UNCLOS.
275 Art.143(1), UNCLOS.
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278 Para 53, CBD-UNDOALOS Study.
279 Gorina-Ysern, M., "Legal Issues Raised by Profitable Biotechnology Development Through Marine Scientific Research" (2003) American Society of International Law Insights, available at <http://www.asil.org/insights/insigh116.htm>.
280 Art.269, UNCLOS.
281 Art.273, UNCLOS.
282 Section 5(1)(a), (b), and (c), 1994 Part XI Agreement.
283 Art.1(4), UNCLOS.
284 Art.194(3)(c), UNCLOS. Art.196 specifically refers to pollution resulting from the use of technologies under States' jurisdiction or control.
285 Art.194(5) and (4), UNCLOS.
286 Preamble, Declaration of Principles Governing the Seabed and the Ocean Floor, and the Subsoil Thereof, Beyond the Limits of National Jurisdiction (UN General Assembly Resolution 2749(XXV)).
287 Para 9, UN General Assembly Resolution 2749 (XXV).
288 Para 1(a), UN General Assembly Resolution 2750 (XXV) on the reservation exclusively for peaceful purposes of the seabed and the ocean floor and the subsoil thereof, underlying the High Seas beyond the limits of present national jurisdiction and use of their resources in the interests of humankind, and the convening of a conference on the law of the sea.
289 Increasing attention to the issue of exploitation of the living resources of the deep seabed, including within the CBD framework, prompted the UN Secretary-General, in its 1995 annual report on developments regarding the law of the sea to the 50th session of the UN General Assembly, to draw the General Assembly's attention to the issue (see Annual Report by the Secretary-General on developments regarding the law of the sea (A/50/713)). Following adoption of Decision II/10 by the COP to the CBD, in his annual report to the 51st session of the UN General Assembly, the Secretary-General particularly drew attention to the fact that "[t]he topic [i.e. the issue of access to the genetic resources of the deep seabed] touches not only to the protection and preservation of the marine environment, including that of the international seabed area, but also on such matters as the operation of the consent regime for [MSR], (...), the duties of conservation and management of the living resources of the High Seas, the sustainable development of the living resources of the High Seas and the sustainable development of living marine resources generally. The specific issue of access points to the need for the rational and orderly development of activities relating to the utilization of genetic resources derived from the deep seabed area beyond the limits of national jurisdiction" (Annual report by the Secretary-General on developments regarding the law of the sea (A/51/645)).
290 Para 16, 56 and 62, "Oceans and the law of the sea" (A/RES/57/141).
291 Para 420 and 422, "Oceans and the law of the sea. Report by the Secretary-General" (A/57/57).
292 Para 18, "Oceans and the law of the sea. Report by the Secretary-General" (A/58/65).
293 Para 195, Doc. A/58/65.
294 Para 147, Doc. A/58/65.
295 Para 250, "Oceans and the law of the sea. Report of the Secretary-General to the 59th session of the UN General Assembly" (A/59/62).
296 Para 264 and 266, Doc. A/59/62.
297 Para 260-262, Doc. A/59/62.
298 Para 266, Doc. A/59/62.
299 Para 2, "Results of the review by the Commission on Sustainable Development of the sectoral theme of 'Oceans and seas': international coordination and cooperation" (A/RES/54/33).
300 Para 20, "Report on the work of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea at its third meeting" (A/57/80).
301 Para 23-24, Doc. A/57/80.
302 Part C, Doc. A/57/80.
303 Para 16, 56 and 62, "Oceans and the law of the sea" (A/RES/57/141).
304 Para 98-100, "Report on the work of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea at its fourth meeting" (A/58/95), hereafter referred to as "ICP Report – Fourth meeting."
305 Para 103-106, ICP Report – Fourth meeting.
306 Para 20, ICP Report – Fourth meeting.
307 Para 22, ICP Report – Fourth meeting.
308 Para 51-54, "Oceans and the law of the sea" (A/58/240).
309 Para 68, Doc. A/58/240.
310 "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" (A/59/122), hereafter referred to as "ICP Report – Fifth meeting."
311 Para 90-94, ICP Report – Fifth meeting.
312 Para 5, ICP Report – Fifth meeting.
313 Para 7, ICP Report – Fifth meeting.
314 Para 97, ICP Report – Fifth meeting.
315 Press release GA/10298 of 16 November 2004.
316 Press release GA/10299 of 17 November 2004.
317 Para 68-72, "Oceans and the law of the sea" (A/RES/59/24).
318 Para 73-74, Doc. A/RES/59/24.
319 Para 84-87, Doc. A/RES/59/24.
320 Art.1, CBD. Article 2 (Use of terms) defines biological diversity as "the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part." Sustainable use is defined as "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations." For the definitions of genetic resources and genetic material, see section 3.2 of this report.
321 Art.3, CBD.
322 For possible definitions, see section 3.2. of this report. Doc. UNEP/CBD/COP/5/INF/7 defined bioprospecting as "the exploration of biodiversity for commercially valuable genetic and biochemical resources" and further as "the process of gathering information from the biosphere on the molecular composition of genetic resources for the development of new commercial products." The CBD-UNDOALOS Study endorses this definition (Para 49) and notes other definitions (Para 79, note 102).
323 Art.4, CBD.
324 Art.5, CBD.
325 Art.22, CBD. As of 12 November 2004, there were 188 Parties to the CBD and 145 Parties to UNCLOS.
326 The CBD-UNDOALOS Study provides a detailed account of how each provision impacts on the regulation of bioprospecting undertaken with regard to deep seabed genetic resources (Para 77-96).
327 Report of the First Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) (UNEP/CBD/COP/2/5). Following recommendations by a workshop on marine biodiversity held prior to SBSTTA-1, Recommendation I/8 of the SBSTTA related to scientific, technical and technological aspects of the conservation and sustainable use of coastal and marine biological diversity, recommended that the next meeting of the SBSTTA consider questions related to bioprospecting on the deep seabed, including access to its genetic resources. For a brief account of discussions, see Glowka, L., "Genetic Resources, Marine Scientific Research and the International Seabed Authority," (1999) Review of European Community and

International Environmental Law 8(1), 56-66.
328 Decision II/10 "Conservation and sustainable use of marine and coastal biological diversity."
329 Para 12, Decision II/10.
330 Annex to CBD Decision IV/5. The programme of work as adopted by COP-4 included elements on: integrated marine and coastal area management; marine and coastal living resources; marine and coastal protected areas; mariculture; and alien species and genotypes.
331 Para 103, CBD-UNDOALOS Study.
332 Para 104, CBD-UNDOALOS Study.
333 Para 72, CBD-UNDOALOS Study.
334 Earth Negotiations Bulletin, Thursday 13 March 2003, Vol.09, No.250.
335 Section D, SBSTTA Recommendation VIII/3 "Marine and coastal biodiversity: review, further elaboration and refinement of the programme of work."
336 Section B, Para 19, SBSTTA Recommendation VIII/3.
337 Earth Negotiations Bulletin, Thursday 19 February 2004, Vol.09, No.282; Earth Negotiations Bulletin, Friday 29 February 2004, Vol.09, No.283.
338 Earth Negotiations Bulletin, "Summary of the Seventh Conference of the Parties to the Convention on Biological Diversity," Vol.09, No.284.
339 Para 54-56, Decision VII/5 "Marine and coastal biological diversity."
340 Para 57-62, Decision VII/5.
341 Para 30-31, Decision VII/5.
342 Para 21, Decision VII/5 and programme element 3 of the elaborated programme of work on marine and coastal biodiversity.
343 Articles 15 to 21 deal respectively with: access to genetic resources; access to and transfer of technology; exchange of information; technical and scientific co-operation; handling of biotechnology and distribution of benefits; financial resources; and financial mechanism.
344 Over 50 Parties have reported efforts to develop national legislation or policies to implement the provisions of the CBD relating to access to, and use of, genetic resources. Regional efforts to apply these provisions have been made under the Andean Pact, Association of South East Asian Nations, European Union, South Pacific Regional Environment Programme, Central American Fund for Environment and Development: Account for the Global Environment, Southern African Biodiversity Support Programme, Pan-European Biological and Landscape Diversity Strategy, Pan-European Ecological Network, and the South Asia Cooperative Environment Programme.
345 Art.15(2) and (4), CBD.
346 Art.15(6) and (7), CBD.
347 Glowka, L., "Genetic Resources, Marine Scientific Research and the International Seabed Area," (1999) Review of European Community and International Environmental Law 8(1), 56-66.
348 Art.2 and 16(1), CBD.
349 Art.16(1), CBD.
350 Art.16(2), CBD.
351 Art.16(4), CBD.
352 Art.16(5), CBD.
353 Art.19(1) and (2), CBD.
354 "Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits Arising Out of their Utilization" (Annex to Decision VI/24 'Access and benefit-sharing as related to genetic resources'), hereafter referred to as "Bonn Guidelines."
355 Para 7, Bonn Guidelines.
356 Part I, Section D, Bonn Guidelines.
357 Para 5, Bonn Guidelines.
358 Para 24, Bonn Guidelines.
359 Para 41, Bonn Guidelines.
360 Para 43, Bonn Guidelines.
361 Para 44, Bonn Guidelines.
362 Para 45-50, Bonn Guidelines.
363 Para 51-61, Bonn Guidelines.
364 Para 1, Part C, Decision VI/24.
365 Part D, Decision VI/24.
366 Part B, Decision VII/19 "Access and benefit-sharing as related to genetic resources (Article 15)."
367 Part C, Decision VII/19.
368 Paragraph 44(o) of the Plan of Implementation of the World Summit on Sustainable Development calls for action to "negotiate within the framework of the Convention on Biological Diversity, bearing in mind the Bonn Guidelines, an international regime to promote and safeguard the fair and equitable sharing of benefits arising out of the utilization of genetic resources." Resolution 57/260 of 20 December 2002, adopted by the UN General Assembly, invites the COP to the CBD to take appropriate steps with regard to the commitment made at the World Summit on Sustainable Development.
369 Para 1, Part D, Decision VII/19. Terms of reference for the ABS Working Group to carry out its task are annexed to the Decision.
370 Preamble, Para 7, Part E, Decision VII/19.
371 Evans-Illidge, E.A. & Murphy, P.T., "A New Approach to Benefit Sharing in Bioprospecting," available at <http://www.biodiv.org/doc/case-studies/abs/cs-abs-au.pdf>.
372 Para 98, CBD-UNDOALOS Study.
373 Para 100 and 133, CBD-UNDOALOS Study.
374 Oldham, P., Global Status and Trends in Intellectual Property Claims: Genomics, Proteomics and Biotechnology, 2004, Centre for Economic and Social Aspects of Genomics, 60 pp.
375 Oldham, P., Global Status and Trends in Intellectual Property Claims: Genomics, Proteomics and Biotechnology, 2004, Centre for Economic and Social Aspects of Genomics, 60 pp.
376 This section draws on a similar section from the United Nations University – Institute of Advanced Studies (UNU-IAS) report The International Regime for Bioprospecting: Existing Policies and Emerging Issues for Antarctica, 2003, UNU-IAS, 24 pp.
377 "Contractual practices and clauses relating to intellectual property, access to genetic resources and benefit-sharing. Document prepared by the Secretariat" (WIPO/GRTKF/IC/5/9), hereafter referred to as "Contractual Practices."
378 Para 34, Contractual Practices.
379 Para 38, Contractual Practices.
380 "Draft Technical Study on Disclosure Requirements related to genetic resources and traditional knowledge. Document prepared by the Secretariat" (WIPO/GRTKF/IC/5/10), hereafter referred to as "Disclosure Requirements Study."
381 Para 24, Disclosure Requirements Study.
382 Para 91, Disclosure Requirements Study.
383 Para 130, Disclosure Requirements Study.
384 Para 102, Disclosure Requirements Study.
385 As of 25 February 2005, there were 60 Parties to the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure, hereafter referred to as "Budapest Treaty."
386 Art.3(1), Budapest Treaty.
387 Art.7 and 6(2), Budapest Treaty.
388 Rules 6, 2, 9 and 11, Budapest Treaty Regulations.
389 Oldham, P., Global Status and Trends in Intellectual Property Claims: Microorganisms, 2004, available at <http://www.cesagen.lancs.ac.uk>.
390 Art.27(1), Agreement on Trade-Related Aspects of Intellectual Property Rights, hereafter referred to as "TRIPS Agreement."
391 For an account of diverging views on how to interpret the provisions of Article 27(3), see the note prepared by the WTO Secretariat in 2002, "Review of the Provisions of Article 27.3(b) – Summary of Issues Raised and Points Made. Note by the Secretariat" (IP/C/W/369).
392 Art.29, TRIPS Agreement.
393 Article 7 states that "the protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and

economic welfare, and to a balance of rights and obligations."
394 Article 8 states, *inter alia*, that: members may adopt measures necessary to protect public health and nutrition, and to promote the public interest in sectors of vital importance to their socioeconomic and technological development; and appropriate measures may be needed to prevent the abuse of intellectual property rights by right holders or the resort to practices which unreasonably restrain or adversely affect the international transfer of technology.
395 Para 19, Doha Ministerial Declaration (WT/MIN(01)/DEC/1).
396 WTO website: <http://www.wto.org/english/tratop_e/trips_e/art27_3b_background_e.htm>.
397 For a summary of views on the issue of disclosure, see Para 20-28, "The Relationship Between the TRIPS Agreement and the Convention on Biological Diversity – Summary of Issues Raised and Points Made. Note by the Secretariat" (IP/C/W/368).
398 The Convention for the Protection of the Marine Environment of the North-East Atlantic (hereafter referred to as "OSPAR") combined and updated the 1972 Oslo Convention on Dumping of Waste at Sea and the 1974 Paris Convention on Land-based Sources of Marine Pollution.
399 There are currently 15 Contracting Parties to OSPAR: Belgium, Denmark, the European Community, Finland, France, Germany, Iceland, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom of Great Britain and Northern Ireland, Luxembourg and Switzerland.
400 Art.1(a), OSPAR.
401 2003 Strategies of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic (Agreement 2003-21).
402 List of Threatened and/or Declining Species and Habitats, Agreement 2004-06.
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449 For details, see <http://www.med.govt.nz/ers/nat-res/bioprospecting/index.html> and <http://www.oceans.govt.nz/>.

450 Statement by the Norwegian delegation at the second meeting of the ICP, May 2001.

451 Under section 35(1) of the Oceans Act, a marine protected area is "an area of the sea that forms part of the internal waters of Canada, the territorial sea of Canada or the [EEZ] of Canada and has been designated for special protection for one or more of the following reasons: 1) the conservation and protection of commercial and non-commercial fishery resources, including marine mammals, and their habitats; 2) the conservation and protection of endangered or threatened marine species, and their habitats; 3) the conservation and protection of unique habitats; 4) the conservation and protection of marine areas of high biodiversity or biological productivity; and 5) the conservation and protection of any other marine resources or habitat as is necessary to fulfill the mandate of the Minister."

452 Fisheries and Oceans Canada, Regulatory Impact Analysis Statement, Endeavour Hydrothermal Vents Marine Protected Area Regulations (Draft), Canada Gazette Part I, (9 June 2001). Endeavour is visited by one to several MSR expeditions per year. In July 1998 the American Museum of Natural History contracted the University of Washington to recover parts of several chimneys for display and specimen study. This joint project of American and Canadian scientists removed u*pper se*ctions of four chimneys, parts of which are now on display in museums in the US (source: Leary, D.K., "Law Reaches New Depths: The Endeavour Hydrothermal Vents Marine Protected Area," In Beumer, J.P., Grant, A. & Smith, D.C. (Eds.), Aquatic Protected Areas. What Works Best and How do we Know? Proceedings of the World Congress on Aquatic Protected Areas, 2002, Cairns, Australia, Australian Society for Fish Biology, University of Queensland, 85-96).

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available at <http://www.pac.dfo-mpo.gc.ca/oceans/Endeavour/management_e.htm>.

454 Management Objectives 1 and 2, Endeavour Hydrothermal Vents Marine Protected Area Management Plan.

455 Para 3(1)(b), Endeavour Hydrothermal Vents Marine Protected Area Regulations, available at <http://canadagazette.gc.ca/partII/2003/20030312/html/sor87-e.html>.

456 Para 3(2), Endeavour Hydrothermal Vents Marine Protected Area Regulations.

457 Para 3(1)(c), Endeavour Hydrothermal Vents Marine Protected Area Regulations.

458 Section 6, Endeavour Hydrothermal Vents Marine Protected Area Management Plan. The Management Committee will be responsible for the overall management of the MPA. Chaired by Fisheries and Oceans Canada, and composed of stakeholders and relevant federal government agencies, the Management Committee has the following tasks: identifying and evaluating emergent or critical issues regarding use of the MPA's resources; reviewing plans for research and other activities, such as submarine tourism; identifying educational opportunities; providing advice to Fisheries and Oceans Canada on the MPA's development and evaluation; and reviewing applications for research and other activities within the MPA.

459 The Management Plan defines the various activities allowed in each site. Only observation and non-invasive research techniques will be permitted in the Salty Dawg field, where activities will be limited to infrequent water sampling and annual visits for monitoring instruments in areas on or near the seafloor, acoustic imaging, water column investigations that have no impact on the seafloor or benthic/near-bottom ecosystems, and activities in the area that contribute to the knowledge and understanding of environmental impacts of human activities on hydrothermal vent ecosystems. The High Rise Field will be a site for research, associated with long term monitoring, and will be utilized as part of the education/outreach strategy of the MPA. Most scientific research will be confined to the Mothra and Main Endeavour fields, where observational and intensive sampling operations will continue to be permitted subject to consistency with the Regulations.

460 Management Objective 6, Endeavour Hydrothermal Vents Marine Protected Area Management Plan.

461 Management Objective 8, Endeavour Hydrothermal Vents Marine Protected Area Management Plan.

462 Horta Workshop Proceedings. Lucky Strike is the largest hydrothermally active area known in the world's oceans with 21 active chimney sites spreading throughout 150 square kilometers at a depth of 1700 meters around a fossil lava lake. The Menez Gwen vent field hosts a 700 meters high volcano and active sites at 850 meters depth.

463 Horta Workshop Proceedings. The goals of the Workshop were to, *inter alia*: identify threats to the sites; draw up a zonation plan of the area; develop a code of conduct; design a management plan; and strike a balance between conservation of the sites and activities such as tourism and scientific research.

464 Horta Workshop Proceedings.

465 Horta Workshop Proceedings.

466 The Workshop proposed that access for tourism be prohibited within defined zones (e.g., experimental areas and highly sensitive sites) and accessible areas be restricted considering, *inter alia*, mode of operation, vessel type and size. It was proposed that: tour operators provide on-board ship access to MPA officials; biological and geological specimen collection be prohibited; photographic and video images be only for private use; professional photographers be charged a fee and their images provided to an MPA data bank; tour operators submit independent environmental assessments; tour operators be licensed and a license fee be set up. (source: Horta Workshop Proceedings).

467 Horta Workshop Proceedings.

468 Horta Workshop Proceedings.

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UNU-IAS

Institute of Advanced Studies

United Nations University
Institute of Advanced Studies
6F, International Organizations Center
Pacifico-Yokohama, 1-1-1 Minato Mirai
Nishi-ku, Yokohama 220-0012,
Japan

Tel: +81 45 221 2300
Fax: +81 45 221 2302
Email: unuias@ias.unu.edu
URL http://www.ias.unu.edu

BIODIVERSITY BEYOND NATIONAL JURISDICTION
- Policy Overview -

BACKGROUND

In November 2004, the 59th session of the UN General Assembly passed a resolution (59/24) mandating the creation of an Ad Hoc Open-ended Informal Working Group to discuss issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction. The Working Group was given four tasks:

(a) To survey the past and present activities of the United Nations and other relevant international organizations with regard to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction;

(b) To examine the scientific, technical, economic, legal, environmental, socio-economic and other aspects of these issues;

(c) To identify key issues and questions where more detailed background studies would facilitate consideration by States of these issues;

(d) To indicate, where appropriate, possible options and approaches to promote international cooperation and coordination for the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction.

The meeting is scheduled to take place in New York, February 13-17, 2006. The following provides a short overview of the context and some of the issues that will likely be discussed at the meeting.[1]

PROBLEMATIQUE

There is an evolving international consensus that the conservation and sustainable use of biodiversity beyond national jurisdiction requires an integrated approach to management, one that meets human requirements to use natural resources, while maintaining the biological richness and ecological processes necessary to sustain the ecosystems concerned.

It has been argued that currently there is no multilateral management mechanism by which to implement integrated oceans management in maritime areas beyond national jurisdiction. While UNCLOS provides the principles and high level framework, and international organizations, such as the International Seabed Authority (ISA) and Regional Fisheries Management Organizations (RFMOs), focus on specific resource management, some say that there is a gap in organizations and/or arrangements that are specifically mandated and have the authority to implement integrated oceans management in maritime areas beyond national jurisdiction. There is also debate as to whether there is a need to regulate bioprospecting in areas beyond national jurisdiction beyond the current marine scientific research regime of the United Nations Convention on the Law of the Sea (UNCLOS) and, if so, whether such regulation would include a mechanism for directing benefits generated from these resources toward conservation efforts and/or for sharing such benefits more broadly with the global community.

[1] A more detailed overview prepared by the Secretary-General in advance of the meeting can be found at: http://daccessdds.un.org/doc/UNDOC/GEN/N05/425/11/PDF/N0542511.pdf?OpenElement.

OPTIONS

A number of options have come forward from the range of stakeholders, i.e. governments, industry, Environmental Non-governmental Organizations (ENGOs) and academia to address the protection of marine biodiversity, in particular of vulnerable marine areas and ensure the sustainable use of marine resources. These options can generally be divided into two separate but related categories, namely: management measures and governance arrangements. The former represent applied management actions that could be either area/place-based or activity-based, while the latter more fundamental, longer term regime and institutional changes. The expectation from stakeholders is that governments will undertake both forms of action in the short and long term to ensure the sustainability of the high seas and its resources.

I Management Options

Increasing emphasis has been put on area-based measures, such as high seas Marine Protected Areas (MPAs) and Particularly Sensitive Sea Areas (PSSAs). Implementing such place-based measures requires consideration of governance. For example, how, who and under what authority would high seas MPAs be established and enforced? Several international arrangements in other contexts may provide useful precedents that could be adapted to meet this need. These include: Regional Seas Arrangements, the UNESCO Convention on the Protection of Underwater Cultural Heritage (UCH) and Particularly Sensitive Sea Areas (PSSAs) under IMO.

Regional Seas arrangements are mechanisms whereby a limited number of interested states participate in the protection of a given maritime area. Regional Seas arrangements have been established under the auspices of the United Nations Environment Programme (UNEP), and include both binding and non-binding instruments. Four of the binding arrangements extend to high seas areas; these have been established in the Northeast Atlantic (OSPAR), the Mediterranean, the South Pacific, and the Southern Ocean around Antarctica. Typically, regional seas arrangements specify the types of activities subject to regulation and require Parties to enact domestic legislation to regulate these activities. The arrangements operate without prejudice to the rights of non-Parties under international law, although states active in the area under protection are urged to accede to the arrangement. In the case of OSPAR, a hydrothermal vent field beyond national jurisdiction has been proposed by the OSPAR working group on MPAs. It will be instructive to follow how this initiative evolves and functions.

Another example is the UNESCO Convention on the Protection of Underwater Cultural Heritage (UCH). Although this Convention has attracted little international support to date, it seeks to establish a regime whereby UNESCO appoints one state to coordinate consultations among states with a verifiable link to the heritage in question, with a view to establishing a regime for access to, research on, and protection of the heritage. This approach has been suggested as a possible model for managing biodiversity beyond national jurisdiction, such that one state could be charged with coordinating the establishment of rules for the protection of a particular area among states that engage, or have engaged, in activities in that area.

Particularly Sensitive Sea Areas (PSSAs) represent a mechanism established through the International Maritime Organization (IMO). PSSAs must: (i) meet at least one of the ecological, socio-economic and scientific criteria contained in the PSSA guidelines; (ii) be at risk from international shipping; and, (iii) need protective measures that are within the competence of the IMO to adopt or approve. PSSAs are proposed for designation by states parties to the IMO and entail the selection of appropriate mechanisms through IMO instruments to reduce or eliminate risks posed by shipping to these areas, or a specific portion thereof. All seven current PSSAs lie

within areas of national jurisdiction, but the theoretical possibility may exist for a PSSA to be declared on the high seas. Should this occur, however, governance and enforcement in areas beyond national jurisdiction may prove a difficult issue to resolve.

While PSSAs are primarily established to mitigate the effects of shipping and do not utilize an integrated approach required to conserve and manage biodiversity, they provide an interesting example of using a combination of existing legal instruments to apply rules to a specific area, together with the potential moral advantage that comes with international recognition being accorded to a specific area through its designation as a PSSA.

In relation to areas of particular interest, there are a range of activities-based management options. For activities that can affect biodiversity for which international policy is weak or non-existent (e.g. deep sea marine tourism), effort could be directed towards requiring environmental impact assessments or developing codes of conduct, guidelines, and sets of agreed principles for operations. Such policies, if adopted through an international process, such as international undertakings or the United Nations General Assembly (UNGA), could represent useful soft law. Widely accepted voluntary guidelines or principles can be a more immediate and useful precursor to binding regimes, if that is what is desired for such activities as bioprospecting for example.

There is a continuing emphasis on the prohibition of specific activities that can affect high seas biodiversity. It is evident that there are areas beyond national jurisdiction that are of special value, are characterized by diverse, unique species and are often particularly sensitive and/or vulnerable. It is important that these areas are first identified and then managed and protected from whatever pressures are having an effect. While much attention has been paid to the affects of fishing in relation to sensitive areas, there are other pressures. For example, some studies have suggested that the most significant impact on hydrothermal vents is in fact scientific exploration. Therefore, efforts perhaps should be directed first to identifying and conserving these areas, irrespective of specific activities. In certain cases scientific evidence may support the imposition of a ban or moratorium on all activities in some especially fragile areas. It is thus critical to determine as a first step how to identify these kinds of areas. The focus should be on developing criteria for identification. In the absence of a targeted approach, an indiscriminate ban or moratorium may not in fact protect the areas that need protecting. Further, immediately implementing a general moratorium on a specific fishing practice for example (bottom trawling or long-lining) would be essentially impossible to implement, monitor and enforce. Currently the necessary international consensus, institutional mechanism, resources or capacity does not exist. Most 'command and control' systems of management are highly resource expensive, tend to reward irresponsible players and typically do not result in long-term, fundamental change. Under a moratorium, irresponsible fishing activity would likely become more profitable.

Ultimately, fundamental change may be needed with respect to how areas beyond national jurisdiction are managed. All relevant players need to collaborate to develop a system whereby the access, development and exploitation of the areas beyond national jurisdiction are done in such a way as to protect biodiversity and ensure long-term sustainability.

II Governance Options

Revised or New Instruments and Institutions

Global

In reviewing the existing multilateral regimes and organizations, there are some that have the potential to include within their mandate the conservation and sustainable use of biodiversity in the high seas. The International Seabed Authority (ISA) clearly has a mandate to manage specific activities associated with the extraction of non-living resources of the seabed and subsoil beyond national jurisdiction. However, since it currently has no direct competence with respect to the conservation and management of living resources, its mandate, structure and culture would have to be significantly altered to allow it to regulate such activities.

It has also been suggested that the Convention on Biological Diversity (CBD) could take on an authoritative role in the conservation and sustainable use of high seas biodiversity but the degree of applicability of the Convention to the high seas is a matter of debate. According to the language of the Convention it is applicable to "processes and activities" carried under the jurisdiction and control of the Party which take place both within and beyond national jurisdiction, but does not apply to the "components of biological diversity" in areas beyond national jurisdiction. While there is a wide range of views as to the interpretation of this part of the CBD, at a minimum it is reasonable to assume that Parties to the CBD have the obligation to ensure that their engagement in activities or processes in areas beyond national jurisdiction is in accordance with the goals and objectives of the Convention. Parties also have an obligation to cooperate with other Parties, directly or, where appropriate, through competent international organizations for the conservation and sustainable use of biodiversity in areas beyond national jurisdiction.

Another fundamental aspect of governance of maritime areas beyond national jurisdiction, which Canada is analyzing is the absence of a specific legal regime governing deep seabed bioprospecting. Contention exists at the international level as to whether deep seabed genetic resources should be considered "open access" or whether they are part of the "common heritage of mankind". Such debates hinge on the issue of whether benefits associated with the exploitation of deep seabed genetic resources should be shared with members of the international community. There are also questions as to whether any of the benefits generated from deep seabed bioprospecting should be directed towards the conservation and sustainable use of ecosystems where these genetic resources are found. If consensus emerges that the current international framework is inadequate, a specific regime may be needed to govern bioprospecting, direct benefits toward conservation and management of the seabed or share some of the benefits derived there from.

It has also been suggested that an implementing agreement under UNCLOS is needed for the management of biodiversity, analogous to how the United Nations Fish Stocks Agreement (UNFSA) provided an implementation mechanism to address the goals and objectives of UNCLOS as they relate to straddling and highly migratory fisheries. There is potential for such an agreement to provide a coordinating mechanism to manage for the conservation and sustainable use of high seas biodiversity. It could for example, establish an obligation for sectors (e.g. fisheries, shipping, pharmaceutical, marine science, submarine cable, etc.) to manage for biodiversity values. It could also be the framework under which high seas protected areas could be established. As an extension of UNCLOS, such an agreement could potentially be a credible means of clarifying roles and responsibilities to provide effect to the environmental principles and

objectives of UNCLOS. However, it has to be determined whether the existing legal regime is insufficient or whether the problem is one of implementation. Also, negotiation of such a horizontal instrument would be a daunting, complex endeavour whereby the mandates and authorities of the various international actors in areas beyond national jurisdiction (e.g. ISA, IMO, CBD, RFMOs, Regional Seas, etc.) would all have to be taken into account and specific effort directed to ensure that the relevant specialized authorities maintain their ability to manage. Clearly such an international negotiation process would be a long term option and does not deal immediately with many of the key issues of biodiversity loss that are currently driving the debate.

Other global options suggest a role for a new global oversight body or institution that would be responsible for all things related to areas beyond national jurisdiction. However, the practicality of such an effort is not evident nor the resources available to devote to such an infrastructure. There is little appetite for another supra-national bureaucratic layer. In relation to financing for high seas management it has been suggested that a Global Commons Fund be created. The intent would be to establish a mechanism by which the benefits accrued through the use and development of genetic resources beyond the limits of national jurisdiction, could be directed to support required management efforts.

Regional

Improving how Regional Fisheries Management Organizations (RFMOs) manage fisheries entails, among other things, applying an ecosystem approach broadly. In this regard, it has been proposed that RFMOs expand their coverage to cover all of the high seas and all fisheries species or even all living resources, and that they be given the mandate, authority and capacity to implement an ecosystem approach for fisheries management.

It is possible that a new breed of RFMO could go a long way to conserve biodiversity. In reviewing the global coverage of RFMOs, a significant gap was recognized in the South Pacific and as a result, Australia, Chile and New Zealand have recently initiated a process for states to cooperate in addressing these gaps in the international conservation and management framework through the establishment of a new RFMO.

Fisheries that could be covered by this RFMO are predominantly discrete high seas stocks and those stocks that straddle the high seas and the EEZs of coastal states. These fisheries are both pelagic and demersal. New Zealand is engaging relevant states (i.e. states that have nationals fishing in the area) and leading the development of a RFMO that would be built on the foundation of an ecosystem approach to the management of fisheries. Depending how an ecosystem approach is expressed, this new RFMO could have the effect of conserving biodiversity values but that cannot be determined at this point.

The creation of new RFMOs and RFMO reform could not be considered a short term solution, but there is good momentum for this currently and Canada will need to continue to advance this. Despite these positive changes, there is a growing understanding that an ecosystem approach to fisheries management is likely not enough to ensure the integrated management of the full range of uses/pressures. The current mandates and single species focus of most RFMOs does not make them well-equipped to deal with a broad integrated approach. Further, it is not evident that RFMOs are best-suited to provide the forum in which areas are managed for biodiversity objectives among a wide range of ocean stakeholders. RFMO governance reform will continue in order that RFMOs achieve the existing conservation and management benchmarks but consideration will also need to be given to whether and which other governance mechanisms

could provide a forum for a multi-sectoral, integrated approach to managing areas beyond national jurisdiction.

This apparent governance gap has also led to calls for the establishment of regional management organizations with a broader mandate and function to manage for a range of ecosystem components. These bodies, sometimes referred to as Marine Ecosystem and Resource Management Organizations ("MERMOs") or "ROMOs" (Regional Ocean Management Organizations), would be designed with the express purpose to manage marine areas in an integrated fashion, taking account of all sectoral interests.

However, building such organizations from scratch would also be a longer-term solution given the degree of intergovernmental negotiation that would be required. Administratively, the MERMOS or ROMOS would have to be linked into a multilateral system in such a way to allow for accountability, the engagement and input of all relevant players and information (e.g. FAO/RFMOs, IMO, ISA, UNEP/Regional Seas, CBD, UNESCO/IOC), have the ability and authority to provide practical and integrated management advice and the capacity to monitor the implementation and report on the affect of management decisions or advice.

New Cooperative Arrangements

A pragmatic interim solution may possibly be found through cooperative arrangements between relevant players that approximates an integrated approach to the conservation and sustainable use of biodiversity beyond national jurisdiction. Integration and coordination should be encouraged between international instruments and bodies, and among and between regional organizations and arrangements.

There are several options that relate to cooperative arrangements which include:

- adjustment of mandates and/or development of Memorandum of Understanding (MOUs) among global, regional bodies, and countries;
- development and adherence to arrangements, guidelines and codes of conduct among various user groups, including scientific research, private commercial activities and among like-minded states for areas of common interest;
- cooperatively conduct environmental impact assessments as appropriate under existing international instruments;
- expand the geographic scope of regional seas agreements; etc.

CONCLUSION

Several short and long term options have been proposed as possible ways to better manage biodiversity beyond national jurisdiction. In its consideration of these options and others that may arise, Canada will be guided by the overall objective of the improved conservation and sustainable use of biodiversity beyond national jurisdiction, in a manner consistent with Canadian values and interests.